



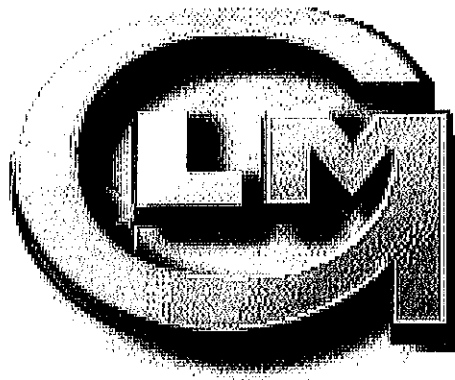
G.L.M. Industries L.P.

**HUSKY ENERGY
C/O
EXCELSIOR ENGINEERING LTD**

400 BBL SKIDDED SLOP TANK

**Tag# T-330
P.O. #8400261587**

G.L.M. Job#: 10-797-2



G.L.M. INDUSTRIES L.P.

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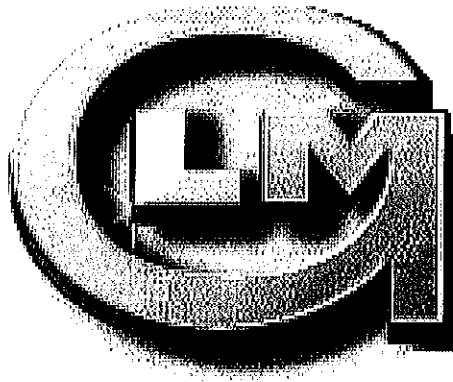
SECTION "2" Calculation Package

SECTION "3" Material Test Reports

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SECTION "6" Nameplate Facsimile



G.L.M. INDUSTRIES L.P.

SECTION 1

DRAWINGS

TANK DATA SHEET

GENERAL NOTES

1. TANK DESIGNED IN NISKUL AB
2. THESE DRAWINGS HAVE BEEN REVIEWED FOR COMPLIANCE WITH GOOD INDUSTRY PRACTICES REFERENCE API-12F AND THE APPLICABLE CONTRACT.
PROCESS CONSIDERATIONS REMAIN THE RESPONSIBILITY OF THE USER OR THE USER'S DESIGNATED AGENT.
3. LADDERS ARE IN COMPLIANCE WITH OH&S SPECIFICATIONS.

DESCRIPTION	NO. REQUIRED	CAPACITY (NOMINAL)	400 BBL
12'-0" O.D. x 20'-0" HIG.			
SERVICE		NOMINAL TANK WEIGHTS	SLOP TANK
		BARE	7,913 LB
		DRESSED	10,581 LB
		FULL OF WATER	150,785 LB
		OPERATING	150,785 LB
Est. ☐ Actual ☐			

DESIGN DATA

DESIGN INT. PRESS. • TEMP	15.0 oz./sq.in. • 200°F
DESIGN EXT. PRESS • TEMP	0.4 oz./sq.in. • 200°F
MOULT	11°F
SPECIFIC GRAVITY	1.0
JOINT EFFICIENCY	SHELL= N/A ROOF= N/A CONE= N/A
CORROSION ALLOWANCE	SHELL= NIL ROOF= NIL
	BOTTOM= NIL NOZZLES= NIL PIPING= NIL
ROOF LOADS	N/A
WIND LOADS	N/A
SEISMIC LOADS	N/A

MATERIAL NOTES

1. MTR REQUIRED FOR MAIN STEEL PIPES AND FLANGES WILL BE ISSUED TO CUSTOMER FOR RECORDS UPON PROJECT COMPLETION.
2. THIEF HATCH NOZZLE IS FABRICATED AND CONSEQUENTLY IS NOT RATED AT CLASS 150.

MATERIALS

SA-105N / REM. INTERVAL: SA-182-430	SA-105N / REM. INTERVAL: SA-182-430
FLANGES	FLANGES
REINFORCING PADS	REINFORCING PADS
INT. FRING	INT. FRING
FITTINGS	FITTINGS
COUPLINGS OR FORGINGS	COUPLINGS OR FORGINGS
BOILING	BOILING
GASKETS	GASKETS
STRUCTURAL	STRUCTURAL
OTHER	OTHER

100

DESCRIPTION	SMR USE ONLY (INT. USE ONLY)
EXTERNAL PREPARATION AND COATING	
1. EXTERIOR OF SHELL, ROOF, STRUCTURAL S.D. & FITTINGS TO RECEIVE: -BRUSH BLAST (SSPC SP7) -(-) COAT OF SHOP PRIMER	
2. EXTERIOR OF BOTTOM TO RECEIVE: -BRUSH BLAST (SSPC SP7) -(-) CO. OF SHOP PRIMER	

PAINTING & COATING DATA

- (1) COAT OF SHOP PRIMER	
INTERNAL PREPARATION AND COATING	
1. INTERIOR OF FLOOR, SHELL, ROOF, & FITTINGS TO RECEIVE:	
- WHITE METAL BLAST (SSPC SP5)	
- (15.0 TO 20.0 MILS DFT) OF DEVCO COATINGS, 100 EPOXY	
2. REMOVABLE TANK INTERNALS TO RECEIVE:	
- NIL	
INSULATION	
1. EXTERIOR OF SHELL & ROOF TO RECEIVE:	
2" THK. SPRAY FOAM INSULATION c/w BLACK STEALER & SELF PRIMING BLACK PAINT ON ALL	

1. TANK ROOF & SHELL :
2. TANK FLOOR SHALL BE

3. TANK SHELL-FLOOR WELD TO RECEIVE 100% MPI.

SHIPPING NOTES

- OPEN CONNECTIONS SHALL BE BLANKED WITH TEMPORARY SHIPPING COVERS.

SUPP. NO.	DESCRIPTION	REV. NO.	REVISION DATE	RELEASE DATE	REVISION DATE
1	TANK DATA	3	08/20/11	01/31/11	01/31/11
2	GENERAL ARRANGEMENT	3	08/20/11	01/31/11	01/31/11
3	MISC. NOZZLE/COUPLING DETAILS	1	02/22/11	01/31/11	01/31/11
4	ENVIROVAULT DETAILS	1	02/22/11	01/31/11	01/31/11
50	TANK ASSEMBLY DETAILS	0	-	01/31/11	01/31/11

G.L.M. INDUSTRIES L.P.		APR 12 1972		ED 12		ADD 12		APP 12		MOO 12		NOO 12	
SERIAL NO. 10		10		787-2		1		2		1		2011	
OWNER TAG NO.		10		7-330		1		2		1		2	
SERVICE		SLOP		1/4		IN		1/4		IN		1/4	
NOM DIA		12.0		FT		BTM		THK		1/4		IN	
NOM HT		20.0		FT		BTM		TYPE		FLAT		IN	
NOM CAP		4500		BT		ROOF		THK		3/16		IN	
DES. PRES.		15.0		OZ		P.W.H.T		NO		NO		IN	
DES. S.G.		1.0		DES.		LIQ.		LM		20.0		FT	
MDMT		11		F		MAX		TEMP		200		°F	
SHELL THICKNESS		3/16"		MATERIAL		A-36							

NAMEPLATE STAMPING DETAIL
(STAMPING TO BE 1/4" MIN.)



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[illegible]

NOZZLE SCHEDULE

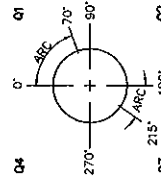
MR#	QTY.	SIZE	CLASS	TYPE	O.S.P.	S.P.	SERVICE/DESCRIPTION	ELEVATION (SEE NOZZLE DATA SHEET 1)	ASSY
N1	1	10"	FAB'D	FAB'D	8"	FLUSH	VENT NOZZLE c/w FAB'D MUSHROOM TOP 1/2" W/ BROSSECRE MESH	0-11 13/16"	3-A
N2	1	3"	150	RFWN	SEE PLAN	6"	PUMP OUT CORR c/w INT. DOWNCOMER	0-11 13/16"	3-F
N3	1	3"	150	RFWN	SEE PLAN	6"	INLET CORR.	0-11 13/16"	3-E
N4	1	3"	150	RFWN	8"	6"	DRYDN CORR. c/w REL. INT. S.S. STATION 3" W/ COMPANION F.G. W/ GATE VALVES (A-1950) F.G. W/ COMPANION ASSY	2'-0"	4-A
N5	1	4"	150	RFWN	8"	1/4"	NOZZLE CORR. (1.5HR)	15'-0 3/16"	3-C
N6	1	4"	150	RFWN	8"	1/4"	SPARE c/w BLIND F.G. (LT)	ROOF	3-B
N7	1	4"	150	RFWN	8"	1/4"	SPARE c/w BLIND F.G.	0-11 13/16"	3-C
N8	1	3"	150	RFWN	8"	1/4"	VENT NOZZLE c/w REM	ROOF	3-B
N9	1	3"	150	RFWN	8"	1/4"	3" CR. LG. PIPE EXTENSION	0-11 13/16"	3-D
C1	1	1"	3000	NPT	FULL	1/4"	FUEL GAS	0'-7"	3-H
M1	1	30"	FAB'D	FAB'D	6"	1/4"	GLM STD. SHELL MANNAY ASSY (MODEL# XOSHW-1-1R124)	3'-0"	3OSHW
NP			N/A	N/A	N/A	N/A	GLM STD. ALUM. NAMEPLATE c/w S.S. BRACKET	5'-6"	NP-A
TH	1	8"	FAB'D	FAB'D	8"	1/4"	GLM STD. THATCH HATCH c/w ENMAR 330 PT THF HATCH (SET @ 12.0 or P. / 0.4 oz Wc.)	ROOF	THIEF
LI	1	1 1/2"	3000	FNPT	FULL	1/4"	GLM STD. CLOSED TYPE LEVEL INDICATOR c/w LIN. M. BOARD, GUIDE WARES & PVC FLOAT	ROOF	3-G CTIG-1 TEN-1
EV	1	N/A	N/A	N/A	N/A	N/A	60" x 40" ENVIROVAULT c/w (1) 24" x 24" - 24,000 HEATER c/w INPUT CATALYTIC BRUVER c/w REGULATOR, WALL MOUNT, THERMOSTAT AND 25 PSI PRESS. REDUCING VALVE (2) 2V POWER & NATURAL GAS)	STD	4-A
LAD	1	N/A	N/A	N/A	N/A	N/A	CHMS LADDER c/w FULL CAGE	STD	LADTHMS
LI	2	N/A	N/A	N/A	N/A	N/A	GLM STD. LIFTING USE (MODEL# 250U-1)	STD	LLUC
INS	4	N/A	N/A	N/A	N/A	N/A	GLM STD. INSULATION STANDOFFS	STD	STANDOFF

SMALL DIM'S TABLE	
TAG	DIMENSION
'A'	0'-11 13/16"

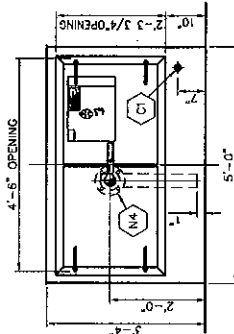
TANGENTIAL NOZZLE TABLE		
MK #	REF. ARC LENGTH (SEE PLAN)	REF. ANGLE
N2	8'-5 3/16"	350.5°
N3	0'-11 15/16"	9.5°

NOZZLE LOCATION NOTES:

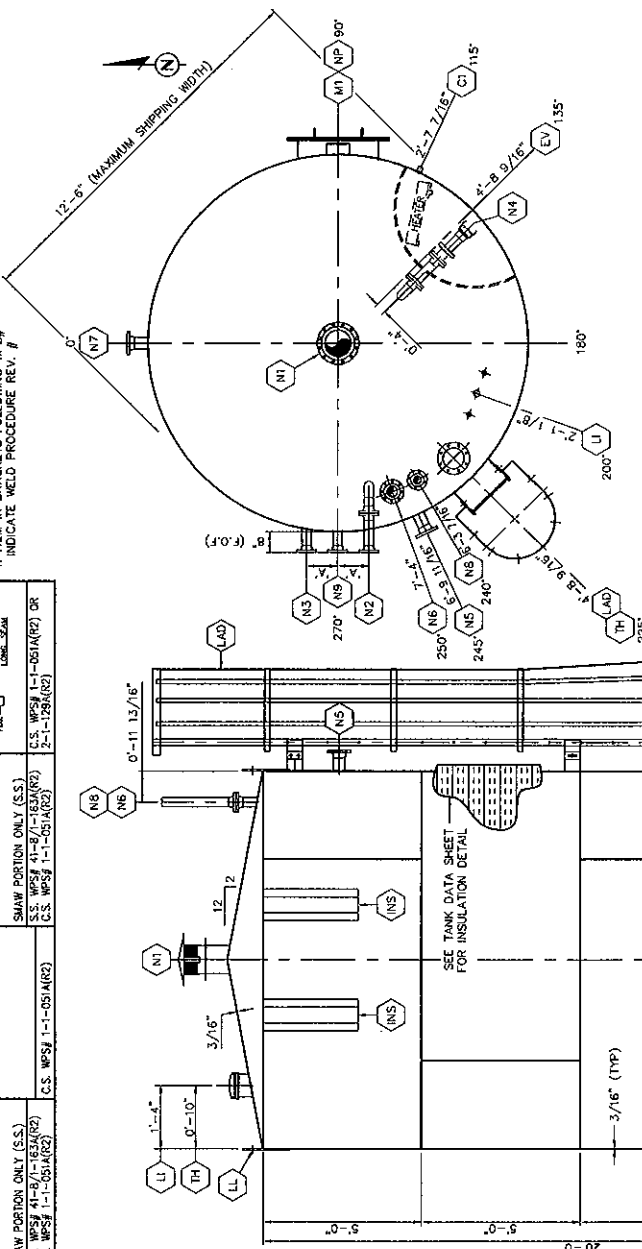
1. ELEVATIONS ARE GIVEN REFERENCEING DATUM AS SHOWN IN ELEVATION.
 2. ALL ARC LENGTHS ARE MEASURED CLOCKWISE, REFERENCEING NEAREST MAJOR CENTERLINE ON THE OUTSIDE OF BOTTOM SHELL COURSE.
- OUTSIDE DIAMETER = 12'-0"
CIRCUMFERENCE = 37'-8 3/8"
90° ARC LENGTH = 9'-5 1/8"



ARC DIMENSION DIAGRAM

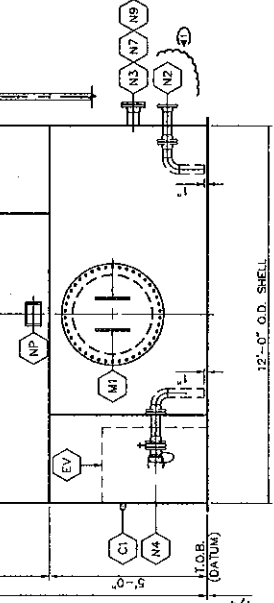


40" HG. VAULT DETAIL



PLAN

PLAN
(LL. & INS NOT SHOWN FOR SHOP TO LOCATE)

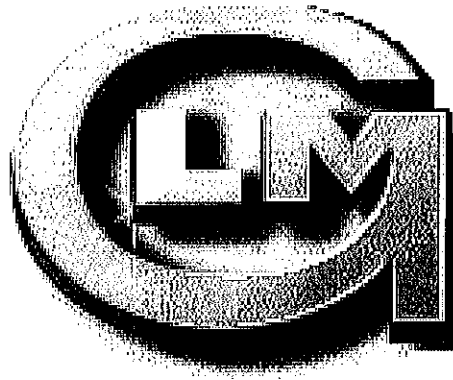


ELEVATION

(ALL ATTACHMENTS IN THIS VIEW ARE FOR REPRESENTATION ONLY.
REFER TO NOZZLE SCHEDULE FOR TRUE ELEVATION)

BY	APPT	DATE	REVISION	REASON AS SHOWN	ISSUED BY LY	CHECKED BY AV	APPROVED FOR CONSTRUCTION BY AV
BT	10	11/11/11	02	REV D WPS	JAN. 07, 2011	FEB. 03/11	FEB. 03/11
BT	11	11/07/10	01	REV D WPS			
BT	12	06/30/09	11	REV D WPS			
 G.L.M. Industries L.P. TELEGRAMS: 149-127 (MODIFIED) 12th EDITION GLM GOOD INDUSTRIES PRACTICES SCALE: N.T.S. 1/2" = 1' O.D. x 20" = 0' HIGH 400 BBL SKIDDED SLOP TANK (T-330) ANSELL 3-6 MINIFLOW COMPRESSOR STATION							
NO	1	DATE	REV	BY	REASON	DATE	REV
NO	1	11/11/11	02	BT	PURCHASE ORDER # 8400251567	10-797-2-2	REV. 3

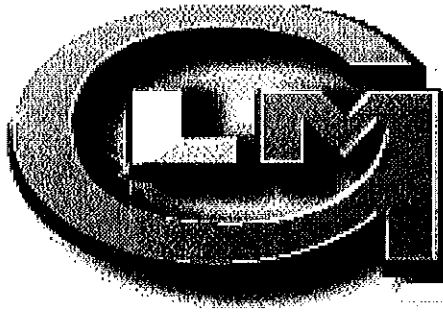
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SECTION 2

CALCULATIONS



G.L.M. INDUSTRIES L.P.

TANK DESIGN CALCULATION PACKAGE

V 2.6

FOR

Husky Oil Operations Ltd.

12 ft - 0 in OD x 20 ft - 0 in Height

Tag # TBD

P.O. # 8400261587

GLM Job# 10-797-1/2

MADE BY: J. Brunton

January 4, 2011

CHECKED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

Rev #	Date	By	Comments
0	1/4/2011	J. Brunton	Created Calculation Package

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DESIGN CALCULATIONS

Tank Calculation Summary Sheet

V 2.6



GLM INDUSTRIES L.P.

API-650 11th Ed. Modified

Size:

Outside Diameter = 12 ft - 0 in
Height = 20 ft

Approx Capacity = 402 BBL

Tag # TBD

Design: Pressure 1 psi Vacuum 0.025 psi @ Temp. 200 F

MDMT: 11 F

Service: Water/Slop Tanks Product specific gravity: 1.000

Floor CA Nil

Roof Load: 48.1 psf (2.3 kPa) Wind: 92 MPH (147.1 Km/h) Seismic: Nil

Roof C.A.: Nil

ABC 2006 Environmental loads used for Edson

Materials:

Roof A-36
Pipe SA-106-B
Bolting A-193-B7 A-194-2H

Shell A-36
Flange SA-105N
Gaskets Manways - Neoprene
Nozzles - S.S. Flexitallic

Bottom A-36
Structural G40.21-44W
Other

Roof Slope: 2.25 : 12 Rafter Type N/A
Thickness: 0.1875 # Req'd N/A
Stiffener: C3 x 4.1 Ctr Column N/A
Radius: N/A

Bottom Type Flat
Thickness: 0.25
Anchors: 4
1/2 Apex Angle: N/A
Stiffener: N/A
Skirt: N/A

Shell

Course	Width [ft]	Thkns [in]	CA
1	5	3/16	0
2	5	3/16	0
3	5	3/16	0
4	5	3/16	0

Insulation : 2" Urethane Panel with Steel Cladding
Lifting/Tailing Lugs: 25k LL, 25 kTL

Venting: Pump in Rate = 0. bbl/hr
Pump Out Rate = 0. bbl/hr

Max Emerg. Venting Pressure = 49.73 oz
Normal Free Vent size required 2in
Emergency Free Vent size required 10 in

Estimated Tank Weights:

Tank Empty: 12230 LB (5559 Kg)
Tank Full of Product: 152999 LB (69545 Kg)
Tank Full of Water: 152999 LB (69545 Kg)

Testing/Inspection:

Air test pressure: 15 - 1/8 in H2O

Tank to be air/soap leak tested.

Tank floor to be vacuum box tested to 3.0 PSIG

Spot radiography per API-650

All internal inspections to obtain thickness readings and record same, are as per SSPC-PA2

Internal coating holiday detection to be conducted in accordance with NACE RPO 188-90

Other Information:

Settings



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Tank Calculations references the following codes:

AISC ASD 9th Ed

ABC 2006 / NBC 2005

API 650 11th Ed June 2007

Modified	☒	See Notes:	Appendix J	☐	Shop Built
Appendix A	☐	Small Field Tanks	Appendix M	☐	Elevated Temperature
Appendix E	☐	Seismic	Appendix S	☐	Stainless
Appendix F	☒	Small Internal Pressure	Appendix V	☐	External Pressure
Appendix I	☒	Leak Detection	Appendix P	☐	Nozzle Loads

Notes:

1. Shell thickness determined using the one foot method

2. Snow loads determined referencing NBC 2005 / ABC 2006. The roof snow load is determined referencing the ground snow load with a low importance factor and the snow load has a 1/50 chance of occurring.

3. Hourly 1/50 Wind pressures from NBC 2005 / ABC 2006 with a gust factor of 2. Wind Analysis for overturning is based on API 650.

Warnings

Max Operating Pressure per API650 App R.2 is 6.4 oz

#REF!

Shell Thickness



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Tank Data:

Nominal Diameter	11.984 ft	Sd =	23200	psi
Height	20 ft	Shell Joint Eff =	0.85	
Specific Gravity	1	E =	28,800,000	psi
		St =	24900	psi

Shell Thickness - Includes considerations for Appendices M, F and V as required

API 650 5.6.3.2

$$t_d = 2.6 * D * (H - 1) / (S_d * E) + CA$$

H = Design Pressure plus liquid head at bottom of shell course under consideration

Course	Width	Minimum Design Thickness	Hydrotest Design Thickness	Actual Thickness
1 (Bottom)	5 ft	0.03367 in	0.0298 in	3/16 in
2	5 ft	0.02577 in	0.0225 in	3/16 in
3	5 ft	0.01787 in	0.0151 in	3/16 in
4	5 ft	0.00997 in	0.0077 in	3/16 in
5				
6				
7				
8				
9				
10				

Number of Intermediate Wind Girders Required	0
Number of Intermediate Vacuum Rings Required	0
Bottom Thickness Required for external pressure	0.0880 in



Shell Thickness

API 650 5.6.3.2

$$S_d = 23200 \text{ psi}$$

First Shell Course

$$t = 2.6 * D * (H_{\text{liquid}} + H_{\text{preshead}} - 1) * S_{pg} / (S_d * E) + CA$$

$$t = 2.6 * 11.984 \text{ ft} * (20 \text{ ft} + 1 \text{ psi} * 27.7 / (12) - 1) * 1 / (23200 \text{ psi} * 0.85) + 0 \text{ in}$$

$$t = 0.0337 \text{ in}$$

$$t_l = 2.6 * d * (H_{\text{liquid}} + H_{\text{preshead}} - 1) / S_t * E$$

$$t_l = 2.6 * 12 \text{ ft} * (20 \text{ ft} + 1.26 \text{ ft} - 1) / (24900 \text{ psi} * 0.85)$$

$$t_l = 0.0298 \text{ in}$$

Note: Remaining shell courses calculated using same method.

Check Shell Thickness for external pressure per App V.8

CA excluded from shell stiffness calculations

Elastic Buckling

$$(D / t_s)^{0.75} * (H_t / D) * (F_y / E)^{0.5} > 0.19$$

$$(11.984 \text{ ft} / 0.1875 \text{ in})^{0.75} * (20 \text{ ft} / 11.984 \text{ ft}) * (36000 / 28800000 \text{ psi})^{0.5}$$

$$1.334 > 0.19$$

Elastic Buckling will occur

(See wind overturning analysis for wind speed and pressure calculations)

$$P_s = \text{Max}(P_e, P_H + 0.4 * P_e)$$

$$P_s = \text{Max}(3.6 \text{ psf}, 10.4 \text{ psf} + 0.4 * 3.6 \text{ psf})$$

$$P_s = \text{Max}(3.6 \text{ psf}, 11.9 \text{ psf})$$

$$P_s = 11.88 \text{ psf}$$

Transformed Height of Shell

$$H_t = \text{transformed width of shell} \quad t_{\text{top}} = 0.1875 \text{ in}$$

$$H_t = \sum W_i * (t_{\text{top}} / t_i)^{2.5} / (\# \text{ stiffeners} + 1)$$

$$H_t = (5 * (0.1875 / 0.1875)^{2.5} + 5 * (0.1875 / 0.1875)^{2.5} + \dots) / 1$$

$$H_t = 20.0000 \text{ ft}$$

Minimum Shell Thickness on unstiffened shell (for stiffened shell use Hts between stiffeners)

$$t_{\text{min}} = 1.903 * (H_t * P_s)^{0.4} * D^{0.6} / (E^{0.4})$$

$$t_{\text{min}} = 1.903 * (20 * 11.88)^{0.4} * 11.984^{0.6} / (28800000^{0.4})$$

$$t_{\text{min}} = 0.078 \text{ in}$$

t_{min} applies to all shell courses

$$t_{\text{smin}} = 0.1875 \text{ in}$$

Max External Pressure for an unstiffened Shell

$$P_{\text{max}} = 0.2 * E / ((H_t / D) * (D / t_{\text{smin}})^{2.5})$$

$$P_{\text{max}} = 0.2 * 28800000 \text{ psi} / ((20 \text{ ft} / 11.984 \text{ ft}) * (11.984 \text{ ft} / 0.1875 \text{ in})^{2.5})$$

$$P_{\text{max}} = 105.680 \text{ psf}$$

$$P_{\text{max}} = 0.734 \text{ psi}$$

Intermediate Stiffening Rings



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Intermediate Wind Girders

Maximum Height of Unstiffened Shell - API 650 3.9.7.1

$$H_u = 600,000 * t^{2.5} / D^{1.5} * (120 \text{ mph} / V)^2$$

$$H_u = 600,000 * (0.1875 \text{ in})^{2.5} / (11.98 \text{ ft})^{1.5} * (120 \text{ mph} / 91.41 \text{ mph})^2$$

$$H_u = 379.435 \text{ ft}$$

Number of intermediate wind girders Required

$$N = H_{ts} / H_u$$

$$N = 20 \text{ ft} / 379.44 \text{ ft}$$

$$N = 0$$

Vacuum Stiffening Rings Per Appendix V (External Pressure must be greater then 0.0361 psi)

$$H_{safe} = 0.2 * t_{min}^{2.5} * E / (D^{1.5} * P_s)$$

$$H_{safe} = \text{N/A}$$

$$H_{safe} = \text{N/A} \text{ ft}$$

$$N_s = H_{ts} / H_{safe} - 1$$

$$N_s = \text{N/A}$$

$$N_s = 0$$

0 Intermediate Girders Required

Bottom Thickness



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Bottom Thickness

API 650 5.4.1

$$t_{bot1} = 1/4" + CA$$

$$t_{bot1} = 0.25 \text{ in}$$

API 650 App V

If weight of bottom plate exceeds vacuum no further calculation is required

$$PE_{max} = \text{density} \times \text{thickness}$$

$$PE_{max} = 0.284 \text{ lb in}^3 \times 0.25 \text{ in}$$

$$PE_{max} = 0.071 \text{ psi}$$

$$t_{min2} = P_{ext} / \text{density}$$

$$t_{min2} = 0.025 \text{ psi} / 0.284 \text{ lb/in}^3$$

$$t_{min2} = 0.0880 \text{ in}$$

Grillage Spacing - (If Required)

$$\text{Grillage spacing} = 28.76 \text{ in}$$

$$\text{Number of Supports} = 6$$

$$t_{min4} = 0.2408 \text{ in}$$

$$t_{bot} = \text{Max}(t_{min1}, t_{min2}, t_{min4})$$

$$t_{bot} = 0.2500 \text{ in}$$

Self Supported Roof



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Tank Data:

Nominal Diameter = 11.984 ft
Height = 20 ft
Pr = 48.13 psf
Roof Corrosion Allowance = 0
Consider CA for External Pressure? No

Sd = 23200 psi
Shell Joint Eff = 0.85
E = 28,800,000 psi
Sts = 16000 psi

Conical Roof

API 650 3.10.5.1

Roof Slope = 2.25 in 12 $\Theta = 10.62$
Dead Load = 9.52 psf
Roof Live Load = 37.18 psf
Insulation Pressure = 1.85 psf
External Pressure = 3.60 psf
Additional Live Load = 0 psf

Load Combinations API 650 App R e)1 and 2

Roof Load	
e) 1	48.1 psf
e) 2	28 psf

Minimum Roof Thickness = 0.1681 in including corrosion allowance

Min Compression Ring Area = -0.2421 in²

C3 x 4.1 is sufficient for use as a top compression ring

Self Supported Roof



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NBC 2005 Snow Load

Design Snow Load = $0.8 * \text{Ground Snow Load} + \text{Rain Load}$

Design Snow Load = $0.8 * 2.1 \text{ kPa} + 0.1 \text{ kPa}$

Design Snow Load = 1.78 kPa

Design Snow Load = 37.18 psf

Roof Load Combinations API 650 App R e)1 and 2

e)1 Roof Load = Dead Load + Snow and Live Load + $0.4 * \text{External Pressure}$

Roof Load = $10 \text{ psf} + 37.18 \text{ psf} + 0.4 * 3.6 \text{ psf}$

Roof Load = 48.13 psf

e)2 Roof Load = Dead Load + External Pressure + $0.4 * \text{Snow and Live Load}$

Roof Load = $10 \text{ psf} + 3.6 \text{ psf} + 0.4 * 37.18 \text{ psf}$

Roof Load = 27.99 psf

Dead Load

$DL = \rho_{\text{plate}} * t_{\text{roof}} + P_{\text{insul}} + \text{Additional Weight} / A_{\text{roof}}$

$DL = (0.284 \text{ lb/in}^3 * 0.1875 \text{ in}) * 144 + 1.85 \text{ psf} + 0 \text{ lbs} / 113 \text{ ft}^2$

DL = 9.52 psf

Design Roof Load

$T = \text{Max}(e.1, e.2)$

$T = \text{Max}(48.13 \text{ psf}, 27.99 \text{ psf})$

T = 48.13 psf

Roof Minimum Thickness

Appendix M 5.1 If Applicable

Temp Factor = $E / E_{\text{@temp}}$

TF = $28800000 \text{ psi} / 28800000 \text{ psi}$

TF = 1.0000

API 650 5.10.5.1

$t_{\text{roof1}} = D / (400 * \sin(\Theta)) * (T / 45)^{0.5} * (TF) + CA$

$t_{\text{roof1}} = 11.984 \text{ ft} / (400 * \sin(10.62)) * (48.13 \text{ psf} / 45)^{0.5} * 10 \text{ in}$

$t_{\text{roof1}} = 0.1681$

App V - If External Pressure > $1 \text{ inH}_2\text{O}$

$t_{\text{roof2}} = (D / \sin(\theta)) * (T / (0.248 * E))^{0.5} * TF / JEr$

$t_{\text{roof2}} =$

$t_{\text{roof2}} =$

$t_{\text{roof}} = \text{Max}(t_{\text{roof1}}, t_{\text{roof2}}, t_{\text{roof3}})$

$t_{\text{roof}} = 0.1681 \text{ in}$

Self Supported Roof



GLM INDUSTRIES, L.P.

Roof to Shell Junction

API 650 5.10.5.2 - for self supported roofs only

$$A1_{req} = D^2 * T / (3000 * \sin(\theta) * 45) * TF$$

$$A1_{req} = (11.98 \text{ ft})^2 * 48.13 \text{ psf} / (3000 * 45 * \sin(10.62)) * 1$$

$$A1_{req} = 0.2779 \text{ in}^2$$

API 650 App F 5.1 - corroded condition

$$A2_{req} = (P - 8 * t_{\text{roof}}) * D^2 / (30800 * \tan(\theta))$$

$$A2_{req} = (27.7 - 8 * 0.1875) * 11.984^2 / (30800 * \tan(10.62))$$

$$A2_{req} = 0.6516 \text{ in}^2$$

$$A_{req} = \text{Max}(A1_{req}, A2_{req}, A4_{req}, A5_{req})$$

$$A_{req} = 0.652 \text{ in}^2$$

Roof to Shell Joint compression ring area Fig F-2

$$R_c = 71.81025 \text{ in} \quad - \text{Inside Radius}$$

$$w_c = 0.6 * (R_c * (t_s))^{0.5}$$

$$w_c = 0.6 * (71.81 * (0.1875))^{0.5}$$

$$w_c = 2.2016 \text{ in (Corroded Condition)}$$

$$R_2 = R_c / \sin(\theta) = 389.662059 \text{ in}$$

$$w_h = 0.3 * (R_2 * (t_h))^{0.5} < 12$$

$$w_h = 0.3 * (389.662 * (0.1875))^{0.5} < 12$$

$$w_h = 2.564 \text{ in (Corroded Condition)}$$

$$A_{\text{roof joint}} = w_h * t_r + w_c * t_s$$

$$A_{\text{roof joint}} = 2.56 \text{ in} * 0.1875 \text{ in} + 2.202 \text{ in} * 0.1875 \text{ in}$$

$$A_{\text{roof joint}} = 0.894 \text{ in}^2 \text{ (Corroded Condition)}$$

Required Compression ring Area

$$A_{C.R.} = A_{req} - A_{\text{roof joint}}$$

$$A_{C.R.} = 0.652 \text{ in}^2 - 0.894 \text{ in}^2$$

$$A_{C.R.} = -0.2421 \text{ in}^2$$

$$A_{\text{Actual}} = 2.104 \text{ in}^2$$

C3 x 4.1 is sufficient for use as a top compression ring



Roof to Shell Junction

Appendix V.7.2 - corrosion not included in design for external pressure

$$X_{\text{roof}} = 1.47 * (D * t_{\text{cone}} / \sin(\theta))^{\wedge}0.5$$

$$X_{\text{roof}} = 1.47 * (11.984 \text{ ft} * 0.1875 \text{ in} / \sin(10.62))^{\wedge}0.5$$

$$X_{\text{roof}} = 5.1330 \text{ in}$$

$$\text{top} \quad X_{\text{shell}} = 1.47 * (D * t_{\text{top}})^{\wedge}0.5$$

$$X_{\text{shell}} = 1.47 * (11.984 \text{ ft} * 0.1875)^{\wedge}0.5$$

$$X_{\text{shell}} = 2.20 \text{ in}$$

$$A_{4\text{req}} = Pr * D^2 / (8 * f * \tan(\theta))$$

$$A_{4\text{req}} = 48.13 \text{ psf} * 11.984^2 / (8 * 23200 * \tan(10.62))$$

$$A_{4\text{req}} = 0.0000 \text{ in}^2$$

Top Stiffener

$$A_{1\text{stiff}} = (A_{\text{req}} - JE_s * t_{\text{top}} * X_{\text{shell}} - JE_r * t_r * X_{\text{cone}}) / JE_{\text{st}}$$

$$A_{1\text{stiff}} = (0 \text{ in}^2 - 0.85 * 0.1875 \text{ in} * 2.2 \text{ in} - 0.7 * 0.1875 \text{ in} * 5.13 \text{ in}) / 0.7$$

$$A_{1\text{stiff}} = -1.464 \text{ in}^2$$

$$A_{\text{stiff}} = \text{Max}(0.5 * A_{4\text{req}}, A_{1\text{stiff}})$$

$$A_{\text{stiff}} = \text{Max}(0.5 * 0, -1.464)$$

$$A_{\text{stiff}} = 0 \text{ in}^2$$

For Anchored Tanks Only

API 620 -5.12.4

$$w_h = 0.6 * (R_2 * (t_h))^{\wedge}0.5$$

$$w_h = 0.6 * (389.662 * (0.1875))^{\wedge}0.5$$

$$w_h = 5.1286 \text{ in (Corroded Condition)}$$

$$w_c = 0.6 * (R_c * (t_c))^{\wedge}0.5$$

$$w_c = 0.6 * (71.81 * (0.1875))^{\wedge}0.5$$

$$w_c = 2.2016 \text{ in (Corroded Condition)}$$

$$R3 = 71.81025 \text{ in}$$

$$F = 0 \text{ psi} \quad \text{- additional downward force on Roof}$$

$$T_1 = (R3 / (2 * \sin(\theta))) * (DL + (W + F) / A)$$

$$T_1 = (71.81 \text{ in} / (2 * \sin(10.62))) * (1 \text{ psi} + (-0.066 \text{ psi} + 0))$$

$$T_1 = 181.9532 \text{ lb/in}$$

$$T_2 = DP * R3 / \sin(\theta)$$

$$T_2 = 1 \text{ psi} * 71.81 \text{ in} / \sin(10.62)$$

$$T_2 = 389.6621 \text{ lb/in}$$

Self Supported Roof



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$$T_{2s} = P_g * R_c$$

$$T_{2s} = 1 * 71.81$$

$$T_{2s} = 71.81 \text{ lb/in}$$

$$Q = T_2 * w_h + T_{2s} * w_c - T_1 * R_c * \cos(\theta)$$

$$Q = 389.66 * 5.13 + 71.81 * 2.2 - 181.95 * 71.81 * \cos(10.62)$$

$$Q = -10685.81 \text{ lb}$$

$$A_{5req} = Q / 20000$$

$$A_{5req} = -10685.8 / 20000$$

$$A_{5req} = 0.53 \text{ in}^2$$

API 620 5.10.3

$$t_{roof3} = \text{Max}(T_1, T_2) / (S_t * E) + R_{CA}$$

$$t_{roof3} = 389.66 / (16000 * 0.7) + 0$$

$$t_{roof3} = 0.03479 \text{ in}$$

Wind Overturning and Pmax



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Tank Data:

Diameter	D	11.984	ft		
Height	H	20	ft		
Roof plate thickness, corroded	th	0.1875	in		
Overturning resistance	D _{LS} =	8,022 lb	Excluding CA		
Design pressure	P	27.7	in H2O =	16.00 oz/in ² =	1.0000 psi

Notes:

1. Simultaneous wind and pressure loading must be applied unless specifically waived by the purchaser.

Roof weight 878 lb (Corroded)

Wind Code:

See NBC2005 / ABC 2006 4.1.7 for definitions

1/50 Hourly Wind Pressure, q =	0.46 kPa		
Gust factor, C _g =	2.00		
Exposure Factor, C _e =	0.91		
External Pres Coefficient, C _p =	1.0		
Force Coefficient, C _f =	0.600	(Cylindrical Surfaces)	
Importance factor, I _w =	1.0		
Design Shell Wind Pressure, p _s =	0.5 kPa	=	10.44 psf
Design Roof Wind Pressure, p _r =	0.83 kPa	=	17.4 psf
Design Wind Speed, V =	91.41	mph	

Overturning Moments API650 5.11.2

Mw (ft lbs)	Mpi (ft lbs)	Mdi (ft lbs)	Mf (ft lbs)
36,790	97,326	53,325	223,342

Anchors Required

Anchors:

Number of anchors	4
Anchor diameter	12.734



API 650 5.11.2 - Corroded Condition

Wind Moment

$$Mw = (\text{arm} * \text{area} * P_H) + (\text{area} * \text{arm} * P_V)$$

$$Mw = H / 2 * OD * H * P_H + OD^3 / 8 * 3.14 * P_V$$

$$Mw = 20 \text{ ft} / 2 * 11.984 \text{ ft} * 20 \text{ ft} * 10.44 \text{ psf} + (11.984 \text{ ft})^3 / 8 * 3.14 * 17.4 \text{ psf}$$

$$Mw = 36,790 \text{ ft lbs}$$

Pressure Moment

$$Mpi = P_{int} * \text{area} * OD / 2$$

$$Mpi = 144 \text{ psf} * 3.142 * (11.984 \text{ ft})^2 / 4 * 11.984 \text{ ft} / 2$$

$$Mpi = 97,326 \text{ ft lbs}$$

Resisting Moment

$$Mdl = (D_{LS} + \text{Roof supported by Shell}) * OD / 2$$

from tank weight

$$Mdl = (8899 \text{ lbs}) * 11.984 \text{ ft} / 2$$

$$Mdl = 53,325 \text{ ft lbs}$$

Weight of fluid that resists overturning

API 650 5.11.2

$$w_a = 7.9 * t_b * (F_y * H_{1/2} * 0.7)^{0.5}$$

$$w_a = 7.9 * 0.25 \text{ in} * (36000 \text{ psi} * 10 \text{ ft} * 0.7)^{0.5}$$

$$w_a = 991 \text{ lb/ft}$$

Customer Specified Max

$$w = 7.9 * t_b * (F_y * H_{LL} * SPG)^{0.5}$$

$$w = 990 \text{ lb/ft}$$

$$W_L = w_a * \pi * D$$

$$W_L = 990 \text{ lb/ft} * 3.14 * 11.98 \text{ ft}$$

$$W_L = 37,273 \text{ lb}$$

Liquid Resisting Moment

$$Mf = W_L * D / 2$$

$$Mf = 37273 \text{ lb} * 11.98 \text{ ft} / 2$$

$$Mf = 223,342 \text{ ft lbs}$$

If Internal pressure exceeds the following limits then Anchors are required

5.11.2.1

$$P_{max1} = (Mdl / 1.5 - 0.6 * Mw) / (\pi / 8 * D^3)$$

(Check empty Tank)

$$P_{max1} = (53325 \text{ ft lbs} / 1.5 - 0.6 * 36790 \text{ ft lbs}) / (\pi / 8 * 11.98 \text{ ft}^3) * 0.111$$

$$P_{max1} = 2.215 \text{ oz}$$

5.11.2.2

$$P_{max2} = [(Mdl + Mf) / 2 - Mw] / (0.4 * \pi / 8 * D^3)$$

(Check half full tank)

$$P_{max2} = [(53325 \text{ ft lbs} + 223342 \text{ ft lbs}) / 2 - 36790 \text{ ft lbs}] / (0.4 * \pi / 8 * 11.98 \text{ ft}^3) * 0.111$$

$$P_{max2} = 41.729 \text{ oz}$$

F4.2

$$P_{max3} = 0.245 * (D_{LS}) / OD^2 + 8 * t_{roof} - 0.817 * Mw / OD^3$$

(Check full tank)

$$P_{max3} = 0.245 * 8021 \text{ lbs} / 11.984^2 \text{ ft}^2 + 8 * (0.1875 \text{ in}) - 0.817 * 36790 \text{ ft lbs} / 11.984^3 \text{ ft}^3$$

$$P_{max3} = -1.317 \text{ oz} = -2.28 \text{ inH}_2\text{O}$$

$$P_{max} = -1.317 \text{ oz}$$

$$\text{Design Pressure} = 16 \text{ oz}$$

Anchors Required

Anchor Spacing (If Required)

$$\text{Min Number of Anchors} = \text{circumference} / 10$$

$$\text{Min \# Anchors} = 11.984 \text{ ft} * 3.14 / 10 \text{ ft}$$

$$\text{Min \# Anchors} = 4$$

Estimated Tank Weight



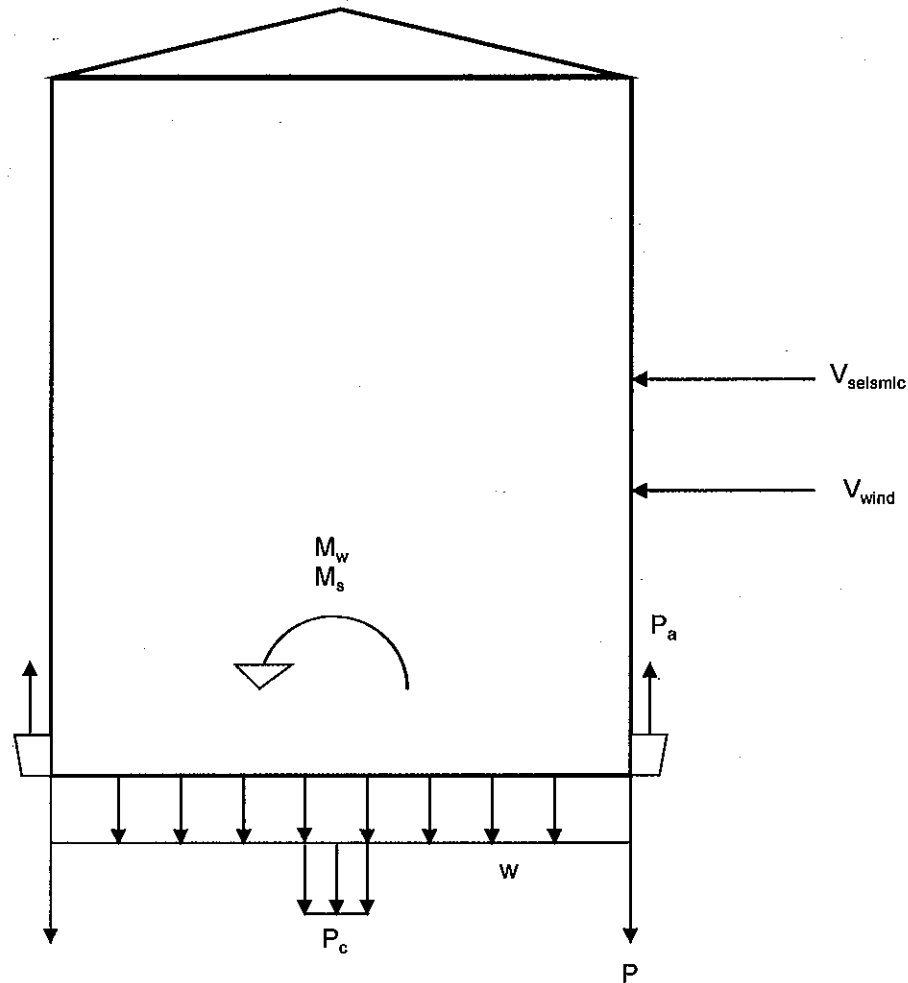
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Estimated Tank Weights

Item	Uncorroded		Corroded	
Roof	878	lb	878	lb
Top Angle	154	lb	154	lb*
Rafters	0	lb	0	lb*
Columns	0	lb	0	lb*
Shell	5,760	lb	5,760	lb
Secondary Shell	0	lb	0	lb
Cone Bottom	0	lb	0	lb
Cone Stiffener		lb	0	lb*
Skirt	0	lb	0	lb
Legs	0	lb	0	lb*
Floor	1,249	lb	1,249	lb
Secondary Floor	0	lb	0	lb
Fittings	498	lb	498	lb*
Internals		lb	0	lb*
Attachments (skid)	1,500	lb	1,500	lb*
Insulation - Roof	216	lb	216	lb
Insulation - Shell	1,393	lb	1,393	lb*
Est Total, Empty	12,230	lb	12,230	lb
Total, Full of Product	153,000	lb	153,000	lb
Total, Full of Test Water	153,000	lb	153,000	lb

* - corrosion not considered

* - fittings weight is an approximation



Load	Imperial		Metric
Perimeter Load, P (Includes Weight of tank minus weight of floor)	413.86 lb/ft	=	6. kN/m
Distributed load, w (Includes weight of bottom, liquid and internal pressure)	9.7 psi	=	67.16 kPa
Max Anchor Load, Pa (See anchor chair summary for list of anchor loads)	4,918 lb	=	2,235 kg
Column Load, Pc (Weight of column and roof supported by column)	N/A	=	N/A
Seismic Shear, V _{seismic}	N/A	=	N/A
Wind Shear, V _{wind}	2,503 lb	=	1,138 kg
Wind Moment, Mw Seismic Moment, Ms	36,790 N/A ft lbs	=	49,881 N/A N m

Anchor Bolt Chair Design



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Tank Data:

Tank diameter	D =	11.98 ft	W1 =	7,950 lbf
Shell thickness (corroded)	ts =	.1875 in	W2 =	8,535 lbf
Bottom Thickness (corroded)	tb =	.25 in	W3 =	7,950 lbf
Roof Thickness (corroded)	th =	.1875 in	Pt =	15.13 inH2O
			Pf =	. inH2O

Pf is only applicable to tanks with frangible roofs

API 650 - Table 5.21b - Uplift Loads (US Customary Units)

Uplift Load	Net Uplift Formula (lbf) and calculated result - U	Allowable Anchor Bolt Stress	Total Anchor Bolt Load	Allowable Shell Stress	Shell Stress (no Repad)
Design Pressure	$[(P-8*th)D^2 * 4.08] - W1$ 7,391 lbf	15,000 psi	7,391 lbf	20,000 psi	4,826 psi
Test Pressure	$[(Pt-8*th)D^2 * 4.08] - W1$ 34 lbf	20,000 psi	34 lbf	25,000 psi	22 psi
Failure Pressure	$[(1.5 * Pf - 8*th)D^2 * 4.08] - W3$ -8,828 lbf	Fy	0	36,000 psi	psi
Wind Load	$[4 * Mw / D] - W2$ 3,745 lbf	0.8 x Fy	3,745 lbf	25,000 psi	2,446 psi
Seismic Load	$[4 * Ms / D] - W2$ N/A	0.8 x Fy	N/A	25,000 psi	psi
Design Pressure + Wind	$[(P-8*th)D^2 * 4.08] + [4 Mw / D] - W1$ 19,671 lbf	20,000 psi	19,671 lbf	25,000 psi	12,846 psi
Design Pressure + Seismic	$[(P-8*th)D^2 * 4.08] + [4 Ms / D] - W1$ N/A	0.8 x Fy	N/A	25,000 psi	psi

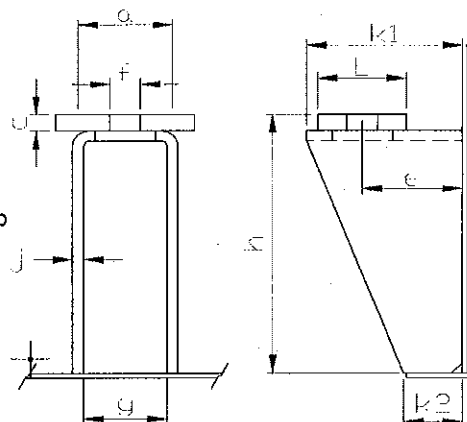
Note: API 650 Formulas for Failure based solely on roof / shell failure - subject to future improvement

Worst Case, U = 19,671 lbf
of Anchors, N = 4

Anchor Chair Data:

Max Anchor chair load (bolt load)	P
Anchor bolt diameter	d
Anchor chair height	h
Anchor bolt eccentricity	e
Top plate width along shell	a
Repad Height	H
Repad Width	A
Repad Thickness	tr

4.918 kip
1.25 in
12 in
4.5 in
5.5 in
0 in
0 in
0 in



Vertical Side Plates:

Plate width - top	k1	7 in
Plate width - bottom	k2	2.625 in
Plate thickness	j	0.5 in

Washer Plate Data:

Distance between vertical plates	g	4.5 in
Washer Bolt Hole Diameter	f	1.375 in
Washer plate thickness	c	1 in
Washer plate length	L	4 in

Washer plate stress	S_w	9.44 ksi	max = 25 ksi
			ACCEPTABLE

Welds:

Allowable weld stress across throat	f	9.6 ksi
Minimum weld size	w	0.0625 in



Calculations

Washer Plate Stress - AISI T-192 Volume II Part VII (Anchor Bolt Chairs)

$$S_w = 1.5 * P * L / (c^2 * (g - f))$$

$$S_w = 1.5 * 4.918 \text{ kip} * 4 / (1^2 * (4.5 - 1.375))$$

$$S_w = 9.442 \text{ ksi}$$

Reduction Factor

$$Z = 1.0 / (0.177 * a * m / (R * t)^{0.5} * (m / t)^2 + 1.0)$$

$$Z = 1.0 / (0.177 * 5.5 \text{ in} * 0.25 \text{ in} / (71.904 \text{ in} * 0.1875 \text{ in})^{0.5} * (0.25 \text{ in} / 0.1875 \text{ in})^2 + 1.0)$$

$$Z = 0.8946$$

Tank Shell Stress - for highest anchor load, remaining shell stresses calculated using same method

$$S = \frac{P \cdot e}{t^2} \left[\frac{1.32 \cdot Z}{\frac{1.43 \cdot a \cdot h^2}{R \cdot t} + (4 \cdot a \cdot h^2)^{0.333}} + \frac{0.031}{\sqrt{R \cdot t}} \right]$$

$$S = \frac{4.91 \text{ kip} * 4.5 \text{ in} * 1.32 * 0.89}{0.1875^2} + \frac{0.031 / (71.904 \text{ in} * 0.1875 \text{ in})}{\frac{1.43 * 5.5 \text{ in} * 12^2 \text{ in}^2 + (4 * 5.5 \text{ in} * 12^2 \text{ in}^2)^{0.33}}{(71.904 \text{ in} * 0.1875 \text{ in})}}$$

$$S = 12.85 \text{ ksi}$$

Shear in Weld

$$W_v = \text{Load} / \text{Weld Length}$$

$$W_v = 4.91 \text{ kip} / (4 \text{ in} + 2 * 12 \text{ in})$$

$$W_v = 0.1756 \text{ kip / in weld}$$

Max bending

$$W_h = p * e / (a * h + 2/3 * h^2)$$

$$W_h = 4.91 \text{ kip} * 4.5 \text{ in} / (4 \text{ in} * 12 \text{ in} + 2/3 * 12^2 \text{ in}^2)$$

$$W_h = 0.1537 \text{ kip / in weld}$$

Weld Stress

$$W = (W_v^2 + W_h^2)^{0.5}$$

$$W = (0.175^2 + 0.153)^{0.5}$$

$$W = 0.2334 \text{ kip / in weld}$$

Min Weld Size

$$w = W / f$$

$$w = 0.233 \text{ kip/in} / 9.6 \text{ ksi}$$

$$w = 0.024309547 \text{ in}$$

$$j_{min} = \text{Max}(1/2", 0.04 * (h - c))$$

$$j_{min} = \text{Max}(1/2", 0.04 * (12 - 1))$$

$$j_{min} = 0.5$$

check

$$j * k - P / 25 > 0$$

$$0.5 * 4.81 - 4.918 / 25 = 2.21$$

API-650 Repad Sheet

Bottom Shell course



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Nozzle Design Data: (see table below)

D_o = outside diameter of nozzle [in]
 t_n = nominal nozzle wall thickness [in]
 t_{min} = minimum nozzle wall thickness = $(0.875t_n - CA)$ [in]
 $D_{c.o.}$ = cutout opening in shell for nozzle [in]

Notes:

1. Based on corroded condition.
2. Nozzle wall thickness based on XS pipe.

Opening Reinforcement per Para. 5.7.2: (see table below)

A_1 = area of excess metal in shell available for reinforcement = $(t_s - t_d)D_{c.o.}$ [in²]

A_2 = area removed from cutout = $(t_d - CA) D_{c.o.}$ [in²]

A_3 = portion of nozzle projecting outward = $2 * 4(t_{min})^2$ [in²]

A_4 = shell to nozzle cross-sectional area = $2 * t_s t_{min}$ [in²]

Repad Requirement: (see table below)

If $A_1 + A_3 + A_4 < A_2$, Repad is Required

Sample Results for First Shell Course

NOZZLE DATA				REINFORCEMENT DATA				REPAD REQ'D ?
[D _o]	[t _n]	[t _{min}]	[D _{c.o.}]	[A ₂]	[A ₁]	[A ₃ + A ₄]	[A ₁ + A ₃ + A ₄]	
3.500	0.3000	0.2625	3.625	0.1221	0.5576	0.6497	1.2073	no
4.500	0.3370	0.2949	4.625	0.1557	0.7115	0.8062	1.5176	no
6.625	0.4320	0.3780	6.750	0.2273	1.0383	1.2848	2.3232	no
8.625	0.5	0.4375	8.750	0.2946	1.3460	1.6953	3.0413	no
10.75	0.5	0.4375	10.875	0.3662	1.6729	1.6953	3.3682	no
12.75	0.5	0.4375	12.875	0.4336	1.9806	1.6953	3.6759	no
24.5 *	0.250	0.2188	24.625	0.8291	3.7880	0.4648	4.2529	no
OTHER:								
48.000	0.2500	0.2500	48.125	1.6204	7.4030	0.5938	7.9968	no

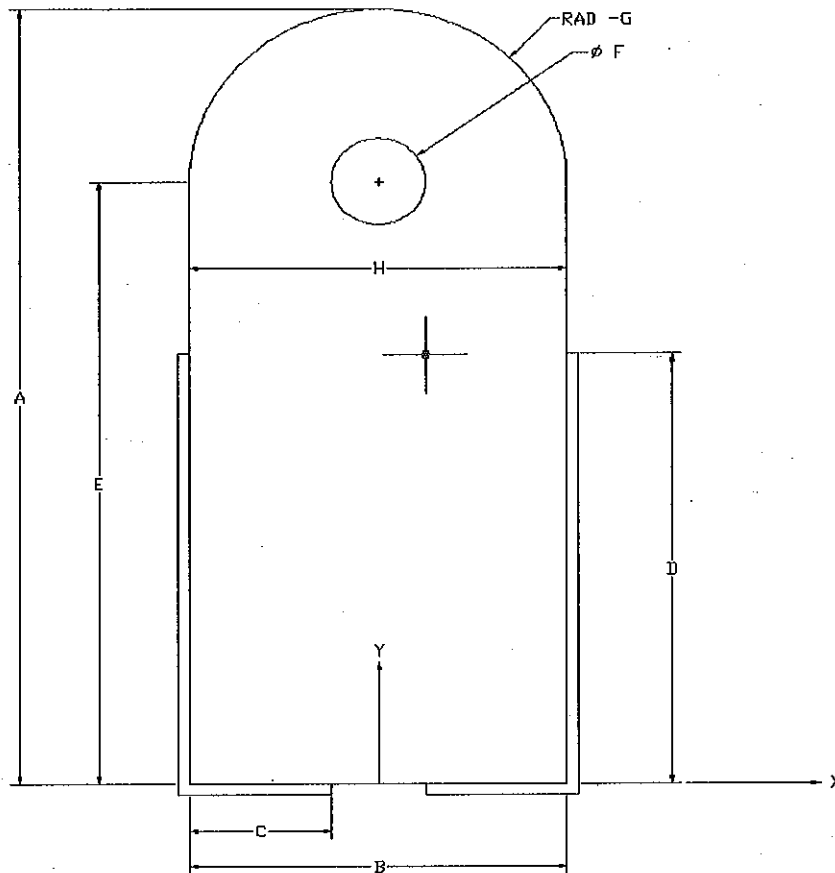
Nozzle Size NPS	Repads Required for Shell Course:							
	1	2	3	4	5	6	7	8
3	No	No	No	No				
4	No	No	No	No				
6	No	No	No	No				
8	No	No	No	No				
10	No	No	No	No				
12	No	No	No	No				
24*	No	No	No	No				
48	No	No	No	No				

* - API 650 Shell Manway

Lifting Lug Design/Lift Analysis



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25k LL ▼

A =	18	in
B =	8	in
C =	2	in
D =	10	in
E =	14	in
F =	2	in
G =	4	in
H =	8	in
Lug t =	0.625	in

Bolt Hole Reinforcement

Thickness rt =	0	in
OD =	0	in

API 650 APP J3.8.3: Lifting lugs are to be designed to carry their share of twice the weight of the tank with a safety factor of 4.

Weld $\sigma_{T.S.}$: 70,000 psi E70XX

Weld Size 3/16 in

Material : SA 516 Gr 70

$\sigma_{T.S.}$ = 70,000

$\sigma_{Y.S.}$ = 38,000

Failure Modes

Tension Failure	5.05 OK
Hoop Tension Failure	2.52 OK
Bearing Stress Failure	2.88 OK
Double Shear Failure	5.85 OK
Weld Failure	2.25 OK

Weld Failure Governs Design

Tank Weight =	13,000	lb
Tank Height =	20	ft
Center of Gravity =	10	ft
Tailing lug height =	4.5	in
radial distance to TL =	6.37	ft
Tank OD =	11.984	ft
LL Load =	13,000	lb
Min Pin Diameter =	1.75	in

Lifting Lug Design/Lift Analysis



GLM INDUSTRIES, L.P.

Allowable Stresses API 650 APP J: Safety factor of 4 when lifting twice the tank weight

Tension Failure

$$\begin{aligned}\sigma_{All} &= \sigma_{T.S.} / 4 \\ &= 70000 \text{ psi} / 4 \\ \sigma_{All} &= 17,500 \text{ psi}\end{aligned}$$

Bearing Stress

$$\begin{aligned}\sigma_{All} &= 0.9 * \sigma_{Y.S.} \\ &= 0.9 * 38000 \text{ psi} \\ \sigma_{All} &= 34,200 \text{ psi} \\ &\text{Allowable stress is from AISC (J8-1)}\end{aligned}$$

Shear Failure

$$\begin{aligned}\sigma_{All} &= 0.4 * \sigma_{Y.S.} \\ &= 0.4 * 38000 \text{ psi} \\ \sigma_{All} &= 15,200 \text{ psi}\end{aligned}$$

Weld Failure

$$\begin{aligned}\sigma_{All} &= 0.25 * \sigma_{T.S.weld} \\ &= 0.25 * 70000 \text{ psi} \\ \sigma_{All} &= 17500 \text{ psi}\end{aligned}$$

AISC F4 used for allowable Shear because it is more conservative than API 650 APP J

Critical Stresses Lug stresses when used on a tank

Tension Failure

$$\begin{aligned}\sigma &= P / (t * (H - F)) \\ \sigma &= 13000 / (0.63 * (8 - 2)) \\ \sigma &= 3,467 \text{ psi} \\ \text{OK} \\ \text{FS} &= 5.05\end{aligned}$$

Bearing Stress

$$\begin{aligned}\sigma &= P / (t * \text{Shackle Pin Diameter}) \\ \sigma &= 13000 / (0.625 * 1.75) \\ \sigma &= 11,886 \text{ psi} \\ \text{OK} \\ \text{FS} &= 2.88\end{aligned}$$

Hoop Tension Failure

$$\begin{aligned}\sigma &= P / ((G - F/2) * t + (OD/2 - F/2) * rt) \\ \sigma &= 13000 / ((4 - 2/2) * 0.625 + (-1) * 0) \\ \sigma &= 6,933 \text{ psi} \\ \text{OK} \\ \text{FS} &= 2.52\end{aligned}$$

Double Shear Failure

$$\begin{aligned}\sigma &= P / (2 * t * g) \\ \sigma &= 13000 / (2 * 0.625 * 4) \\ \sigma &= 2,600 \text{ psi} \\ \text{OK} \\ \text{FS} &= 5.85\end{aligned}$$



Weld Check

Center of gravity of weld

$$x\text{-bar} = 0 \text{ in}$$

$$y\text{-bar} = D^2 / (2C + 2D)$$

$$y\text{-bar} = 10^2 / (2 * 10 + 2 * 2)$$

$$y\text{-bar} = 4.167 \text{ in}$$

$$J = 2 * J1 + 2 * J2$$

$$J1 = (D^3 * t / 12) + D * t * [(B / 2)^2 + (D / 2 - y\text{-bar})^2]$$

$$J1 = (10^3 * 0.133 / 12) + 10 * 0.133 * [(8 / 2)^2 + (10 / 2 - 4.167)^2]$$

$$J1 = 33.287 \text{ in}^4$$

$$J2 = (C^3 * t / 12) + C * t * [(y\text{-bar})^2 + ((B - C) / 2)^2]$$

$$J2 = (2^3 * 0.133 / 12) + 2 * 0.133 * [(4.167)^2 + ((8 - 2) / 2)^2]$$

$$J2 = 7.101 \text{ in}^4$$

$$J = 80.78 \text{ in}^4$$

Lifting Lug Weld Stresses

$$T_x = P * \sin \theta * (E - y\text{-bar}) * (D - y\text{-bar}) / J + P * \sin \theta / ((D + C)^2 * t)$$

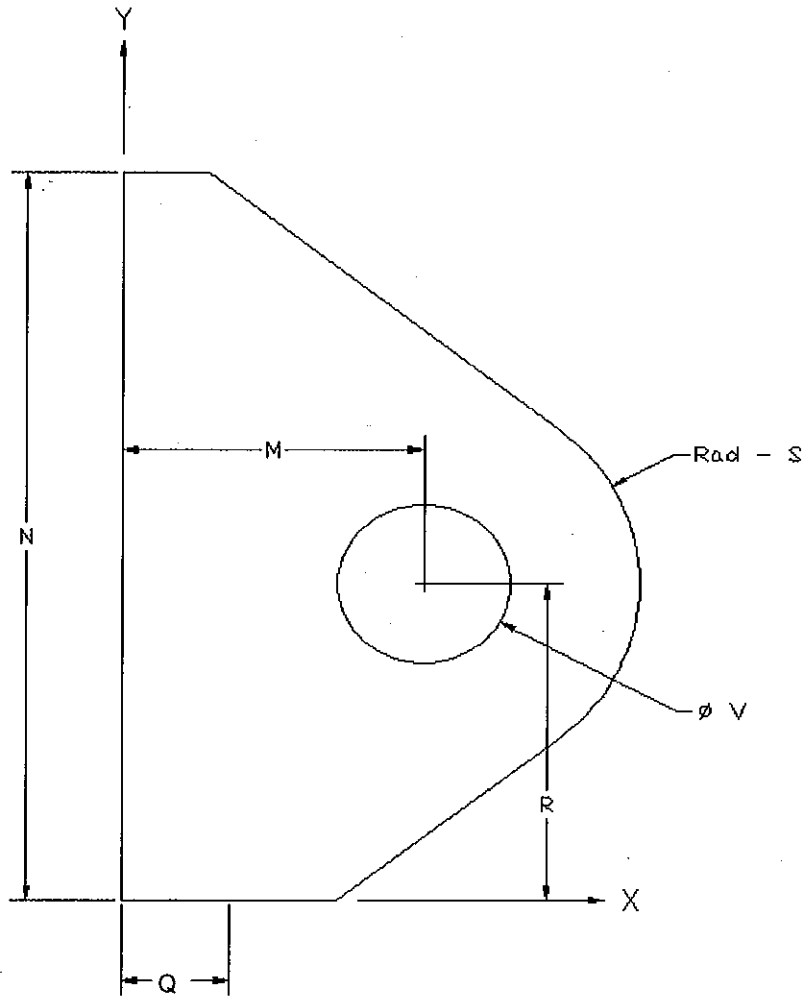
$$T_y = P * \sin \theta * (E - y\text{-bar}) * (B / 2) / J + P * \cos \theta / ((D + C)^2 * t)$$

$$T_{\text{total}} = (T_y^2 + T_x^2)^{1/2}$$

Table 1. Lifting Lug Stress (Twice tank Weight)

Angle	Distance LL from CG	Distance TL from CG	LL Load	TL Load	Lifting Lug Weld Stress (psi)
0	124	116	6,269	13,461	7,105
5	124	122	6,452	13,096	7,362
10	122	127	6,628	12,744	7,560
15	120	131	6,800	12,401	7,697
20	117	135	6,970	12,060	7,773
25	112	137	7,141	11,717	7,788
30	107	138	7,317	11,367	7,743
35	102	138	7,499	11,003	7,638
40	95	138	7,691	10,618	7,475
45	88	136	7,898	10,204	7,255
50	80	133	8,124	9,752	6,982
55	71	129	8,377	9,247	6,658
60	62	124	8,665	8,669	6,290
65	52	118	9,004	7,992	5,883
70	42	111	9,414	7,172	5,449
75	32	104	9,928	6,144	5,003
80	22	95	10,605	4,790	4,575
85	11	86	11,552	2,896	4,223
90	0	76	13,000	0	4,073

Max lifting Lug Shear Stress = 7,788 psi
OK



Lifting Lug

25 KTL ▼

M = 4.5 in
 N = 9 in
 R = 4.5 in
 S = 3.375 in
 V = 2 in
 Q = 2 in
 Tail thickness = 0.75 in
 Weld size 0.25 in
 Shackle Pin = 1.75

Max Tank Weight 13,000 lbs

TL on Tank

Tension Failure 4.63
 Hoop Failure 2.32
 Double Shear Failure 5.72
 Bearing Failure 3.33
 Weld Failure 3.77

1

Hoop Failure Governs Design



Critical Stresses

Tension Failure

$$\sigma = P / (t * (2 * S - V))$$

$$\sigma = 13461 / (0.75 * (2 * 3.375 - 2))$$

$$\sigma = 3,779 \text{ psi}$$

OK

Tank FS = 4.63

Bearing Stress

$$\sigma = P / (t * \text{Shackle Pin D})$$

$$\sigma = 13461 / (0.75 * 1.75)$$

$$\sigma = 10256 \text{ psi}$$

OK

Tank FS = 3.33

Hoop Tension Failure

$$\sigma = P / ((S - V/2) * t)$$

$$\sigma = 13461 / ((3.375 - 2/2) * 0.75)$$

$$\sigma = 7,557 \text{ psi}$$

OK

Tank FS = 2.32

Double Shear Failure

$$\sigma = P / (2 * t * S)$$

$$\sigma = 13461 / (2 * 0.75 * 3.375)$$

$$\sigma = 2,659 \text{ psi}$$

OK

Tank FS = 5.72

Weld Check

Weld Center of Gravity

$$X_{\text{bar}} = 0.5 * Q^2 / (N + Q)$$

$$X_{\text{bar}} = 0.5 * 2^2 / (9 + 2)$$

$$X_{\text{bar}} = 0.182 \text{ in}$$

$$Y_{\text{bar}} = 0.5 * N^2 / (N + Q)$$

$$Y_{\text{bar}} = 0.5 * 9^2 / (9 + 2)$$

$$Y_{\text{bar}} = 3.682 \text{ in}$$

$$J1 = t * N^3 / 12 + N * t * (X^2 + (N/2 - Y)^2)$$

$$J1 = 0.177 * 9^3 / 12 + 9 * 0.177 * (0.182^2 + (9/2 - 3.682)^2)$$

$$J1 = 11.871 \text{ in}^4$$

$$J2 = t * Q^3 / 12 + Q * t * (Y^2 + (Q/2 - X)^2)$$

$$J2 = 0.177 * 2^3 / 12 + 2 * 0.177 * (3.682^2 + (2/2 - 0.182)^2)$$

$$J2 = 5.154 \text{ in}^4$$

$$J = 2 * (J1 + J2) \quad \text{- Welded on both sides}$$

$$J = 2 * (11.87 + 5.15)$$

$$J = 34.05 \text{ in}^4$$

Lifting Lug Weld Stresses

$$T = P * \cos(\theta) * (R - Y_{\text{bar}}) - P * \sin(\theta) * (M - X_{\text{bar}})$$

$$\tau_x = T * Y_{\text{bar}} / J + P * \cos(\theta) / (t * (N + Q))$$

$$\tau_y = T * X_{\text{bar}} / J + P * \sin(\theta) / (t * (N + Q))$$

Tailing Lug Design/Lift Analysis



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$$T_{\text{total}} = (T_y^2 + T_x^2)^{1/2}$$

Table 2. Tailing Lug Stress (Twice tank Weight)

Angle	TL Load (lbs)	Weld Torque (lb in)	T _x (psi)	T _y (psi)	Weld Stress (psi)
0	13,461	11,011	4,648	59	4,648
5	12,963	5,685	3,931	321	3,944
10	12,464	695	3,227	560	3,276
15	11,966	-3,918	2,544	774	2,660
20	11,467	-8,121	1,889	964	2,121
25	10,969	-11,884	1,268	1,127	1,696
30	10,470	-15,188	686	1,263	1,438
35	9,971	-18,015	150	1,372	1,381
40	9,473	-20,356	-338	1,455	1,494
45	8,974	-22,210	-772	1,511	1,697
50	8,476	-23,579	-1,151	1,541	1,923
55	7,977	-24,473	-1,471	1,547	2,135
60	7,479	-24,907	-1,733	1,530	2,312
65	6,980	-24,903	-1,935	1,491	2,443
70	6,481	-24,486	-2,078	1,433	2,525
75	5,983	-23,687	-2,164	1,357	2,554
80	5,484	-22,542	-2,193	1,267	2,532
85	4,986	-21,091	-2,169	1,163	2,461
90	4,487	-19,375	-2,095	1,049	2,343

Max Stress = 4,648 psi

F.S. = 3.765 On Tank



Liquid Height	H =	20	ft
Specific Gravity	G =	1	
Design Pressure	P _d =	27.700	in H2O = 1 psi
Hydrostatic Pressure at tank bottom	P =	9.74	psi
Bottom Plate Thickness	t _g =	0.25	in
Bottom Plate Corrosion Allowance	CA =	0	in
Bottom Plate Material	F _y =	A-36	psi
Bottom Plate Yield Strength	F _y =	58000	psi
Center-Center Grillage Spacing:	b =	28.762	in
Grillage width:	w =	6	in
Number of Supports:	N =	6	

Calculations

$$t_{\text{bottom}} = ((b - w)^2 * P / (1.5 * F_y))^{0.5} + CA$$

$$t_{\text{bottom}} = ((28.76 \text{ in} - 6 \text{ in})^2 * 9.74 \text{ psi} / (1.5 * 58000 \text{ psi}))^{0.5} + 0 \text{ in}$$

$$t_{\text{bottom}} = 0.2408 \text{ in}$$

Check floor deflection

$$d_{\text{max}} = 0.0284 * p * (b - w)^4 / (E * (t_g - CA)^3)$$

$$d_{\text{max}} = 0.0284 * 9.74 * (28.76 - 6)^4 / (28800000 * (0.25 - 0)^3)$$

$$d_{\text{max}} = 0.16 \text{ in}$$

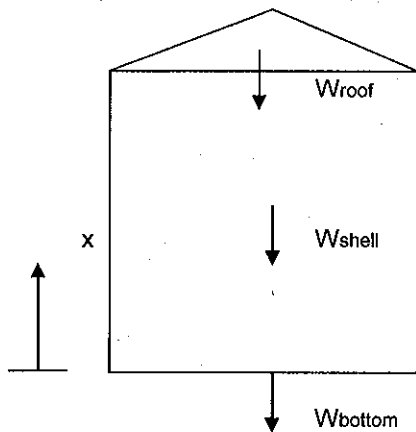
$$d_{\text{limit}} = (t_g) / 2$$

$$d_{\text{limit}} = 0.125 \text{ in}$$

Approximate Center of Gravity



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Weight of Roof	878	lb
Centroid of roof, x	244.49	in
Weight of Shell	5,760	lb
Centroid of shell, x	120	in
Weight of Bottom	1,249	lb
Centroid of Bot, x	0.125	in
Weight of Insulation	1,393	lb
Centroid of In, x	120	in
Weight of top angle	154	lb
Centroid of T.A., x	238.125	in
for C3 x 4.1 3/8" from top of shell		
Weight of Product	132,196.63	lb
Centroid, x	120	ft
Other Weight	1500	lb
Centroid, x	3	in

$$\text{Approx Center of Gravity (Empty)} = \frac{\text{Sum}(x_i W_i)}{\text{Sum}(W_i)}$$

$$= \frac{(877 \text{ lbs} * 244 \text{ in} + 5760 \text{ lbs} * 120 \text{ in} + 1248 \text{ lbs} * 0.125 \text{ in} + 1393 \text{ lbs} * 120 \text{ in} + 154 \text{ lbs} * 238.125 \text{ in} + 1500 \text{ lbs} * 3 \text{ in})}{(877 \text{ lbs} + 5760 \text{ lbs} + 1248 \text{ lbs} + 1393 \text{ lbs} + 154 \text{ lbs} + 1500 \text{ lbs})}$$

$$= 101.92 \text{ in} = 8.49 \text{ ft}$$

$$\text{Approx Center of Gravity (Full)} = \frac{\text{Sum}(x_i W_i)}{\text{Sum}(W_i)}$$

$$= \frac{(877 \text{ lbs} * 244 \text{ in} + 5760 \text{ lbs} * 120 \text{ in} + 1248 \text{ lbs} * 0.125 \text{ in} + 1393 \text{ lbs} * 120 \text{ in} + 154 \text{ lbs} * 238.125 \text{ in} + 1500 \text{ lbs} * 3 \text{ in} + 132196 \text{ lbs} * 120 \text{ in})}{(877 \text{ lbs} + 5760 \text{ lbs} + 1248 \text{ lbs} + 1393 \text{ lbs} + 154 \text{ lbs} + 1500 \text{ lbs} + 132196 \text{ lbs})}$$

$$= 118.62 \text{ in} = 9.88 \text{ ft}$$

NOTE: The above approximation does not include the effects from nozzles and attachments. Therefore it is to used as a guide only.

[illegible]

APPENDIX 1:
BASE SKID ANALYSIS



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BASE SKID ANALYSIS:

$$\text{STATIC HEAD PRESSURE} = SGPH = \frac{(1.0)(62.4)(20)}{144} = 8.67 \text{ psi}$$

$$\text{TOTAL PRESSURE} = ZP = P_{\text{DESIGN}} + P_{\text{STATIC}} = 1 + 8.67 = 9.67 \text{ psi}$$

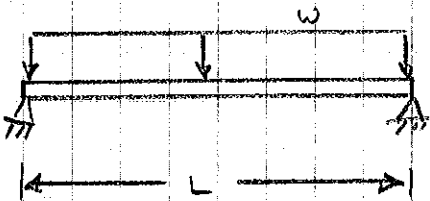
$$\text{WEIGHT} = P \cdot A = (9.67)(\pi)(72)^2 = 157486 \text{ lb.}$$

$$\text{MATERIAL WT} = 15000 \text{ lb. (APPROX.)}$$

$$\text{TOTAL WT} = \Sigma W = 157486 + 15000 = 172486 \text{ lb.}$$

ASSUME (6) MAIN BEAMS TAKE THE ENTIRE WEIGHT.

$$\text{RESULTANT LOADING, } W = \frac{\text{WEIGHT}}{\Sigma L} = \frac{172486}{(2)(135) + (2)(123) + (2)(89)} = 245 \text{ lb/in}$$



ALLOWABLE STRESSES (A40, 21-44W MATERIAL)

$$F_y = 43500 \text{ psi}$$

$$\sigma_{\text{TALL}} = 0.4 F_y = 17400 \text{ psi}$$

$$\sigma_{\text{DALL}} = 0.6 F_y = 26100 \text{ psi}$$

NOTE: LENGTH 'L' ASSUMED AS DISTANCE ON OUTER MEMBERS OF SKID BETWEEN PILE LOCATIONS.

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$$R = \frac{WL}{2} = \frac{(245)(56.5)}{2} = 6921 \text{ lb.}$$

$$M = \frac{WL^2}{8} = \frac{(245)(56.5)^2}{8} = 97763 \text{ lb.in}$$

$$A_{REQ'D} = \frac{R}{\sigma_{TALL}} = \frac{6921}{17400} = 0.40 \text{ in}^2$$

$$S_{REQ'D} = \frac{M}{\sigma_{BALL}} = \frac{97763}{26100} = 3.75 \text{ in}^3$$

Use 8" x 4" x 1/4" HSS

$$A = 5.59 \text{ in}^2 ; S = 11.3 \text{ in}^3$$

CHECK INNER BEAMS:

$$A_{REQ'D} = \frac{R}{\sigma_{TALL}} = \frac{WL}{2\sigma_{TALL}} = \frac{(245)(135)}{2(17400)} = 0.95 \text{ in}^2$$

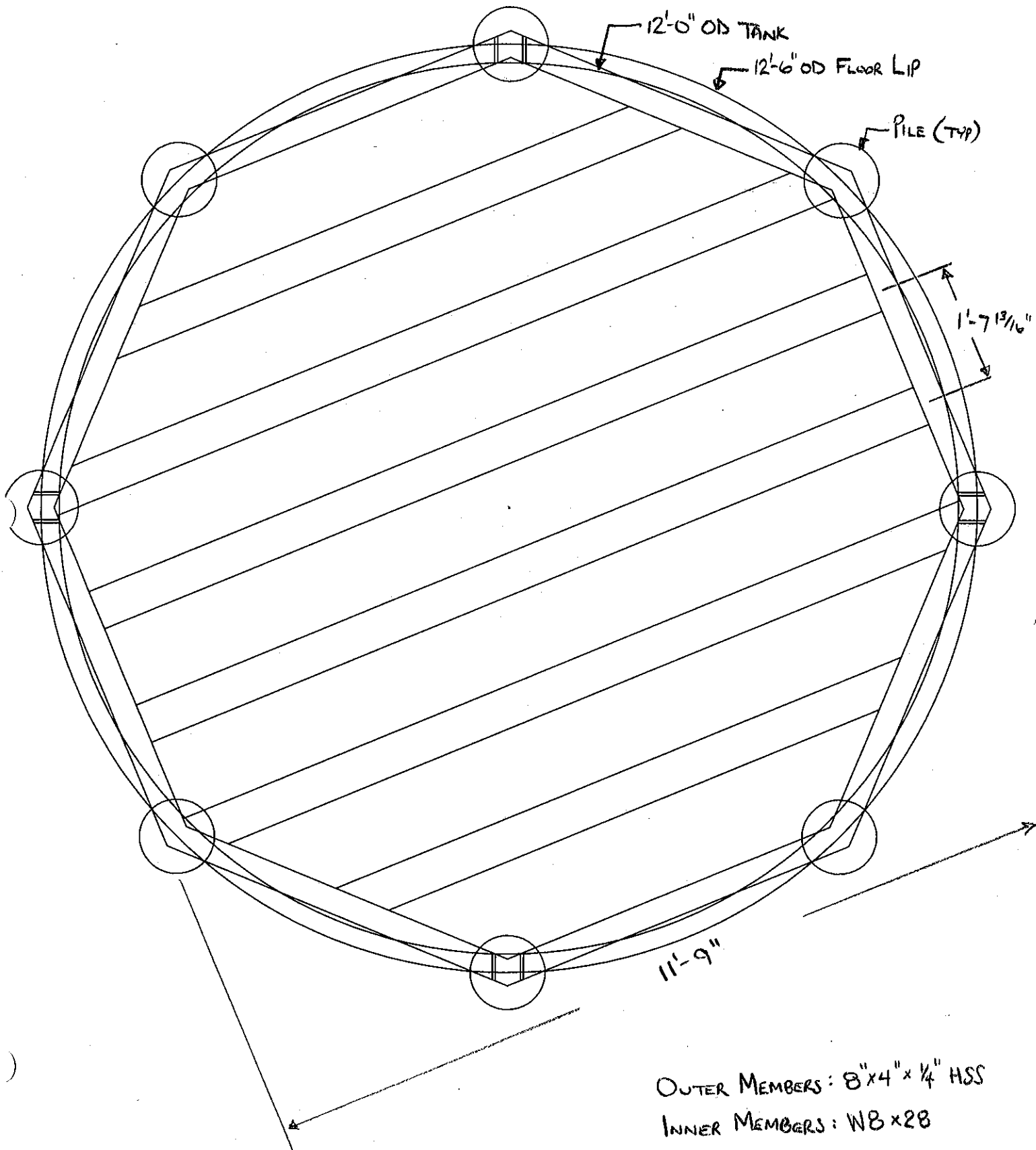
$$S_{REQ'D} = \frac{M}{\sigma_{BALL}} = \frac{WL^2}{8\sigma_{BALL}} = \frac{(245)(135)^2}{8(26100)} = 21.4 \text{ in}^3$$

Use WB x 28

$$A = 8.25 \text{ in}^2 ; S = 24.3 \text{ in}^3$$

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BASE SKID LAYOUT:



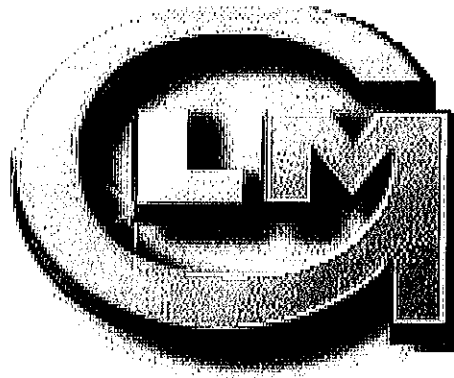
OUTER MEMBERS: 8"X4"X ¹/₄" HSS

INNER MEMBERS: W8X28

10-797-1/2

SHT. 3 OF 3

JB
JAN. 4/11



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SECTION 3

MATERIAL TEST REPORTS



MATERIAL IDENTIFICATION SHEET

GLM JOB #:		DESCRIPTION:		CUSTOMER:		FAB. FACILITY: Nisku
10-797-2		12'-0" O.D. X 20'-0" HIGH 400 BBL Skidded Slop Tank (T-330)		Husky Energy c/o Excelsior Engineering Ltd		Date: June 30'11
DWG #	PC #	QTY	DESCRIPTION	MATERIAL	DWG MARK	HEAT #
3	2	1	1/4" PLATE X SKETCH	A36	N1	A0P0896
3	4	1	10" STD ERW PIPE	A-53-B	N1	58142
3	10	1	3" XS RFWN 150#	SA-105N	N8	70225
3	11	1	3" XS SMLS PIPE	SA-106-B	N8	965485
3	12	1	4" XS RFWN 150#	SA-105N	N6	80407
3	13	1	4" XS SMLS PIPE	SA-106-B	N6	24137
3	14	1	4" RFBL 150#	SA-105N	N6	10/31380
3	17	1	4" XS RFWN 150#	SA-105N	N5	80407
3	18	1	4" XS SMLS PIPE	SA-106-B	N5	24137
3	19	1	4" XS RFWN 150#	SA-105N	N7	80407
3	20	1	4" XS SMLS PIPE	SA-106-B	N7	24137
3	21	1	4" RFBL 150#	SA-105N	N7	10/31380
3	24	1	3" XS RFWN 150#	SA-105N	N9	70225
3	25	1	3" XS SMLS PIPE	SA-106-B	N9	965485
3	26	1	3/16" THK REPAD X SKETCH	A36	N9	1457V
3	27	1	3" XS RFWN 150#	SA-105N	N3	70225
3	28	1	3" XS SMLS PIPE	SA-106-B	N3	965485
3	35	1	3" XS RFWN 150#	SA-105N	N2	70225
3	36	1	3" XS SMLS PIPE	SA-106-B	N2	965485
3	37	1	3" RFSO 150#	SA-105N	N2	RVC-232
3	38	1	3" STD RFWN 150#	SA-182-F304	N2	2173S
3	45	1	1 1/2" NPT FULL COUPLING 3000#	SA-182-F304	L1	Q199
3	46	2	1 1/4" NPT COUPLING 3000#	SA-182-F304	L1	87B1
3	47	1	1" NPT COUPLING 3000#	SA-182-F304	C1	N969
4	1	1	3" XS RFWN 150#	SA-105N		70225
4	2	1	3" XS SMLS PIPE	SA-106-B		965485
4	23	1	3" RFSO 150#	A-105		RVC-232
50	1	4	3/16" PLATE	A36		1457V
50	B1	2	1/4" THK PLATE X SKETCH	A36		A0P0896
50	R1	2	3/16" THK REPAD X SKETCH	A36		1457V

MIR VERIFICATION STAMP
 DATE: **AUG 18 2010**
 REVIEW BY: *[Signature]*
 CONFORMAS TO ASSAE § II EDITION / ADDENDA: **20096**



SIDERCA S.A.I.C.
 Dr. Jorge A. Sainz 250
 02000 (4) Campana
 Buenos Aires, Argentina
 (54) 3485 433100 int.
 (54) 3485 433405 fax

INSPECTION CERTIFICATE (BS EN 10204 3.1: 2004 - ISO 10474 3.1B: 1991)

Client / Cliente VAN LEEUWEN CANADA	Expediente / Manufacturing Order 511307.03	Número / Number 435305	Fecha / Date 12/08/2008	Pág./Page 1 / 6
Producto / Product SMLS LINE PIPE	Orden de Compra / Purchase Order 43001146	Item 3	Referencia del Cliente / Customer Reference	
Norma / Standard API 5L ED. MARISO 3183-47 + ASME B31.15 + CSA Z245 R1 + P4.17.01 2004 (MCSM) 07/07/00/0103	Grado / Grade BX54N-200SS	Extremos / Ends BEVEL AT 30 DEG. APPX. ISO		
Dimensiones / Dimensions 273.10 x 9.30 mm	Superficie / Surface INT. EXTER. EXT. WASHED	Cantidades / Quantities 294 Pcs 3818.08 m 230369 Kg		
10.750 ± 0.365 inches	Longitud / Length DR (SP)	294 Pcs 12522.57 ft 507943 lb		

ENSAYOS DE TRACCION / TENSILE TEST

Nº de Ensayo	Condición de la probeta	Temp. de Ensayo	Sección	Fuerza / Yield Strength				Reducción de área	Durante / Hardness Tipo / Type HBW
				ESL	Req. Min.	V. Obt.	Req. Min.		
Hacia Test Nº	Zona Ensayo	Especimen condition	Size	Elongation				V. Obt.	V. Obt.
				ESL	Req. Min.	V. Obt.	Req. Min.		
5706	CB	ST	38.00 X 9.32	0.5	200	251.1	405	415	22.3
5706	CB	ST	38.16 X 9.43	0.5	200	332.2	405	415	22.3
5706	CB	ST	38.00 X 9.52	0.5	200	341.9	405	415	22.3
5706	CB	ST	38.00 X 9.70	0.5	200	338.1	405	415	22.3
5706	CB	ST	38.00 X 9.70	0.5	200	338.1	405	415	22.3

TEST TECHNOLOGIES / TECHNOLOGICAL TEST

Aplicación / Application	Fluorografía / Radiography	Ultrasonido / Ultrasonic	Profilometría / Profilometry	Medición de Tracción / Tensile Test	Medición de Impacto / Impact Test	Medición de Dureza / Hardness Test	Medición de Extensión / Elongation Test	Medición de Reducción de Área / Reduction of Area Test	Medición de Viscosidad / Viscosity Test
Resultado / Result	OK	OK	OK	OK	OK	OK	OK	OK	OK

Pro = **PRO** (Proven)
 N = **N** (Not)
 EST = **EST** (Estimated)
 Q & T = **Q & T** (Quality & Temperature)
 TART = **TART** (Tensile & Reduction of Area Test)

RE = **RE** (Refractory)
 CI = **CI** (Cement)
 ST = **ST** (Steel)

L = **L** (Longitudinal)
 T = **T** (Transverse)
 PTT = **PTT** (Tensile & Transverse)
 EXT = **EXT** (Elongation)
 RA = **RA** (Reduction of Area)

V = **V** (Vibratory)
 C = **C** (Chemical)
 D = **D** (Density)
 E = **E** (Elasticity)

10.365 A53B/5A 106B/5L - X42 SML BE SR.



Client / Customer VAN LEEUWEN CANADA		Expedient / Manufacturing Order 51337.03		Número / Number 455365		Fecha / Date 12/08/2002		Pág. / Page 2 / 6	
Product / Product: SRLS LINE FFE		Order de Compra / Purchases Order 45001146		Item 3		Referencia del Cliente / Customer Reference			
Normas / Standard API 5L E3-ED/ISO 3183-07 + ASA 53-106 + CAN22AS R5 + P4.17.81 + FMACENR0775MR0102		Grado / Grade B0424-Z00SS		Especimen / Ends BEVEL AT 30 DEG API 5L ISO					
Schedule 40		Peso Nominal / Nominal Weight 60.30 KG/MET		Longitud / Length DR (SP)		Superficie / Surface INT BARE EXT VARNISHED		Cantidades / Quantities 294Pz 3816.88 m	
Dimensions / Dimensions 273.10 x 9.30 mm		10.730 x 0.365 inches		40.52 LB/FT		294Pcs 12322.57 Ft		230039Kg 507943Lb	
ENSAYOS QUIMICOS / CHEMICAL ANALYSIS									

ENSAYOS QUIMICOS / CHEMICAL ANALYSES

				ENSAYOS QUIMICOS / CHEMICAL ANALYSES																																												254Pcs		12522.57 R		5079431D																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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P = Analisis de procedimiento (análisis de procedimiento)

[illegible]

— = ppm / Part per million

11-11-47



Tenaris

INSPECTION CERTIFICATE

(BS EN 10204 3.1: 2004 - ISO 10474 3.1B: 1991)

SOMICA S.A.I.C.
Dr. Jorge A. Somoza 250
82200-000 (14) Campana
Buenos Aires, Argentina
(54) 3463 423100 Int.
(54) 3463 423405 Fax

Cliente / Customer VAN LEEUWEN CANADA		Expediente / Manufacturing Order 57387.03		Número / Number 455905		Fecha / Date 12/02/2005		Pág. / Page 3 / 6	
Producto / Product SMLS LINE PIPE		Orden de Compra / Purchase Order 45001146		Item 3		Referencia del Cliente / Customer Reference			
Norma / Standard API 5L E04450 3183-AT + ASA 52-106 + CSA Z245 R3 + P4.17.91 R2 + NACE MR0175 MR0103		Grado / Grade BUXAC-250SS		Extrínsecos / Ends BEVEL AT 30 DEG. APPELUSO					
Dimensiones / Dimensions 273.10 x 9.30 mm		Superficie / Surface INT BARE EXT VARNISHED		Cantidades / Quantities 294 Pz 3616.98 m 230398 Kg					
Schedule 40		Longitud / Length DR (SP)		294 Pcs 12522.57 Ft 597943.15					
10.750 x 0.365 inches		Peso Nominal / Nominal Weight 68.20 KG/MT							
		40.52 LB/FT							

ENSAYOS QUÍMICOS / CHEMICAL ANALYSES

		C		S		Si		Mn		Cr		Mo		W		Co		P		S		Se		V		Al		Fe		Cu		Zn		As		Nb		Ti		Pb		Sn		Co		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni		Cu		Zn		Pb		Ag		Au		Pt		Pd		Rh		Ir		Os		Ru		Tc		Zr		Hf		Ta		Nb		Mo		Cr		Mn		Fe		Ni</	
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INSPECTION CERTIFICATE

(BS EN 10204 3.1: 2004 - ISO 10474 3.1B: 1991)

SIDERCA S.A.C.
Dr. Jorge A. Sotelo 290
Buenos Aires, Argentina
CABA 1416 433100 PL
CABA 1416 433425 EX

Cliente / Customer VAN LEEDWEN CANADA		Expediente / Manufacturing Order 312387.03		Número / Number 453885		Fecha / Date 12/08/2008		Página / Page 4 / 6	
Producto / Product SMILS LINE PIPE		Orden de Compra / Purchase Order 45001146		Item 3		Referencia del Cliente / Customer Reference			
Norma / Standard API 5L ED.44ISO 3183-07 + ASA 53-106 +CSA Z245 B1 +P4.17.01 R2+MACE880775NR0103		Grado / Grade BUXEN-20MSS		Extremo / Ends REVEL AT 30 DEG APPELISO					
Dimensiones / Dimensions 273.10 x 9.30 mm 10.750 x 0.365 inches		Peso Nominal / Nominal Weight 60.36 KG/MFT 40.52 LB/FT		Longitud / Length 10R (SP)		Superficie / Surface INT BARE/EXT VARNISHED		Cantidades / Quantities 234 Pz 3816.88 m 230089 Kg 234 Pcs 12522.57 Ft 507943 Lb	
E = Monogramma / Monogram SIDERCA MMLYY = Mes / Año Month / Year		N = Número de tubo / Nbr of pipe YIT = Año / Trimestre Year / Quarter		PPP = Peso / Weight H = Calada / Heat		@ = Monogramma / Monogram API			
Presión / Pressure Valor / Value 2440		Tiempo / Time Segundos / Seconds 5.90		Resultado / Results Satisfactorio / Satisfactory					
Estando (Tubo) / Standoff (Pipe) L.L.L. TENARIS SD SPEC 5L0596 @ MMLYY ISO 3183 ASTM/ASME ASA 53/106 273,1 9.3 B-L245042-L280/250MSS/B PSL1 SMILS 168KPA/100BAR - 30 S - SWEETD 80.5 CSA Z245.1-02 PO45001146 MADE IN ARGENTINA HX0000X MMLNN PEPPEP		Prueba Hidráulica / Hydraulic Test							
FABRICADO POR TENARIS SIDERCA		FABRICADO POR TENARIS SIDERCA		FABRICADO POR TENARIS SIDERCA		FABRICADO POR TENARIS SIDERCA			
SISTEMA DE CONTROL: FUNDICIÓN EN CUBO CONTINUO - ACERO CUBO CONTINUO		SISTEMA DE CONTROL: FUNDICIÓN EN CUBO CONTINUO - ACERO CUBO CONTINUO		SISTEMA DE CONTROL: FUNDICIÓN EN CUBO CONTINUO - ACERO CUBO CONTINUO		SISTEMA DE CONTROL: FUNDICIÓN EN CUBO CONTINUO - ACERO CUBO CONTINUO			
MATERIA PRIMA: ACERO EN CUBO CONTINUO - ACERO CUBO CONTINUO		MATERIA PRIMA: ACERO EN CUBO CONTINUO - ACERO CUBO CONTINUO		MATERIA PRIMA: ACERO EN CUBO CONTINUO - ACERO CUBO CONTINUO		MATERIA PRIMA: ACERO EN CUBO CONTINUO - ACERO CUBO CONTINUO			
PROCESO DE FABRICACIÓN FABRICACIÓN EN CUBO CONTINUO - ACERO CUBO CONTINUO		PROCESO DE FABRICACIÓN FABRICACIÓN EN CUBO CONTINUO - ACERO CUBO CONTINUO		PROCESO DE FABRICACIÓN FABRICACIÓN EN CUBO CONTINUO - ACERO CUBO CONTINUO		PROCESO DE FABRICACIÓN FABRICACIÓN EN CUBO CONTINUO - ACERO CUBO CONTINUO			
CONTROL DE CALIDAD CONTROL DE CALIDAD EN CUBO CONTINUO - ACERO CUBO CONTINUO		CONTROL DE CALIDAD CONTROL DE CALIDAD EN CUBO CONTINUO - ACERO CUBO CONTINUO		CONTROL DE CALIDAD CONTROL DE CALIDAD EN CUBO CONTINUO - ACERO CUBO CONTINUO		CONTROL DE CALIDAD CONTROL DE CALIDAD EN CUBO CONTINUO - ACERO CUBO CONTINUO			
CONDICIONES DE ALMACENAMIENTO CONDICIONES DE ALMACENAMIENTO EN CUBO CONTINUO - ACERO CUBO CONTINUO		CONDICIONES DE ALMACENAMIENTO CONDICIONES DE ALMACENAMIENTO EN CUBO CONTINUO - ACERO CUBO CONTINUO		CONDICIONES DE ALMACENAMIENTO CONDICIONES DE ALMACENAMIENTO EN CUBO CONTINUO - ACERO CUBO CONTINUO		CONDICIONES DE ALMACENAMIENTO CONDICIONES DE ALMACENAMIENTO EN CUBO CONTINUO - ACERO CUBO CONTINUO			
NO REPARADO POR SOLDADURA NO REPARADO POR SOLDADURA EN CUBO CONTINUO - ACERO CUBO CONTINUO		NO REPARADO POR SOLDADURA NO REPARADO POR SOLDADURA EN CUBO CONTINUO - ACERO CUBO CONTINUO		NO REPARADO POR SOLDADURA NO REPARADO POR SOLDADURA EN CUBO CONTINUO - ACERO CUBO CONTINUO		NO REPARADO POR SOLDADURA NO REPARADO POR SOLDADURA EN CUBO CONTINUO - ACERO CUBO CONTINUO			
PROPIEDADES DEL MATERIAL PROPIEDADES DEL MATERIAL EN CUBO CONTINUO - ACERO CUBO CONTINUO		PROPIEDADES DEL MATERIAL PROPIEDADES DEL MATERIAL EN CUBO CONTINUO - ACERO CUBO CONTINUO		PROPIEDADES DEL MATERIAL PROPIEDADES DEL MATERIAL EN CUBO CONTINUO - ACERO CUBO CONTINUO		PROPIEDADES DEL MATERIAL PROPIEDADES DEL MATERIAL EN CUBO CONTINUO - ACERO CUBO CONTINUO			
LA DIBERTE CON LA NORMA LA DIBERTE CON LA NORMA EN CUBO CONTINUO - ACERO CUBO CONTINUO		LA DIBERTE CON LA NORMA LA DIBERTE CON LA NORMA EN CUBO CONTINUO - ACERO CUBO CONTINUO		LA DIBERTE CON LA NORMA LA DIBERTE CON LA NORMA EN CUBO CONTINUO - ACERO CUBO CONTINUO		LA DIBERTE CON LA NORMA LA DIBERTE CON LA NORMA EN CUBO CONTINUO - ACERO CUBO CONTINUO			



(BS EN 10204 3.1: 2004 - ISO 10474 3.1B: 1991)

154 3483 43400 31
154 3483 43405 154

Cliente / Customer YAN LEEBURN CANADA Producto / Product SMALLS LINE PIPE	Expediente / Manufacturing Order 51387 AS Orden de Compra / Purchase Order 45981148	Número / Number 453985 Referencia del Cliente / Customer Reference Item 3	Fecha / Date 12/08/2008 Pág. / Page 5 / 6
Norma / Standard API 5L ED 40S0 3103-07 + AISI 52-106 +CSA Z245 R1 +PNL 17.91 RD+NACE MR0175 MR0103	Grado / Grade BX62+200SS Extremo / Ends BEVEL AT 90 DEG. API 5L ISO	Superficie / Surface INT BARE TEXT VARNISHED Cantidades / Quantities 294 Pz 33416.88 m 236389 Kg 294 Pcs 12522.57 Ft 597843 Lb	
Dimensiones / Dimensions 273.16 x 9.30 mm 10.750 x 0.365 inches	Schedule 40	Peso Nominal / Nominal Weight 60.30 KG/MTR 40.52 LB/FT	Longitud / Length DR (SP)
- EL MATERIAL CUMPLE CON LOS REQUERIMIENTOS CSA Z245.1 GR 241/250 CAT I - EL MATERIAL CUMPLE CON LOS REQUERIMIENTOS DE MICRODUREZA HV500 MAXIMO 248 VICKERS SEGUN CSA Z245.1 02 - EL MATERIAL CUMPLE CON LOS REQUERIMIENTOS NACE MR 0103-2003.			
"NORMAS" -EDICION DE LA NORMA: CSA Z245.1/02 -EDICION DE LA NORMA: API 5L 44° Edition 2007 - ISO 3183:2007 -EDICION DE LA NORMA: ASTM A53/A 53 2007 -EDICION DE LA NORMA: ASTM A 106/ 2008A -EDICION DE LA NORMA: ASME SA 53/2007 -EDICION DE LA NORMA: ASME SA 106/ 2007 -EDICION DE LA NORMA: MR 01-75 - ISO 15848-1/2007 -EDICION DE LA NORMA: NACE MR 01-03-2003			
"STANDARDS" -EDITION OF REGULATION: CSA Z245.1/02 -EDITION OF REGULATION: API 5L 44° Edition 2007 - ISO 3183:2007 -EDITION OF REGULATION: ASTM A53/A 53 2007 -EDITION OF REGULATION: ASTM A 106/ 2008A -EDITION OF REGULATION: ASME SA 53/2007 -EDITION OF REGULATION: ASME SA 106/ 2007 -EDITION OF REGULATION: MR 01-75 - ISO 15848-1/2007 -EDITION OF REGULATION: NACE MR 01-03-2003			
Observaciones / Remarks NON DESTRUCTIVE TEST: SATISFACTORY INSPECTION RESULTS: E.M.L LONG.(EXT.) NOTCH 5% E.M.L LONG.(INT.) NOTCH 10% E.M.L TRANSV.(EXT.) NOTCH 10% E.M.L TRANSV.(INT.) NOTCH 10% U.T. 100% FALLOUTS CONTROL SATISFACTORY ONE REDUCTIONAL BAND END MARKING ONE ORANGE BAND SEE ATTACHED VICKERS HARDNESS TEST REPORT. Magnitudes de Control de Calidad / Quality Control Magnitudes 30			



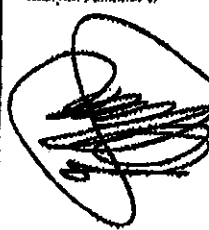
INSPECTION CERTIFICATE

(BS EN 10204 3.1: 2004 - ISO 10474 3.1B: 1991)

SIDERCA S.A.C.
Dr. Jorge A. Smal 250
02000 (P.A.) Caracas
Buenos Aires, Argentina
54-3483 433000 tel.
54-3483 433405 fax

Cliente / Customer VAN LEUWEN CANADA		Expediente / Manufacturing Order 51937.03		Numero / Number 433385		Fecha / Date 12/02/2008		Pag. / Page 6 / 6	
Producto / Product SMLS LINE PIPE		Orden de Compra / Purchase Order 45001446		Item 3		Referencia del Cliente / Customer Reference			
Norma / Standard API 5L ED 44 ISO 3183-07 + ASA 53-106 + CSA Z245 R1 + PL 17.01 R3 + NACE MR0175 + N1003		Grado / Grade B7042+20SS		Extremo / Ends BEVEL AT 30 DEG APPELISO					
Dimensiones / Dimensions 273.10 x 9.38 mm		Superficie / Surface INT BARE EXT YARNISHED		Cantidades / Quantities 294 Pz 3816.88 m 230399 Kg					
Schedule 40		Longitud / Length IDR (SP)		294 Pcs 1252.57 Ft 587943 Lb					
Peso Nominal / Nominal Weight 60.50 KG/MT		Longitud / Length IDR (SP)							
10.750 x 0.385 inches		40.52 LB/FT							

Por la presente certificamos que el material aqui descrito ha sido fabricado de acuerdo con las especificaciones indicadas en las normas de referencia y satisface las especificaciones respectivas.		We hereby certify that the material herein described has been manufactured in accordance with the specifications indicated in the reference standards and satisfies the respective specifications.	
Este certificado es valido solo en la forma en que aparece en el original firmado por el representante autorizado de la empresa.		This certificate is valid only in the form in which it appears in the original signed by the authorized representative of the company.	
El representante autorizado de la empresa es el responsable de la veracidad de la informacion contenida en este certificado.		The authorized representative of the company is responsible for the truthfulness of the information contained in this certificate.	
Cualquier uso no autorizado de este certificado es considerado una infraccion de las leyes de propiedad intelectual.		Any unauthorized use of this certificate is considered an infringement of the laws of intellectual property.	
Si necesita una copia de este certificado, comuniquese con SIDERCA S.A.C. al correo electronico: certificados@siderca.com		If you need a copy of this certificate, contact SIDERCA S.A.C. at the e-mail: certificados@siderca.com	



QUALITY CONTROL DEPT.
DTO CERTIFICADO DE CALIDAD
ENUARDIA AVERE

965485

V&M FRANCE TUBERIE SAINT SAULVE SAINT SAULVE ZONE INDUSTRIELLE 59860 SAINT SAULVE	 VALLOUREC & MANNESMANN TUBES Vallourec Group	MATERIAL TEST REPORT INSPECTION CERTIFICATE 3.1 EN 10204 : 2004 No. : 110709-10 Page: 1 / 5 Date: 19.11.2010
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3 xH A106

(A01) V&M FRANCE	(A06.1) V&M-Order-No. LA1889 (A06.2) Suborder 858/8888 0
(A06.1) Customer OCTF CORPORATION 5407 -53RD AVENUE EDMONTON AB T6B 3G2 T6B 3G2	(A07.1) Order-No. VM2454
(A06.2) Orderer VALLOUREC TUBES CANADA INC. / BURLINGTON, ONTARIO L7L 6G4	(A07.2) Order-No. VM2454 Date 20.07.2010
	(A07.3) Order-No. 4888381-00
(B01, B02, B04) Description of the product	Hot finished seamless line pipe Ends bevelled, angle 30° (+5 / -0), root face 1.6 mm (± 0.8) Inside without rust protection Outside dry varnish As rolled API spec. 5 L, PSL1, 10.2007 ASTM A 106 M - 08 / ASTM A 530 M - 04 A ASME SA 106, Edition 2007 / ASME SA 530 M, Edition 2007 ASME Boiler and Pressure Vessel Code, Section II, Part A, Edition 2007, Addenda 2008b CSA Z 245.1:2009 Nace MR 0175 / ISO 15156-2:2003 / COR.1:2005 / EN ISO 15156-2:2003, Annexe A.2.1.2 Nace MR 0103-2005, Paragraphe 2.1 X 42 Grade B acc. to API spec. 5 L Grade B acc. to ASTM A 106 M / ASME SA 106 Grade 290 acc. to CSA Z 245.1, Cat. I
(B03) Sour service as defined in paragraph 16 of CSA Z 245.1, but without HIC test. These PSL1 products do not conform to Annex H of API 5L.	

(A13) V&M Item	(A09) Cust. Item	(B14) Item text	(B06) Dimensions	(B10) Single length
14		SKU No 2820419	NP8 3 SCH 8D OD-Tolerance + 0.75 % - 0.75 % WT-Tolerance + 16 % - 12.5 %	Fixed length 20 Ft + 4 In - 0 in

MTR VERIFICATION STAMP	
DATE: <u>Jan 26.11</u>	REVIEW BY: <u>[Signature]</u>
CONFORMS TO ASME § II <u>A</u>	EDITION / ADDENDA: <u>2009b</u>

V&M FRANCE TUBERIE SAINT SAULVE SAINT SAULVE ZONE INDUSTRIELLE 59880 SAINT SAULVE	 VALLOUREC & MANNESMANN TUBES Vallourec Group	MATERIAL TEST REPORT - INSPECTION CERTIFICATE 3.1 EN 10204 : 2004 No. : 110708v10 Page: 2 / 5 Date: 19.11.2010
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(A13) V&M Item	(A21) Cust. Item	(B07.1) Heat	(B08) Quantity	(B11) Total length m	(B13) Weight lb
14		965485	253	5.102,030	51.831

(C71)

HEAT CHEMICAL ANALYSIS

For each reduction of 0,01% carbon below 0.30 %, an increase of 0,05% manganese above 1.08 % would be permitted to a maximum of 1,35% manganese.

(B07.1) Heat	(B18) Process	C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Cu %	Ti %
min	-	-	0,10	0,29	-	-	-	-	-	-	-
max	-	0,28	0,50	1,08	0,030	0,030	0,40	0,15	0,40	0,40	0,11
965485	Electro (EAF)	0,16	0,19	0,74	0,016	0,002	0,23	0,06	0,08	0,16	0,00

(B07.1) Heat	Nb/Cb %	V %	B %	0002 %	2528 %	0014 %	1003 %	1089 %				
min	-	-	-	-	3,00	-	-	-				
max	0,11	0,08	0,001	0,15	-	1,00	0,40	0,40				
965485	0,00	0,00	0,000	0,00	4,84	0,62	0,35	0,33				

0002	V+NB+Ti
2528	MN/C
0014	CR+CU+MO+NI+V
1003	CE = C+MN/8+(CR+MO+V)/5+(NI+CU)/15
1089	C+F(MN/8+SI/24+CU/15+NI/20)+((CR+MO+V+NB)/5)+5*B

Heats fully killed

(C73)

PRODUCT CHEMICAL ANALYSIS

For each reduction of 0,01% carbon below 0.30 %, an increase of 0,05% manganese above 1.08 % would be permitted to a maximum of 1,38% manganese.

V&M FRANCE TUBERIE SAINT SAULVE SAINT SAULVE ZONE INDUSTRIELLE 69000 SAINT SAULVE	 VALLOUREC & MANNESMANN TUBES Vallourec Group	MATERIAL TEST REPORT - INSPECTION CERTIFICATE 3.1 EN 10204 : 2004 No. : 110708v10 Page: 3 / 5 Date: 19.11.2010
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(072)
PRODUCT CHEMICAL ANALYSIS

(007.1) Heat	(C00.1) Test Piece	C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Cu %	Ti %
min		-	0,10	0,29	-	-	-	-	-	-	-
max		0,28	0,50	1,06	0,030	0,030	0,40	0,16	0,40	0,40	0,11
985485	01DL276	0,18	0,19	0,75	0,018	0,002	0,23	0,08	0,08	0,16	0,00
985485	02DL276	0,18	0,19	0,76	0,017	0,002	0,23	0,08	0,08	0,16	0,00

(007.1) Heat	(C00.1) Test Piece	Nb/Cb %	V %	B %	0002 %	2528 %	0014 %	1003 %	1099 %		
min		-	-	-	-	3,00	-	-	-		
max		0,11	0,08	0,001	0,15	-	1,00	0,40	0,40		
985485	01DL276	0,00	0,00	0,000	0,00	4,70	0,53	0,36	0,36		
985485	02DL276	0,00	0,00	0,000	0,00	4,61	0,53	0,36	0,36		

0002	V+NB+Ti
2528	MN/C
0014	CR+CU+MO+NI+V
1003	CE = C+MN/8+(CR+MO+V)/5+(NI+CU)/15
1099	C+F(MN/8+SI/24+CU/15+NI/20+((CR+MO+V+NB)/5)+5*B)

(004)
HEAT TREATMENT

NORMALIZED CONDITION MIN 920°C (1688 F) COOLING AIR

TENSILE TEST RESULTS

Type (C10.1)	Tube strip specimen
Test temperature (C03)	Room temperature
Direction (C02)	longitudinal

DOUBLE LENGTH

V&M FRANCE TUBERIE SAINT SAULVE SAINT SAULVE ZONE INDUSTRIELLE 59680 SAINT SAULVE	 VALLOUREC & MANNESMANN TUBES Vallourec Group	MATERIAL TEST REPORT - INSPECTION CERTIFICATE 3.1 EN 10204 : 2004 No. : 110708v10 Page: 4 / 5 Date: 19.11.2010
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TENSILE TEST RESULTS

(B07.1)	(C00.1)	(C10.2)	(C11)	(C12)	(C13.2)						
Heat	Test Piece	Dimension	YS	TS	Elong.						
		in / eq in	R _{p0.2} psi	R _m psi	2" %						
min		-	42000	60000	24,0						
max		-	-	-	-						
885488	01DL276	0,74x0,30 0,22	47208	72975	33,8						

(C10.2)
Dimension

Test piece dimensions
Test piece area

HARDNESS TEST RESULTS

89 HRB EQUIVALENT TO 22 HRC

Method of test (C30) Rockwell B

(B07.1)	(C00.1)	(C31.1)	(C31.1)	(C31.1)	(C32.1)						
Heat	Test Piece	HRB	HRB	HRB	Mean						
min		-	-	-	-						
max		89,0	89,0	89,0	-						
885488	01DL276	81,0	81,0	81,0	81,0						

TECHNOLOGICAL AND OTHER TESTS ON SPECIMENS

Test	Conditions	Test rate	Result
Flattening test	Flattening test (specific)		Satisfactory

OTHER TESTS ON PIPE

Test	Conditions	Test rate	Result
Hydrostatic test	2973 PSI 5 SEC	100% each lot	Satisfactory
Appearance & Dimensions	Aspect & Dimensions (spécifique)	100% each lot	Satisfactory
Eddy Current test	CSA Z245-1	100% each lot	Satisfactory
Residual magnetism	30 GAUSS MAX	100% each lot	Satisfactory

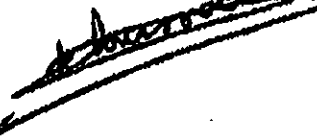
MARKING, IDENTIFICATION

14	Paint stenciled on one side	 V & M FRANCE 6L 0081 API DATE OF MARKING A/SA108 Z245.1-07 3 1/2 X 0.300 88.80 X 7.62 B + X42 + 200 CAT 1 PSL1 S SML8 2970 PSI HT HEAT NUMBER 88 SCH 80 VM2454 4888381-00 LENGTH LENGTH
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V&M FRANCE TUBERIE SAINT SAULVE SAINT SAULVE ZONE INDUSTRIELLE 69880 SAINT SAULVE	(A01)	 VALLOUREC & MANNESMANN TUBES Vallourec Group	MATERIAL TEST REPORT - INSPECTION CERTIFICATE (A02) 3.1 EN 10204 : 2004 No. : 11070Sv10 (A03) Page: 5 / 6 Date: 19.11.2010
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(Z01)
 The supplied products are in compliance with the requirements of the order

(A04, Z02, Z03)

Date	19.11.2010
Validated by	Inspection Representative
	Valérie DELACROIX 
☎	+ (33) 3 27 23 14 56
✉	+ (33) 3 27 23 15 25
@	valerie.delacroix@vmtubes.fr
Stamp	

Indication in parentheses correspond to attributes according to EN 10168

This test report and certification respectively may neither be modified nor used for other products. Offences are regarded as falsification of documents and will be subject to criminal prosecution.



SAN ENG STEEL FORGING CO LTD
311, Jan Hsin Road, Jan Wu Hsiang
Kaohsiung Hsien, Taiwan, R.O.C.
TEL: 07-3724249; FAX: 07-3712923
URL: www.saneng.com.tw
e-mail: saneng@kds.steel.net.tw

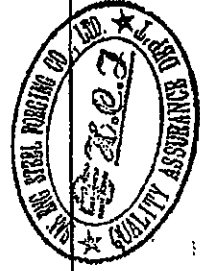
MILL TEST CERTIFICATE

ENT0204-3.1.BIDIN50049/3.1.P)
W.F.FITTINGS & FLANGES (CANADA)
Customer: LTD.
Order No.: D000200/S76908553

Certificate No.: SE180553
Date: 01/17/2011
Page: 1 OF 1

80407

PRODUCT		MATERIAL SPECIFICATIONS		DIMENSIONAL SPECIFICATIONS													
FORGED CARBON STEEL FLANGES		ASTM A105-08/ASME SA105-08		ASME B16.5-08 CSA Z245.12													
Item No.	CUSTOMER P/N	DESCRIPTION	QUANTITY	CHEMICAL COMPOSITION (%)												CE(%)	
			Min Max	C	Si	Mn	P	S	Cu	Cr	Ni	Mo	V	Nb	N		
1		300 SWRF XS 1" A105N	40 PCE	0.207	0.100	0.600	0.035	0.040	0.400	0.300	0.400	0.120	0.080	0.020	-	-	0.395
2		150 WNR STD 4" A105N	1,935 PCE	0.200	0.250	1.050	0.009	0.009	0.009	0.041	0.044	0.005	0.031	0.005	0.004	-	0.416
3		150 WNR XS 4" A105N	15 PCE	0.210	0.210	1.100	0.013	0.019	0.130	0.090	0.050	0.013	0.009	0.001	0.008	-	0.416
4		600 WNR XS 6" A105N	5 PCE	0.200	0.210	1.100	0.013	0.019	0.130	0.090	0.050	0.013	0.009	0.001	0.008	-	0.390
				0.207	0.250	1.070	0.012	0.015	0.012	0.029	0.046	0.005	0.011	0.005	0.004	-	0.390
Item No.	Heat No.	T.S.(MPa) Min Max	Y.S.(MPa)	E.L.(%)	Hardness (HRC)	R.A.(%)	Impact Test Temp: Minimum: Joule	Material Supplier	HEAT TREATMENT(2)		REMARKS						
1	24383	517.8	379.5	35.6	153	89.5	2	NTMK	800°C X 3HRS		CONFORMS WITH NACE MR0103-07 AND NACE MR0175/ISO15156.2						
2	80407	533.5	395.2	34.4	154	89.5	3	WEI CHIH STEEL			CONFORMS WITH Z245.12 CAT I GR.248 SOUR SERVICE-05						
3	80407	533.5	395.2	34.4	154	89.5		WEI CHIH STEEL			TEST SPECIMEN ORIENTATION: TRANSVERSE						
4	40747	503.1	335.4	35.4	149	89.6		NTMK									
*1: T.S. = Tensile Strength, Y.S. = Yield Strength, E.L. = Elongation, R.A. = Reduction of Area. *2: N=Normalized, A=Annealed, Q=Quenched, T=Tempered, S.T.=Solution Treated, S.R.=Stress Relieved, A.C.=Air Cooled, F.C.=Furnace Cooled, W.C.=Water Cooled, O.C.=Oil Cooled. *3: C.E. Value = C + (Mn/8) + (Cr + Mo x 5) / 5 + (Ni + Cu) / 15																	
We hereby certify that the material has been tested in accordance with the above specification and also with the requirements called for by the above order.																	
Manager of Quality Assurance Dept																	



MTR VERIFICATION STAMP

DATE: 10/24/11 REVIEW BY: [Signature]
CONFORMS TO ASME § II 14 EDITION / ADDENDA: 2006

24137

PO# 7423



MILL TEST CERTIFICATE

CERTIFICADO DE PRUEBAS EN FABRICA

Alpoma Tubes Inc.
547 Wallace Terrace
Cauld St. Mary, ON CANADA
POC 1L0
(705) 946-1304
(705) 946-8131 fax

Number / Número: **00030169**
Page / Página: **117**

Date / Día: **December 28, 2010**

Customer / Cliente: MCJUNKIN RED MAN TUBULAR	Customer's Order Item / Orden Cliente - Item: PO # 0012 728237 400	Manufacturer's Works Order N° / Confirmación de Venta: 007183703
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED	Product Type / Tipo de Producto: LINE PIPE SEAMLESS	Surface / Superficie: VARNISHED
Standard or Specification / Normas o Especificaciones: Z245.1 APRIL2007, ASME/ASTM SA4106 B/2006	CONDUCCION SIN COSTURA	Ends / Extremos: BARNIZADO
Dimensions / Dimensiones: 4.5 X 0.337 INCH 114.3 X 8.56 MM	Schedule / Calibre: 080	NORMAL BEVEL
Length / Longitud: 18.01 / 21.98 FT 5.49 / 6.78 MTS	Quantity / Cantidad: 262 Pcs/Plz 5535.814 FT 1687.316 MTS	BISELADO NORMAL
		Nominal Weight / Peso Nominal: 15.00 LBS/FT 22.32 KG/M

TENSILE TEST / ENSAYO DE TENSION

Heat N° Cebada N°	Sample N° Muestra N°	Pipe N° Tubo N°	Specimen condition Condición de la probeta	Specimen dimensions Dimensiones de la probeta		Test Temp. Temp. ensayo	Y.S. Esf 0.2%	U.T.S. Req.	YS/UTS		Elongation / Alargamiento	
				Size Tamaño	Area mm²				Req. Max.	Obt.	Lo	Min. Max.
24137	21708	00001	B AM	25.70 x 8.71	220.25	RT	51 029	72 224	0.71	2	25.4	35.0
24137	21709	00002	B AM	25.69 x 8.64	220.09	RT	51 046	72 623	0.70	2	25.4	35.0
24139	21710	00001	B AM	25.75 x 8.53	222.06	RT	53 335	75 240	0.71	2	25.3	35.0
24139	21711	00002	B AM	25.73 x 8.10	210.58	RT	56 408	76 846	0.73	2	25.0	35.0
24151	21698	00001	B AM	25.67 x 8.56	222.06	RT	52 127	72 992	0.71	2	25.3	35.0
24151	21699	00002	B AM	25.75 x 8.53	222.06	RT	53 393	73 704	0.72	2	25.3	38.0

As: Body / Cuerpo	Location of sample / Ubicación de la muestra	Orientation / Orientación	Specimen condition / Condición de la probeta
L: Longitudinal / Longitudinal	Max: Maximum / Máximo	Req. Max: Required maximum / Máximo requerido	Sc: Strip specimen / Muestra rectangular
Lx: Initial length / Longitud inicial	Min: Minimum / Mínimo	Req: Required / Requerido	U.T.S: Ultimate tensile strength / Resistencia
	Obt: Obtained / Obtenido	RT: Room temperature / Temperatura ambiente	Y.S: Yield strength / Fluencia

MTR VERIFICATION STAMP

DATE: **Jan 28 '11** REVIEW BY: **[Signature]**
CONFORMS TO ASME § II # EDITION / ADDENDA: **2007**

This certificate is issued by a computerized system and it is valid with electronic signature. On the original certificate the stamp must be green colored. "Tenaris" is stamped. In case the owner of the original certificate would release a copy of it, the stamp must be green colored. The original one will be subject to the law. Any alteration or modification will be subject to the law.

Este certificado es emitido por un sistema mecánico electrónico y es válido con firma electrónica. El certificado original posee un sello de color verde. En caso de que el propietario del certificado entregue una copia, deberá garantizar la conformidad con el original haciendo responsable por cualquier uso futuro o modificación. Cualquier alteración o modificación estará sujeta a la ley.

FOR03171



Page / Page: 217

Manufacturero 2 Works Order N° / Confirmación de Venta
00710303

Superficie / Superficie:
VARNISHED
BARNIZADO

Ends / Extremos:
NORMAL BEVEL
BISELADO NORMAL

Nominal Weight / Peso Nominal:
15.00 LB/FT
22.32 KG/M

CHEMICAL COMPOSITION/COMPOSITION CHIMICA

Composition % / Composition %																		
x 100				x 1000														
C	Mn	Si	Cr	Mo	S	P	Ni	V	Cu	Al	Sn	As	Nb	Ti	Co	B	N	x 100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	135	50	40	15	35	30	480	80	400	-	-	-	110	110	-	10	-	40
-	29	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	111	24	4	1	1	11	20	15	48	26	4	3	1	2	15	1	78	352
14	106	24	4	2	3	11	10	16	47	24	4.2	2	1	2	12	2	49	33.9
14	108	23	4	2	3	11	10	15	48	24	4.1	2	0.8	2	15	2	46	33.9
15	108	25	4	1	1.2	11	25	21	41	28	5	2	1	2	11	1	79	36
15	105	24	5	1	3	10	22	19	42	23	5	2	0	2	6	1	72	34.5
15	104	24	5	1	3	10	22	19	41	23	5	2	1	2	8	1	72	34.3
15	108	24	2	1	1	11	20	18	28	24	5	2	1	2	12	1	80	34.4
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	107	24	3	2	2	10	17	19	29	23	5	2	0	2	7	2	56	33.5

Novus Medicum / Medicine

P: Product / Producto

With Heat / Contacts

Este certificado se envía mediante sistema computarizado los viernes con firma electrónica. El certificado especial puede reproducir el logo "Mantente color verde". En caso de que el proveedor del certificado entregue una copia, deberá garantizar la conformidad con el original notificado responsable por cualquier uso legal e indebido. Cualquier falsificación, falsificación o alteración, sin autorización, estará sujeta a la ley.

FOR03171



MILL TEST CERTIFICATE
CERTIFICADO DE PRUEBAS EN FABRICA

Aljona Tubos Inc.
5475 Millbrook Terrace
South Ste. 100, ON CANADA
P.O. Box 100
(705) 940-3150 tel
(705) 946-3121 fax

Number / Número:
00030169

Page / Página:
3 / 7

Date / Dia: December 28, 2010

Customer / Cliente: MCJUNKIN RED MAN TUBULAR	Customer's Order Item / Orden Cliente - Item: PO # C012 726237 4D9	Customer's Reference / Ref. del Cliente: C012 726237 4D9	Manufacturer's Works Order N° / Confirmación de Venta: 007103003
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED	Product Type / Tipo de Producto: LINE PIPE SEAMLESS	Surface / Superficie: VARNISHED	Ends / Extremos: BARNIZADO
LAMINADO EN CALIENTE SIN COSTURA	CONDUCCION SIN COSTURA	Steel Grade / Grado de acero: B1290 SS	NORMAL BEVEL
Standard or Specification / Normas o Especificaciones: Z245.1 APRIL 2007, ASME/ASTM SAJ4106 B12066		Quantity / Cantidad: 262 Pcs/Pz	BISELADO NORMAL
Dimensions / Dimensiones: 4.5 X 0.337 INCH	Schedule / Cálculo: 086	5535.814 FT	Nominal Weight / Peso Nominal: 15.00 LBS/FT
114.3 X 8.56 MM	Length / Longitud: 18.01 / 21.98 FT	1687.316 MTS	22.32 KG/M

SUPERFICIAL HARDNESS / DUREZA SUPERFICIAL

Heat N°	Sample N°	External / Extrema	Heat N°	Sample N°	External / Extrema
Colada N°	Muestra N°	Scale / Escala: HBW	Colada N°	Muestra N°	Scale / Escala: HBW
		Req. Min. - Req. Max. 237			Req. Min. - Req. Max. 237
24137	21708	B	24151	21689	B
24137	21709	B	24151	21689	B

B: Body / Cuerpo

LS: Location of sample / Ubicación de la muestra

THROUGH WALL HARDNESS / DUREZA EN EL ESPESOR

Required values		Individuals / Individuales		Average / Promedio		Hardness type HB	
Heat N°	Sample N°	Min. -	Max. 22.0	Min. -	Max. 1	Var. -	Var.
Colada N°	Muestra N°	LS	SC	1	2	3	Avg.
24137	21708	B	AM	1	2	3	Avg.
24137	21709	B	AM	1	2	3	Avg.
24139	21710	B	AM	1	2	3	Avg.
24139	21711	B	AM	1	2	3	Avg.
24151	21689	B	AM	1	2	3	Avg.
24151	21689	B	AM	1	2	3	Avg.

AM: As manufactured / Según proceso de fabricación

Avg: Average / Promedio

B: Body / Cuerpo

ID: Internal diameter / Diámetro interno

LS: Location of sample / Ubicación de la muestra

Max: Maximum / Máximo

Min: Minimum / Mínimo

MD: Middle wall / Centro

OD: Outside diameter / Diámetro externo

Quad: Quadrant / Cuadrante

Sc: Specimen condition / Condición de la probeta

Var: Variation / Variación

This certificate is issued by a computerized system and is valid with electronic signature. On the original certificate the user's name, position, date and time of issue is stamped. In case the original certificate is not available a copy of it, the user must attach it to the original one along with the responsibility for any alteration or not allowed one. Any alteration or falsification will be subjected to the law.

Este certificado es emitido por un sistema automatizado y es válido con firma electrónica. En el original se debe estampar el nombre, cargo, fecha y hora de emisión. En caso de que el original no esté disponible, el usuario debe adjuntar una copia del original, el cual debe ser responsable de cualquier alteración o falsificación no permitida. Cualquier alteración o falsificación será sancionada según la ley.

FOR03171



Number / Número:	Page / Página:
00030169	417

Alpina Tubes Inc.
547 Wilmie Terrace
South St. Mary, ON CANADA
P8C 2L9
(705) 946-8101 ext
(705) 946-8131 fax

Customer / Cliente: MCJUNKIN RED MAN TUBULAR		Customer's Order Item / Orden Cliente - Item:	Customer's Reference / Ref. del Cliente:	Manufacturer's Works Order N° / Confirmación de Venta:
		PO # C912 726237 4D0	C012 726237 4D0	007103003
Manufacturing Process / Proceso de Manufactura:		Product Type / Tipo de Producto:		
SEAMLESS HOT ROLLED LAMINADO EN CALIENTE SIN COSTURA		LINE PIPE SEAMLESS CONDUCCION SIN COSTURA		
Standard or Specification / Normas o Especificaciones:				
Z245.1 APRIL 2007, ASME/ASTM SA41406 B2006				
Schedule / Costado:		Steel Grade / Grado de acero:		
080		B280 SS		
Dimensions / Dimensiones:		Quantity / Cantidad: 262 Pcs/Pz		
4.5 X 0.337 INCH 114.3 X 8.56 MM		5535.614 FT 1687.316 MTS		
		Length / Longitud:		
		18.01 / 21.98 FT 5.49 / 6.70 MTS		
		Ends / Extremos:		
		NORMAL BEVEL BISELADO NORMAL		
		Nominal Weight / Peso Nominal:		
		15.00 LB/FT 22.32 KG/M		

FLATTENING TEST / ENSAYO DE APLASTAMIENTO

Standard / Normas:			
Head N° Cabeza N°	Sample N° Muestra N°	Pipe N° Tubo N°	Result Resultado
24137	21708	00060	Good / Buena
24137	21709	00062	Good / Buena

Standard / Normas:			
Head N° Cabeza N°	Sample N° Muestra N°	Pipe N° Tubo N°	Result Resultado
24139	21710	00064	Good / Buena
24139	21711	00062	Good / Buena

Standard / Normas:			
Head N° Cabeza N°	Sample N° Muestra N°	Pipe N° Tubo N°	Result Resultado
24151	21698	00001	Good / Buena
24151	21699	00002	Good / Buena

HYDROSTATIC TEST/PRUEBA HIDRÁULICA

Presión / Presión		Time / Tiempo	Results / Resultado
Unit / Unidad	Value / Valor	Seconds / Segundos	
psi	3.760	5	Subsactory / Satisfactorio

HEAT TREATMENT / TRATAMIENTO TERMICO

Heat treatment / Tratamiento térmico: Pipe / Tubo	Type / Tipo	Standard
Quench media oil heat treatment process / Medio de enfriamiento del tratamiento térmico: n/a		
Temperature Scale / Escala de Temperatures: celcius		

This certificate is issued by a computerized system and is valid with electronic signatures. On two separate occasions the trust-artist, upon entering "Artist" is stamped. In case the owner of the original certificate would release a copy of it, he must attest its conformity to the original one taking upon himself the responsibility for any falsified or not allowed use. Any alteration and/or falsification will be subjected to the law.

Esto conlleva de otro lado, la plena responsabilidad y el control de los hechos. Es necesario que el sujeto sea responsable de sus actos. En caso de que el sujeto del delito sea un menor, deberá ser tratado como tal y no como un adulto. El sujeto del delito debe ser responsable de sus actos y no ser tratado como un menor. El sujeto del delito debe ser responsable de sus actos y no ser tratado como un menor.

FOR03471



MILL TEST CERTIFICATE CERTIFICADO DE PRUEBAS EN FABRICA

Algarma Tubes Inc.
347 Wilbur Terrace
Suite 300, Wain, ON CANADA
M1C 1L9
(705) 946-4130 Ext.
(705) 946-4131 Ext.

Customer / Cliente: MCJUNKIN RED MAN TUBULAR		Customer's Order Item / Orden Cliente - Item: PO # C012 726237 4D0		Customer's Reference / Ref. del Cliente: C012 726237 4D0		Manufacture's Works Order N° / Confirmación de Venta: 9007183003	
SEAMLESS HOT ROLLED LAINADO EN CALIENTE SIN COSTURA		Product Type / Tipo de Producto: LINE PIPE SEAMLESS CONDUCCION SIN COSTURA		Surface / Superficie: VARINISHED BARNEZADO		Edges / Extremos: NORMAL BEVEL BISELADO NORMAL	
Standard or Specification / Normas o Especificaciones: Z245.1 APRIL 2007, ASME/ASTM SA106 B2006		Length / Longitud: 18.01 / 21.98 FT 5.49 / 6.70 MTS		Steel Grade / Grado de acero: B2790 SS		Nominal Weight / Peso Nominal: 15.00 LB/FT 22.32 KG/M	
Dimensions / Dimensiones: 4.5 X 0.337 INCH 114.3 X 8.56 MM		Schedule / Catálogo: 1088		Quantity / Cantidad: 252 Pcs/Pz 5535.814 FT 1687.316 MTS		37752.000 KG	

SUPPLEMENTARY INFORMATION / INFORMACION SUPLEMENTARIA

Supplementary Information / Información Suplementaria

Manufactured by ALGOMA TUBES
Steel making process:
Electric Arc Furnace-Ladle Furnace-Continuous Casting Machine.
Fully Killed Steel
Material free from Mercury contamination
Not repaired by welding
Non destructive test. Satisfactory
Inspection method
NDE - UT - WALL - FLV - MPI
Inspection Description
EMI & UT NOTCH 5% OD LAT, 10% ID LAT/UT LAMINATION CONTROL WALL THICKNESS VERIFICATION EMI & UT.
Material meets requirements of NACE MR0103-2007, MR0175-2003, CAT 1SS, EN10204 2.1, 2.2, 3.1
OCT2004, CSA Z245.1 APRIL 2007 ASTM A106 B2006 ASME SA106 B2006.
RAIL CAR IC258582
ALGOMA Ref: IC39854

Fabricado por ALGOMA TUBES
Fabricación del acero:
Horno de Arco Eléctrico-Horno de Aluminio-Máquina de Colada Continua.
Acero estirado con eliminado
Material libre de contaminación de Mercurio
No reparado por soldadura
Control no destructivo. Satisfactorio
Método de Inspección
NDE - UT - WALL - FLV - MPI
Descripción de Inspección
EMI & UT NOTCH 5% OD LAT, 10% ID LAT/UT LAMINATION CONTROL WALL THICKNESS VERIFICATION EMI & UT.
Material meets requirements of NACE MR0103-2007, MR0175-2003, CAT 1SS, EN10204 2.1, 2.2, 3.1
OCT2004, CSA Z245.1 APRIL 2007 ASTM A106 B2006 ASME SA106 B2006.
RAIL CAR IC258582
ALGOMA Ref: IC39854

MARKING / MARCACION

Marking
Marcación

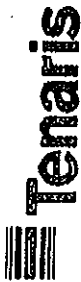
PIPE STENCIL:

MASCARILLA DE TUBO ESTAMPADO:

This certificate is issued by a computerized system and it is valid with electronic signature. On the original certificate one must attach green colored 'Tenaris' stamp. In case the owner of the original certificate would release a copy of it, he must send it conformably to the original one taking upon himself the responsibility for any unlawful or not allowed use. Any alteration made in this document will be subjected to the law.

Este certificado se emite mediante sistema computarizado y es válido con firma electrónica. En el original original se debe adjuntar un sello de color verde 'Tenaris' color verde. En caso de que el poseedor del certificado entregue una copia, deberá garantizar la conformidad con el original. No se podrá responsabilizar por cualquier uso ilegal o no autorizado. Cualquier alteración y/o falsificación será sancionada según la ley.

FOR03171



MILL TEST CERTIFICATE
CERTIFICADO DE PRUEBAS EN FABRICA

Aljona Tubes Inc.
547 Village Terrace
Sault Ste. Marie, ON CANADA
PSC 719
(705) 946-8130 (t)
(705) 946-8131 (f)

Customer / Cliente: MICJUNKIN RED MAN TUBULAR		Customer's Order Item / Orden Cliente - Item: PO # C012 726237 4D0		Customer's Reference / Ref. del Cliente: C012 726237 4D0		Manufacturer's Work Order / Ordenación de Venta: 007103/03	
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED		Product Type / Tipo de Producto: LINE PIPE SEAMLESS		Surface / Superficie: VARNISHED		Ends / Extremos: BARNIZADO	
Laminado en caliente sin costura		(CONDUCCION SIN COSTURA)		Steel Grade / Grado de acero: B290 SS		Normal Bevel	
Standard or Specification / Normas o Especificaciones: Z245.1 APRIL/2007, ASME/ASTM SA106 B2006		Length / Longitud: 18.01 / 21.98 FT		Quantity / Cantidad: 262 Pcs/Pz		Biselado normal	
Dimensions / Dimensiones: 4.5 X 0.337 INCH		Schedule / Calibre: 880		1687.316 MTS		Nominal Weight / Peso Nominal: 15.00 LB/FT	
114.3 X 8.56 MM		5.49 / 6.70 MTS		37752.009 KG		22.32 KG/M	

MARKING / MARCACION

TENARIS AT #FE3 ASTM A106 ASME SA106 CSA Z245.1-07 GR B290CAT 1 SS 114.3 8.56 S 26.1 INDE HEAT		TENARIS AT #FE3 ASTM A106 ASME SA106 CSA Z245.1-07 GR B290CAT 1 SS 114.3 8.56 S 26.1 INDE HEAT	
WHERE: #C#### #N#### #K#### #M#### #H#### #R#### #S#### #T#### #U#### #V#### #W#### #X#### #Y#### #Z####		DONDE: #C#### #N#### #K#### #M#### #H#### #R#### #S#### #T#### #U#### #V#### #W#### #X#### #Y#### #Z####	
Heat number #C####		Número de calado #C####	
Net weight of pipe in Kgs #K####		Peso real de tubo en Kgs #K####	
Length Mts #M####		Longitud del tubo en Mts #M####	
Pipe number #N####		Número de secuencia #N####	

SUMMARY REPORT / REPORTE RESUMEN

Heat N° Calada N°	Quantity Cantidad (Pieces)	Length Longitud (m)	Weight Peso (Tons)
24137	144	3,048.81	929.277
24138	34	711.98	217.81
Average length per pipe Longitud promedio por tubo (m)	6.44	15.035	22.376

24137	144	3,048.81	929.277	20.758	4.87
24138	34	711.98	217.81	20.758	4.87
Average length per pipe Longitud promedio por tubo (m)	6.44	15.035	22.376	20.758	4.87

This certificate is issued by a computerized system and it is void with electronic signature. On the original certificate the total heat price entered "Tenaris" is stamped. In case the owner of the original certificate would release a copy of it, he must attest its conformity to the original one taking upon himself the responsibility for any alteration or not allowed use. Any alteration or not allowed use will be subjected to the law.

Este certificado se emite mediante sistema computarizado y es válido con firma electrónica. El certificado original posee impreso el logo "Tenaris" con sello. En caso de que el poseedor del certificado entregara una copia, deberá garantizar la conformidad con el original bajo pena de ser responsable por cualquier uso no autorizado y/o falsificación. Cualquier alteración y/o falsificación quedará sujeta a la ley.

FOR08171



MILL TEST CERTIFICATE CERTIFICADO DE PRUEBAS EN FABRICA

Alpines Tubes Inc.
547 Watcote Terrace
South St. Marie, ON CANADA
POC 1L6
(705) 945-4131 (t)
(705) 945-4131 (f)

Customer / Cliente: MCJUNKIN RED HAN TUBULAR		Customer's Order Item / Orden Cliente - Item: PO # C012 726237 409		Manufacturer's Works Order N° / Confirmación de Venta: 007103903	
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED		Product Type / Tipo de Producto: LINE PIPE SEAMLESS		Surface / Superficie: VARNISHED	
Laminado en caliente sin costura		(CONDUCCION SIN COSTURA)		BARNIZADO	
Standard or Specification / Normas o Especificaciones: Z245.1 APR81/2007, ASME/ASTM SA186 B12006		Steel Grade / Grado de acero: B1290 SS		Ends / Extremos: NORMAL BEVEL	
Dimensions / Dimensiones: 4.5 X 0.337 INCH		Length / Longitud: 18.04 / 21.98 FT		BISelado NORMAL	
114.3 X 8.58 MM		Schedule / Cédula: 080		Nominal Weight / Peso Nominal: 15.00 LB/FT	
				22.32 KG/M	

This is to certify that the product described here has been manufactured, sampled, tested, and inspected in accordance with purchaser order requirements. This certificate is not a declaration of origin nor may it be used as a declaration of origin.

Por el presente certificamos que el material aquí descrito ha sido fabricado, muestreado, ensayado e inspeccionado de acuerdo a los requisitos de su orden de compra. Este certificado no es, ni puede ser usado, como una declaración de origen.

CUSTOMER - THIRD PARTY		TENARIS QUALITY DEPARTMENT SIGNATURE	
 Quality System Certified N° 149560007 The certification covers the Tenaris Quality Management System exclusively		 QUALITY CERTIFICATION DEPT. DEPTO. DE CERTIFICACION DE CALIDAD VAN BOERDONK Dave	
INSPECTION COMPANY COMPANIA DE INSPECCION NOT APPLY Employee Name: N/A		 CHIEF OF QUALITY CERTIFICATION DEPT. RESPONSABLE DEL DEPTO. DE CERTIFICACION DE CALIDAD PFI Diego	

This certificate is issued by a computerized system and is valid with electronic signature. On the original certificate the code-man, given colored "Tenaris" is stamped. In case the owner of the original certificate would release a copy of it, he must attach the code-man to the original one taking upon himself the responsibility for any falsified or not allowed use. Any alteration and/or falsification will be subjected to the law.

Este certificado es emitido mediante sistema computarizado y es válido con firma electrónica. En el certificado original poseen código en color "Tenaris". En caso de que el poseedor del certificado entregue una copia, deberá garantizar la conformidad con el original haciéndose responsable por cualquier uso ilegal o no autorizado. Cualquier alteración o falsificación quedará sujeta a la ley.

FOR03171

64 1457V

ALGOMA STEEL INC. 105 West St., Sault Ste. Marie, Ontario, Canada, P6A 7B4

CUSTOMER PURCHASE ORDER NUMBER	ENTRY DATE	SHIP DATE	ITALY NUMBER	SHIPPER'S NUMBER	CARRIER	MILL ORDER
P71102DI006	2007/11/08	2007/12/02	051273	-	CP	28748

CHARGE TO CUSTOMER NAME & ADDRESS	SHIP TO CUSTOMER NAME & ADDRESS
WILKINSON A DIVISION OF PREMOTALCO INC 888 SOUTH EAST MARINE DRIVE VANCOUVER BRITISH COLUMBIA V5X 2V3	WILKINSON A DIVISION OF PREMOTALCO INC STATION 9777, FRASER STREET VANCOUVER, BRITISH COLUMBIA 90# 7390

MILL TEST REPORTS	
ALGOMA STEEL INC. HEREBY CERTIFIES THAT THE MATERIAL HEREIN DESCRIBED WAS MADE AND TESTED IN ACCORDANCE WITH THE RULES OF THE SPECIFICATION SHOWN. ALL RESULTS ARE RETAINED IN ACCORDANCE WITH THE COMPANY'S STANDARD RECORD KEEPING PRACTICES.	
J. JOHNSTON MANAGING METALLURGIST	
THIS MILL TEST REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL WITHOUT WRITTEN APPROVAL OF ALGOMA STEEL INC. IF YOU RECEIVE THIS DOCUMENT AND ARE NOT THE INTENDED RECEIVER, PLEASE CALL (705)945-2624 COLLECT FOR INSTRUCTIONS ON METHOD OF DISPOSAL OF DOCUMENT.	

TEST CERT 1:	TEST CERT 2:
TEST REPORTS REQUIRED	PLATE TEST COUPON:
RESALE	
MEETS EN 10204 3.1	
CUSTOMER ITEM 00003	OUR ITEM 004
DIMENSIONS .188 X 96 X COIL	

COIL NUMBER	HEAT	NO. PIECES	WEIGHT	COIL NUMBER	HEAT	NO. PIECES	WEIGHT
487104000	7571G-05	1	22660	487105000	7571G-05	1	22230
487106000	7571G-53	1	22840	487107000	7571G-53	1	22600
487108000	7571G-54	1	22790	487130000	1457V-23	1	24940
487131000	1457V-23	1	24940				

TENSILE TESTS:							
HEAT	SRCE	GAGE	* SAMPLE	* TEST	* YIELD	TENSILE	% ELONG
1457V	106"	.1880	COND METH	DIR	2	51.0	29(2")
7571G	106"	.1880	AR	.2	43.5	69.0	32(2")

HEAT	C	SI	CR	NI	CU	MO	AL	CB	V	B
1457V	.86	.01	.01	.04	.01	.02	.01	.048	.002	.002
7571G	.85	.015	.010	.02	.02	.01	.02	.01	.036	.000

WTR VERIFICATION STAMP	
DATE: Jan 28 '11	REVIEW BY: [Signature]
CONFORMS TO ASME § II	
EDITION / ADDENDA: 2007	

THE TEST RESULTS AND VALUES REPORTED HEREIN INDICATE ONLY THAT (1) THE PARTICULAR STEEL FOR WHICH THIS CERTIFICATE IS ISSUED MEETS THE MINIMUM SPECIFIED YIELD STRENGTH AND (2) THE CHEMICAL ANALYSIS AND PHYSICAL PROPERTIES OF SUCH STEEL ARE IN CONFORMANCE WITH THE REQUIREMENTS OF THE SPECIFICATION INDICATED. THE RESULTS OR VALUES REPORTED HEREIN CAN NOT BE USED TO QUALIFY THE STEEL FOR ANY SPECIFICATION OTHER THAN THE ONE INDICATED AND CAN NOT BE RELIED UPON FOR ANY PURPOSE (INCLUDING DESIGN OR CALCULATIONS) AS REPRESENTING THE ACTUAL STRENGTH OF SUCH STEEL.

90573588

RVC-232

TEST CERTIFICATE

Test Report/Inspection Certificate No.: RFL/CFF/10-11/1290-011		DATE 16.10.2010		As Per DIN EN 10204 - 3.1																																																																								
Invoice No./Date		1290		48/13/Oct/2010																																																																								
Marking		As P.O.		Manufacturers Mark																																																																								
ROLLWELL FORGE LTD. Survey No 2391 BH GEB Sub Station N.H. 38 Rajkot - Gondal Highway, Shepat - 360062 Phone: 02827 253671 Fax: 02827 253571 E-mail: rollwellforge@rediffmail.com 																																																																												
Designation of Article		Grade		Specification																																																																								
CARBON STEEL FORGED FLANGES		AISA 105N		ASTM 2009/ ASME 2008																																																																								
Quantity		Dimension		Heat Code																																																																								
500		3" 150# SO RF -105N -FINISH		RVC-232																																																																								
CHEMICAL ANALYSIS AND CHEMICAL PROPERTIES <table border="1"> <thead> <tr> <th>H.NO</th> <th>C %</th> <th>Si %</th> <th>Mn %</th> <th>P %</th> <th>S %</th> <th>Cr %</th> <th>Mo %</th> <th>Ni %</th> <th>Nb %</th> <th>Al %</th> <th>Cu %</th> <th>V %</th> <th>CE</th> </tr> </thead> <tbody> <tr> <td>SPECIFIED</td> <td>0.350 Max</td> <td>0.10 / 0.35</td> <td>0.60 / 1.05</td> <td>0.035 Max</td> <td>0.040 Max</td> <td>0.30 Max</td> <td>0.12 Max</td> <td>0.40 Max</td> <td></td> <td></td> <td>0.40 Max</td> <td>0.08 Max</td> <td>0.47 Max</td> </tr> <tr> <td>/RVC-232</td> <td>0.197</td> <td>0.251</td> <td>0.680</td> <td>0.020</td> <td>0.015</td> <td>0.011</td> <td>0.003</td> <td>0.007</td> <td>0.003</td> <td>0.034</td> <td>0.004</td> <td>0.006</td> <td>0.32</td> </tr> </tbody> </table>						H.NO	C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Nb %	Al %	Cu %	V %	CE	SPECIFIED	0.350 Max	0.10 / 0.35	0.60 / 1.05	0.035 Max	0.040 Max	0.30 Max	0.12 Max	0.40 Max			0.40 Max	0.08 Max	0.47 Max	/RVC-232	0.197	0.251	0.680	0.020	0.015	0.011	0.003	0.007	0.003	0.034	0.004	0.006	0.32																													
H.NO	C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Nb %	Al %	Cu %	V %	CE																																																															
SPECIFIED	0.350 Max	0.10 / 0.35	0.60 / 1.05	0.035 Max	0.040 Max	0.30 Max	0.12 Max	0.40 Max			0.40 Max	0.08 Max	0.47 Max																																																															
/RVC-232	0.197	0.251	0.680	0.020	0.015	0.011	0.003	0.007	0.003	0.034	0.004	0.006	0.32																																																															
Heat Treatment: Normalized at 910° C & air cooled.																																																																												
Mechanical Tests: <table border="1"> <thead> <tr> <th colspan="4">DIN EN 10002 - 1: Tensile Test (A 370 - 2009)</th> <th colspan="4">DIN EN 10045; ISO - V - Notch Charpy/Impact Test</th> </tr> <tr> <th>Test No.</th> <th>Direction</th> <th>Yield Strength Re</th> <th>Tensile Strength Rm</th> <th>Elongation A</th> <th>Reduct of area Z</th> <th colspan="3">Energy of Impact (TEMPERATURE +20°C)</th> </tr> <tr> <td></td> <td></td> <td>Reb/Rp 0.2% MPa</td> <td>MPa</td> <td>%</td> <td>%</td> <td colspan="3">27 J Min</td> </tr> <tr> <td></td> <td></td> <td>250Min</td> <td>480Min</td> <td>22Min</td> <td>30Min</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td></td> <td></td> <td>307.77</td> <td>469.17</td> <td>34.60%</td> <td>61.66%</td> <td></td> <td></td> <td></td> </tr> <tr> <td>SPECIFIED</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td colspan="3">Bln</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td colspan="3">137-187</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td colspan="3">144-153</td> </tr> </thead></table>						DIN EN 10002 - 1: Tensile Test (A 370 - 2009)				DIN EN 10045; ISO - V - Notch Charpy/Impact Test				Test No.	Direction	Yield Strength Re	Tensile Strength Rm	Elongation A	Reduct of area Z	Energy of Impact (TEMPERATURE +20°C)					Reb/Rp 0.2% MPa	MPa	%	%	27 J Min					250Min	480Min	22Min	30Min	1	2	3			307.77	469.17	34.60%	61.66%				SPECIFIED						Bln									137-187									144-153		
DIN EN 10002 - 1: Tensile Test (A 370 - 2009)				DIN EN 10045; ISO - V - Notch Charpy/Impact Test																																																																								
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SPECIFIED						Bln																																																																						
						137-187																																																																						
						144-153																																																																						
Additional Test - Conform to NACE MR-0175 & NACE MR-0103																																																																												
Surface and Dimensional Inspection																																																																												
Testing of material																																																																												
Remarks: We hereby certify that the material has been tested and complies with the given purchase order																																																																												
ROLLWELL FORGE LTD. DATE: 20.08.11 CONFORMS TO ASME S II A EDITION / ADDENDA: 2009b MTR VERIFICATION STAMP REVIEW BY: [Signature]																																																																												
ROLLWELL FORGE LTD. For (Signature) ROLLWELL FORGE LTD. For (Signature)																																																																												

21735

D# 7967



PARAMOUNT FORGE™

MANUFACTURERS OF : FORGED FLANGES & FITTINGS

PF®

TEST CERTIFICATE

TYPB EN10204:2004 3.1

CUSTOMER: M/S. UNIFIED ALLOYS, CANADA				PF/TC/13698	DATE:30/11/2010	
P O. NO & DATE: EP-88593		DTD. 14/10/2010		INSPECTION AGENCY: TUV (I) PVT.LTD.		
P.O.SR.NO.	DESCRIPTION	SIZE	DIMENSION	MATERIAL	HEAT NO.	QTY.(Nos.)
128	WNRF FLANGES 150# SCH.40S	2" NPS	ASME B16.5 2003	ASTM/ASME A/SA182F304/304L 2008a	2172S	35
131	WNRF FLANGES 150# SCH.40S	3" NPS	ASME B16.5 2003	ASTM/ASME A/SA182F304/304L 2008a	2173S	25
133	WNRF FLANGES 600# SCH.40S	3" NPS	ASME B16.5 2003	ASTM/ASME A/SA182F304/304L 2008a	2170S	10
134	WNRF FLANGES 600# SCH.40S	4" NPS	ASME B16.5 2003	ASTM/ASME A/SA182F304/304L 2008a	2171S	15
135	WNRF FLANGES 300# SCH.40S	6" NPS	ASME B16.5 2003	ASTM/ASME A/SA182F304/304L 2008a	2171S	02

CHEMICAL COMPOSITION %

HEAT NO.	C	MN	P	S	SI	Cu	NI	Cr	Mo	V	N	TI	CEO
2172S	0.028	1.86	0.038	0.008	0.36	--	8.21	18.06	--	--	0.096	--	--
2173S	0.023	1.90	0.043	0.010	0.36	--	8.38	18.20	--	--	0.082	--	--
2170S	0.023	1.54	0.040	0.010	0.35	--	8.17	18.18	--	--	0.031	--	--
2171S	0.018	1.63	0.044	0.027	0.28	--	8.17	18.14	--	--	0.095	--	--
2171S	0.018	1.63	0.044	0.027	0.28	--	8.17	18.14	--	--	0.095	--	--

PHYSICAL PROPERTIES

HEAT NO.	UTS	Y.S	%EL	RED. IN	HARDNESS	CHARPY V IMPACT TEST				
	MPa	MPa	-	AREA %		TEMP.	1	2	3	AVG.
2172S	610.10	307.07	50.60	67.08	< 22 HRC	--	--	--	--	--
2173S	589.15	287.72	46.80	73.20	< 22 HRC	--	--	--	--	--
2170S	571.72	306.87	51.42	70.81	< 22 HRC	--	--	--	--	--
2171S	602.85	305.34	52.00	68.11	< 22 HRC	--	--	--	--	--
2171S	602.85	305.34	52.00	68.11	< 22 HRC	--	--	--	--	--

HEAT NO.	HEAT TREATMENT	HEAT TREATMENT TEMP.	LAB REF NO.
2172S	SOLUTION ANNEALED	1060 °C & WATER QUENCHED	PP/794/10 & AC/18707 (1-3)
2173S	SOLUTION ANNEALED	1060 °C & WATER QUENCHED	PP/812/10 & AC/18745 (1-3)
2170S	SOLUTION ANNEALED	1060 °C & WATER QUENCHED	PP/823/10 & AJ2136
2171S	SOLUTION ANNEALED	1060 °C & WATER QUENCHED	PP/824/10 & AC/18654 (1-2)
2171S	SOLUTION ANNEALED	1060 °C & WATER QUENCHED	PP/824/10 & AC/18654 (1-2)

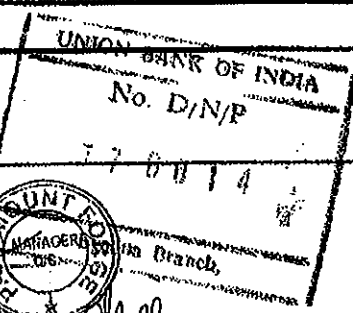
REMARKS:

100% PMI TEST & FOUND SATISFACTORY.

ASTM A262 IGC PRACTICE 'E' TEST SATISFACTORY.

GEIGER - MULLER TEST SATISFACTORY - NIL RADIOACTIVITY.

MATERIAL CONFIRMS TO NACE MR0175 (2003) & NACE MR0103 (2007).

 Signature/Seal Of Surveyor		PARAMOUNT FORGE Reviewed VIKAS SINGH MTR VERIFICATION STAMP DATE: March 3, 2011 CONFORMS TO ASME § II 14 EDITION 7 ADDENDA 2009b		 UNION BANK OF INDIA No. D/N/P 17 00 14
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Registered Office : 3, Guru Himmat Bldg., 140, Dr. Mascarenhas Road, Mazgaon, Mumbai - 400 010.

☎ : 91-22-2378 0007 / 6667 0979 • ☎ : 91-22-2373 2657

 Factory : 99/100, 280/283, Jawahar Industrial Estate, Kamothe - 410 209, Panvel, (Dist. Raigadh) • ☎ : 91-22-2742 0301, 2742 0716, 2742 5058
 ☎ : 91-22-2742 0802, 2742 0300 • ✉ : pforge@bom5.vsnl.net.in / qa@paramountforge.org • Website : www.pforgeindia.com

We Certify that all items herein conform to the applicable standards and customer requirements

QA/QR/08

1/1/08

REV : 01.

3150RFWN44



柏緯鐵工股份有限公司

高雄縣仁武鄉烏林村仁心路 303 號

BOTH-WELL STEEL FITTINGS CO., LTD.

NO.303, JEN-HSIN ROAD JEN-WU HSIANG

KAOSIUNG HSIEN, TAIWAN R.O.C.(81405)

TEL: (07) 371-0497, 371-1536, 372-0260 FAX: (886-7) 371-3864, 371-3882

WEB SITE: <http://www.bothwell.com.tw> E-MAIL: bothwell@www.bothwell.com.tw or box@mail.bothwell.com.tw

An ISO-9001 Registered Manufacturer



Q199

MILL TEST & INSPECTION CERTIFICATE

PO#

65665

ACCORDING TO EN10204/DIN50049/3.1.B

CUSTOMER: UNIFIED ALLOYS

INVOICE NO: BW049307064

DATE: 11/17/04

CERT NO: 41968

ORDER NO: EP-41414

L/C NO:

PAGE: 19

ITEM	RAW MATERIAL HEAT NO.	BOTH WELL HT. CD.	DESCRIPTION	QUANTITY	SPECIFICATION: A182/SA182 -02 F304 / 304L DIMENSION: ASME B16.11 - 2001 SURFACE: BY VISUAL...GOOD
084	9Q160	N588	FULL CPLG 1"x 3-1/2"L 3000# NPT	50 PC	
085	A65478	Q199	FULL CPLG 1-1/2" 3000# NPT	50 PC	
086	A64386	Q201	FULL CPLG 2" 3000# NPT	125 PC	
087	A56944	Q190	FULL CPLG 3" 3000# NPT	3 PC	
088	9S012	N656	TEE 3/4" 3000# NPT	10 PC	
089	S25032	N663	TEE 1" 3000# NPT	10 PC	
090	6R222	N610	THR 2" 3000# NPT	5 PC	

CHEMICAL COMPOSITION (%)

ITEM	C	Si	Mn	P	S	Cu	Cr	Ni	Mo	V	Nb	N
Min	-	-	-	-	-	-	18.000	8.000	-	-	-	-
Max	0.030	1.000	2.000	0.045	0.030	-	20.000	13.000	-	-	-	0.100
084	0.019	0.520	1.700	0.027	0.027	-	18.150	8.110	-	-	-	0.087
085	0.017	0.427	1.693	0.027	0.004	-	18.200	9.233	-	-	-	0.068
086	0.014	0.343	1.679	0.027	0.001	-	18.296	9.066	-	-	-	0.064
087	0.014	0.378	1.700	0.031	0.001	-	18.300	9.250	-	-	-	0.074
088	0.018	0.260	1.690	0.025	0.025	-	18.210	8.340	-	-	-	0.081
089	0.023	0.405	1.370	0.029	0.012	-	18.190	9.096	-	-	-	0.056
090	0.019	0.500	1.820	0.025	0.025	-	18.280	8.110	-	-	-	0.085

MECHANICAL TEST

ITEM	Tensile Strength (KSI)	Yield Strength (KSI)	Elongation (%)	R of A (%)	Hardness (HB)
Min	75.0	30.0	30.0	50.0	-
Max	-	-	-	-	235
084	83.7	40.9	64.4	73.8	167
085	87.6	43.8	54.2	67.1	174
086	84.9	42.4	58.8	85.2	167
087	88.4	45.6	55.4	77.2	174
088	81.4	35.2	60.4	76.0	161
089	79.8	37.2	66.2	76.1	156
090	78.8	38.1	62.8	74.6	152

Remark:
SOLUTION TREATED : 1040°C, W.Q.
CONFORMS TO NACE MR0175-97
STEEL MARKING PROCESS : ELECTRIC FURNACE
MERCURY FREE

WE CERTIFY THE ABOVE MENTIONED FITTINGS HAVE BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH THE SPECIFICATIONS SHOWN

S. C. Lee

C. C. Huang

Q.C. MANAGER
SHENG CHANG LEE

INSPECTOR
CHUN CHIH HUANG

BW-D0839 REV.0

A65478-Q199 (1 1/2" FULL CPLG) SA182

MTR VERIFICATION STAMP

DATE: July 4, 11

REVIEW BY: *8*

CONFORMS TO ASME § II A

EDITION / ADDENDA: 2009b

EP-41414 112T3C4F

Phone (780) 466-4122
Fax (780) 463-5587

KS Manufacturing Enterprises Ltd.

87B1
5203-76 Avenue
Edmonton, Alberta T6B 0A7

MATERIAL TEST REPORT 19920

Purchaser: MRC MIDFIELD SUPPLY LTD., NISKU

Purchaser Order No. 7500952359-B0

Date: 2011-01-21

Distributor: NISKU, AB

Distributor Order No: 80#7396

Products

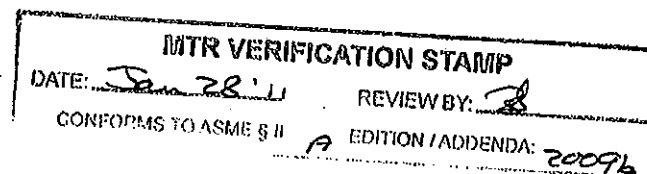
Item No.	Qty.	Product	Specification	Heat No	Description
1	50	1-1/4" X 3-1/2" LONG 3000 THRD COUPLING B16.11	A/SA182 F304/F304L	87B1	2-1/4" RD BAR ASTM A276-04, A479-04, A193-03 CL 1 GR B8, A320-03 CL 1 GR B8, ASME SA479-04, SA320-04 CL 1 GR B8, SA193-04 CL 1 GR B8, EN 10204 3.1B

Chemical Properties

Heat No.	C	Mn	P	S	Si	Cr	Ni	Mo	Cu	V	Nb	Co	N	Al	Sn	Ti
87B1		.023	1.601	.031	.021	.279	18.147	8.666	.416	.480	-	.166	.077	-	-	-

Mechanical Properties

Item No.	Heat No	Yield	Tensile	Elong % in 2"	RA	B.H.N.	Impact FT LB	Remarks
1	87B1	41,000 PSI	81,000 PSI	62	70	142		CORROSION TEST: SOLUTION ASTM A262-02a PR E ANNEALED



We hereby certify the above results to be correct as contained in the records of the company.

[Signature]
Kwang Y. Lee

PO#7404

N969



柏緯鐵工股份有限公司

An ISO-9001 Registered Manufacturer

高雄縣仁武鄉烏林村仁心路 303 號

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MILL TEST & INSPECTION CERTIFICATE

ACCORDING TO EN10204/DIN50049/3.1.B

ORIGIN: TAIWAN

CUSTOMER: UNIFIED ALLOYS

INVOICE NO: BW079611092

DATE: 03/03/08

CERT NO: 80373

ORDER NO: EP-65954

L/C NO:

PAGE: 2

ITEM	BOTH WELL HT. CD.	RAW MATERIAL HEAT NO.	DESCRIPTION	QUANTITY	SPECIFICATION: ASTM A182 -06 ASME SA182 -A06 F304 / 304L								
055	N647	12550	HEX PLUG 1" NPT	50 PC	DIMENSION: ASME-B16.11 - 2005								
056	N990	9W182	CAP 3/4" 3000# NPT	50 PC	SURFACE: BY VISUAL...GOOD								
058	N969	9W179	FULL CPLG 1"x3-1/2"L 3000# NPT ✓	100 PC									
059	N966	FS-2934	90D ELBOW 1-1/2" 3000# NPT	7 PC									
079	N956	9W178	FULL CPLG 1/2" 3000# S/W	50 PC									
080	NB052	YT071604	90D ELBOW 1" 3000# S/W	250 PC									
081	N962	FS-2936	90D ELBOW 2" 3000# S/W	150 PC									
ITEM	BOTH WELL HT. CD.	CHEMICAL COMPOSITION (%)											
Min		C	Si	Mn	P	S	Cu	Cr	Ni	Mo	V	Cb(Nb)	N
Max		0.030	1.000	2.000	0.045	0.030	-	18.000 20.000	8.000 13.000	-	-	-	-
055	N647	0.019	0.500	0.970	0.031	0.021	-	18.080	9.470	-	-	-	0.060
056	N990	0.030	0.270	1.810	0.029	0.026	-	18.210	8.200	-	-	-	0.100
058	N969	0.030	0.270	1.820	0.029	0.028	-	18.120	8.160	-	-	-	0.100
059	N966	0.018	0.360	1.840	0.038	0.020	-	18.150	8.100	-	-	-	0.099
079	N956	0.020	0.280	1.830	0.029	0.028	-	18.180	8.220	-	-	-	0.100
080	NB052	0.023	0.500	1.060	0.040	0.025	-	18.150	8.130	-	-	-	0.081
081	N962	0.021	0.260	1.860	0.038	0.024	-	18.280	8.150	-	-	-	0.091
ITEM	BOTH WELL HT. CD.	MECHANICAL TEST					Remark: SOLUTION TREATED : 1040°C, W.Q. CONFORMS TO NACE MR0175-2003 STEEL MAKING PROCESS : ELECTRIC FURNACE MERCURY FREE						
Min		Tensile Strength (KSI)	Yield Strength (KSI)	Elongation (%)	R of A (%)	Hardness (AVG.) (HB)							
Max		75.0	30.0	30.0	50.0	235							
055	N647	87.7	34.3	62.0	78.0	170	WE CERTIFY THE ABOVE MENTIONED FITTINGS HAVE BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH THE SPECIFICATIONS SHOWN <i>C.C. Manager</i> <i>C.C. Huang</i> C.C. MANAGER INSPECTOR CHIN CHENG HSIEH CHUN CHIEH HUANG						
056	N990	85.5	39.4	63.6	74.6	158							
058	N969	85.3	38.8	63.8	75.6	170							
059	N966	82.8	40.0	65.0	75.9	158							
079	N956	84.8	38.1	53.0	75.5	156							
080	NB052	99.7	45.1	54.0	71.7	172							
081	N962	83.7	37.2	65.0	75.3	158							

BW-D0839 REV.0

MTR VERIFICATION STAMP

DATE: Jan 24, 11

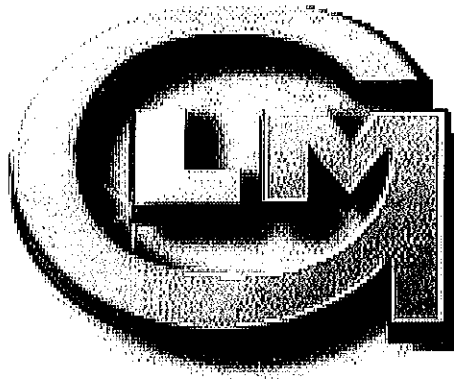
REVIEW BY: [Signature]

CONFORMS TO ASME § II

EDITION / ADDENDA: 2009b

ENTERED

1730010-4F



G.L.M. INDUSTRIES L.P.

SECTION 4

WELD PROCEDURES

WELDING PROCEDURE SPECIFICATION NO.: 1-1-051A (Rev.2)

WELDING PROCEDURE QUALIFICATION RECORD NO. (S): 1-1-051-2

QUALIFIED FOR

Restricted Applications: API 12D, 12F, 620 & 650 Welded Storage Tank Fabrication

Base Metal (Typical): P1 Groups 1 & 2 to P1 Groups 1 & 2

(SA 333 Gr.6, SA 350 Gr.1F2, SA 420 WPL6, SA 516 Gr.70, etc.)

Process(es): SMAW Weld Types: GROOVE & FILLET

Position: ALL POSITIONS Diameter: ALL DIAMETERS

Filler Metal: E6010, E7018-1

BASE METAL CONDITIONS & GROOVE THICKNESS RANGE QUALIFIED:

NOTCH TOUGHNESS APPLICATIONS TO -46°C AS WELDED

BASE METAL THICKNESS RANGE 3.2 to 12.7 mm (0.125 to 0.500 in.) inclusive

COMBINED DEPOSITED WELD METAL THICKNESS

ASME SECTION IX 12.7 mm (0.500 in.) maximum

PROVINCIAL REGISTRATION

QW-482 WELDING PROCEDURE SPECIFICATION (WPS)

G.L.M. Industries L.P.

Welding Procedure Specification No. 1-1-051A (Rev.2) Date February 22, 2007
Revision(s) Rev. 1 (Essential) - Format update, company name change (formerly G.L.M. Tanks & Equipment Ltd.), updated to ASME Section IX- 2004 edition, 2006 addenda, and PQR No. 1-1-051 replaced with PQR No. 1-1-051-2
Supporting PQR No. (s) 1-1-051-2
Welding Process(es) SMAW Type(s) Manual

JOINTS (QW-402)

Joint Design All ASME groove & fillet, reference construction drawing for joint details. Where joint details are not specified, refer to figures 1 to 15 attached
Root Opening As per attached typical groove designs, see figures 1 to 15 attached
Backing With or without Retainers Not required

BASE METALS (QW-403)

P-Number P1 Groups 1 & 2 To P-Number P1 Groups 1 & 2
Thickness Range: Groove See cover page for thickness qualified by governing code
Fillet All base metal thicknesses
Pipe Diameter Ranges: Groove All diameters
Fillet All diameters
Deposited Weld Metal (Per Pass) 12.7 mm (0.500 in.) maximum

FILLER METALS (QW-404)

	SMAW	SMAW
Specification No. (SFA)	<u>SFA 5.1</u>	<u>SFA 5.1</u>
AWS No. (Class)	<u>E6010</u>	<u>E7018-1</u>
F-No.	<u>F3</u>	<u>F4</u>
A-No.	<u>A1</u>	<u>A1</u>
Size	<u>3/32 to 5/32 in. inclusive</u>	<u>3/32 to 1/4 in. inclusive</u>
Deposited Weld Metal Thickness Range:		
Groove	<u>4.8 mm (0.188 in.) max.</u>	<u>7.9 mm (0.312 in.) max.</u>
Fillet	<u>All fillet sizes</u>	<u>All fillet sizes</u>

POSITION (QW-405)

Position of Groove All positions Position of Fillet All positions
Weld Progression F3: Vertical down F4: Vertical down

PREHEAT (QW-406)

Preheat Temperature (Minimum) 10°C (50°F)
Interpass Temperature (Maximum) 260°C (500°F)
Preheat Maintenance 10°C (50°F) prior to welding. Preheat maintenance is not required if welding is interrupted or after the completion of welding unless required by the code of construction.

WPS No. 1-1-051A (Rev.2)

POST WELD HEAT TREATMENT (QW-407)

Temperature Range N/A Time Range N/A

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
 Amps See Table #1 Volts See Table #1

Maximum Heat Input

Base Metal Thickness Range	E6010 Electrode	E7018-1 Electrode
0.125 - 0.500 in.	17,770 J/in.	20,210 J/in.

TECHNIQUE (QW-410)

String or Weave E6010: Either E7018-1: Either Travel Speed See Table #1
 Initial & Interpass Cleaning Brushing, chipping or grinding as required
 Method of Back Gouging Air carbon arc, back-grind as required
 Multiple or Single Pass Per Side F3: Either F4: Multiple
 Peening Not permitted

TABLE 1 - WELDING PARAMETERS

Process	Filler Metal	Diameter mm (in.)	Current Type & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min.(l.p.m.)
SMAW	E6010	2.4 (3/32)	DCRP	40 - 100	18 - 28	62 - 300 (2.5 - 12)
SMAW	E6010	3.2 (1/8)	DCRP	60 - 140	19 - 30	98 - 350 (3.9 - 14)
SMAW	E6010	4.0 (5/32)	DCRP	90 - 225	21 - 31	162 - 400 (6.4 - 16)
SMAW	E7018-1	2.4 (3/32)	DCRP	60 - 110	18 - 24	82 - 300 (3.2 - 12)
SMAW	E7018-1	3.2 (1/8)	DCRP	90 - 160	18 - 26	123 - 350 (4.8 - 14)
SMAW	E7018-1	4.0 (5/32)	DCRP	130 - 220	19 - 28	167 - 400 (7.4 - 16)
SMAW	E7018-1	5.0 (3/16)	DCRP	200 - 300	20 - 30	302 - 500 (11.9 - 20)
SMAW	E7018-1	5.5 (7/32)	DCRP	240 - 340	20 - 32	362 - 550 (14.3 - 22)
SMAW	E7018-1	6.4 (1/4)	DCRP	275 - 360	21 - 32	436 - 550 (17.2 - 22)

Note: Welding parameters shall be adjusted to insure that the maximum heat input value specified in QW-409 above is not exceeded.

$$\text{Heat Input (J/in.)} = \frac{\text{Volts} \times \text{Amps} \times 60}{\text{Travel Speed (ipm)}}$$

TYPICAL JOINT DESIGNS

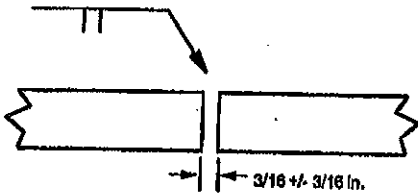


Figure 1
Single Square Butt

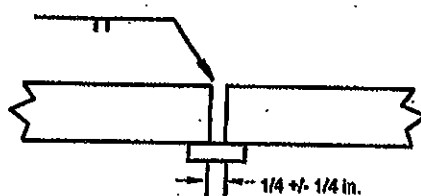
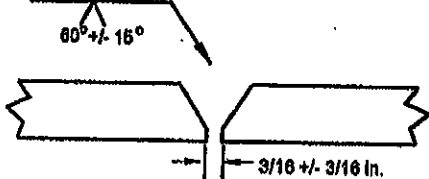


Figure 2
Single Square Butt with Backing Strip

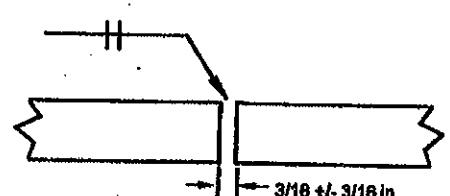
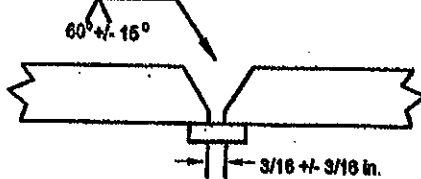


Figure 3
Double Square Butt

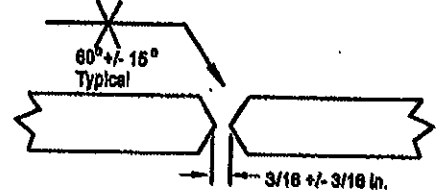


Figure 4
Single Vee Butt

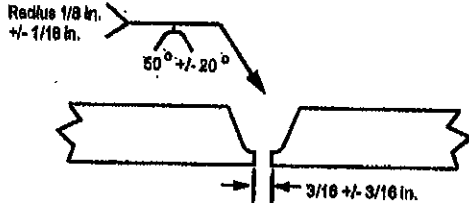


Figure 5
Single Vee Butt with Backing Strip

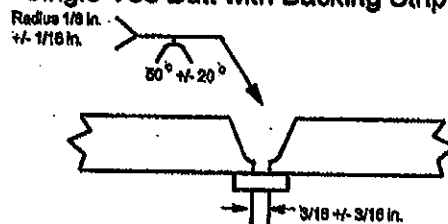


Figure 6
Double Vee Butt

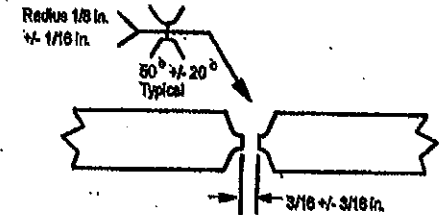


Figure 7
Single U Butt

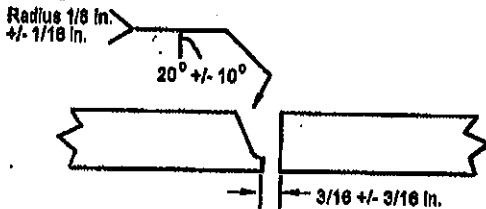


Figure 8
Single U Butt with Backing Strip

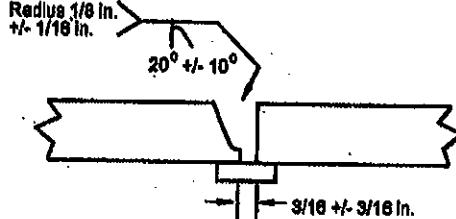


Figure 9
Double U Butt

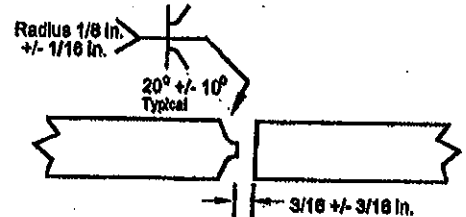


Figure 10
Single J Butt

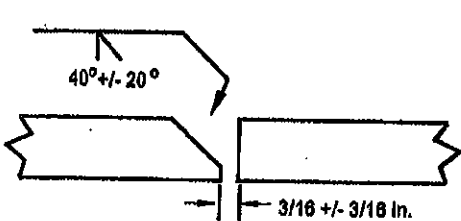


Figure 11
Single J Butt with Backing Strip

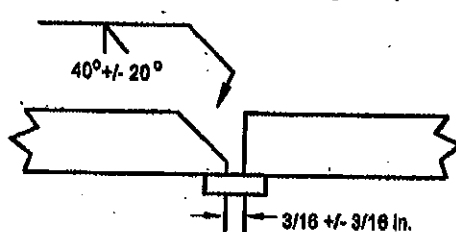


Figure 12
Double J Butt

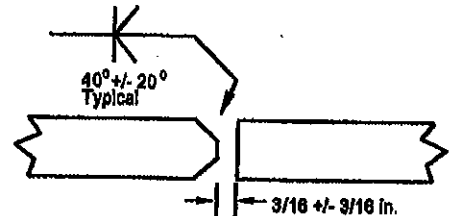


Figure 13
Single Bevel Butt

Figure 14
Single Bevel Butt with Backing Strip

Figure 15
Double Bevel Butt

Or as per the joint design on the approved construction drawing.

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

G.L.M. Industries L.P.

Procedure Qualification Record No. 1-1-051-2 Date December 15, 2006
Welding Procedure Specification No. 1-1-051A (Rev.2)
Welding Process(es) SMAW Type(s) Manual

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 516 to SA 516 Type or Grade Gr. 60 to Gr.70
P-No. P1 Grp.1 To P-No. P1 Grp.2 Thickness 6.32 mm (0.249 in.)
Diameter N/A Other Plate Product Form

FILLER METALS (QW-404)

Specification No. (SFA) SFA 5.1 SFA 5.1
AWS No. (Class) E6010 E7018-1
Filler Metal F-No. F3 F4
Filler Metal A-No. A1 A1
Size of Electrode See attached sketch
Deposited Weld Metal Thickness 2.39 mm (0.094 in.) 3.94 mm (0.155 in.)

POSITION (QW-405)

Position of Groove 3G
Weld Progression Vertical Down

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 232°C (450°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A Time N/A

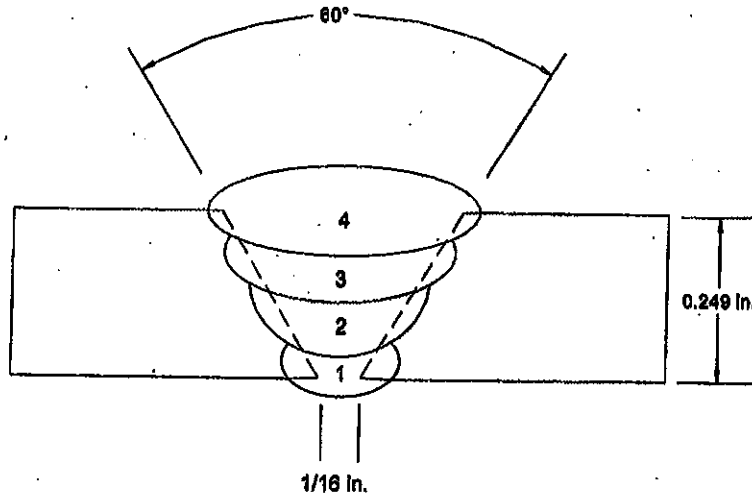
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
Amps See next page Volts See next page
Heat Input F3: 17.770 J/in. maximum F4: 20.210 J/in. maximum

TECHNIQUE (QW-410)

String or Weave Both Travel Speed See next page
Multiple or Single Pass Per Side Multiple

PQR NO. 1-1-051-2



Note: Pass #1 welded from backside followed by grinding out groove side to sound metal and depositing passes #2 to #4.

Pass	Process	Filler Metal	Diameter mm (In.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (I.p.m.)
1	SMAW	E6010	4.0 (5/32)	DCRP	100 - 115	24 - 28	231 (9.1)
2	SMAW	E7018-1	3.2 (1/8)	DCRP	140 - 148	22 - 24	264 (10.4)
3	SMAW	E7018-1	3.2 (1/8)	DCRP	128 - 132	21 - 23	254 (10.0)
4	SMAW	E7018-1	3.2 (1/8)	DCRP	135 - 145	22 - 24	243 (9.6)

PQR NO. 1-1-051-2**TENSILE TEST (QW-150)**

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbs.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	19.1 (0.752)	5.52 (0.217)	106 (0.163)	55 284 (12,400)	524 (76,100)	Partial Cup & Cone Parent Metal (SA 516 Gr. 60)
T2	19.2 (0.756)	5.51 (0.217)	106 (0.164)	53 178 (12,000)	503 (72,900)	Partial Cup & Cone Weld Metal

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.3a, TRB - R1	Pass	QW-462.3a, TFB - F1	Pass
QW-462.3a, TRB - R2	Pass	QW-462.3a, TFB - F2	Pass

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -48°C (-55°F) Specimen Size 10 X 5 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)
B2.1	Weld Metal	16.5 (12.2)
B2.2	Weld Metal	25.8 (19.0)
B2.3	Weld Metal	44.7 (33.0)
B3.1	P1 Grp.1 - HAZ	69.4 (51.2)
B3.2	P1 Grp.1 - HAZ	95.5 (70.4)
B3.3	P1 Grp.1 - HAZ	108 (79.4)
B4.1	P1 Grp.2 - HAZ	90.9 (67.0)
B4.2	P1 Grp.2 - HAZ	101 (74.2)
B4.3	P1 Grp.2 - HAZ	107 (79.0)

OTHER TESTS

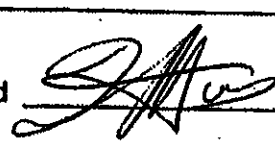
Vickers Hardness - see attached laboratory test report

Welders Name Wilber Davie Stamp No. WD
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E06-1029.2

We certify 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 G.L.M. Industries L.P.

Date Mar 17/07

Signed 



LUDWIG & ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: G.L.M. Industries L.P.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E06-1029.2
Date: January 9, 2007

Attention: Wilber Davie

PQR No.: 1-1-051-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

TENSILE TEST QW-150

SAMPLE NUMBER	T1	QW-462.1(a)	T2	QW-462.1(a)
WIDTH mm (in.)	19.1	(0.752)	19.2	(0.756)
THICKNESS mm (in.)	5.52	(0.217)	5.51	(0.217)
AREA sq. mm (sq. in.)	105	(0.163)	106	(0.164)
ULTIMATE LOAD N (lbs)	55 284	(12,400)	53 178	(12,000)
UTS MPa (psi)	524	(76,100)	503	(72,900)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal (SA 516 Gr. 60)		Weld Metal	

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	38.1 mm (1.50 in.)	SAMPLE THICKNESS:	6.32 mm (0.249 in.)
PLUNGER SIZE:	22.2 mm (0.875 in.)	YOKE SIZE:	41.1 mm (1.62 in.)
QW-462.3(a)	Face Bend	Root Bend	Face Bend
SAMPLE NUMBER(S)	F1	R1	F2
RESULTS	Pass	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 ASME Section IX, 2004 edition and latest addenda. Material information has been provided by the Customer whose name appears on this report.

Samples associated with this report will be discarded in 30 days.

Laboratory Test Conducted By: _____

Natashua Collier, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: G.L.M. Industries L.P.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E06-1029.2
Date: January 2, 2007

Attention: Wilber Davie

PQR No.: 1-1-051-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

NOTCH-TOUGHNESS TEST

TYPE OF TEST: Charpy V-Notch
TEST TEMPERATURE: -48°C (-55°F)

ORIENTATION: Transverse
SPECIMEN SIZE: 10 x 5 mm

Specimen Number	Notch Location	Impact Values	
		Joules	(ft.lbs)
B2.1	Weld Metal within 1/16" of root	16.5	(12.2)
B2.2	Weld Metal within 1/16" of root	25.8	(19.0)
B2.3	Weld Metal within 1/16" of root	44.7	(33.0)
B3.1	Gr. 60 - HAZ	69.4	(51.2)
B3.2	Gr. 60 - HAZ	95.5	(70.4)
B3.3	Gr. 60 - HAZ	108	(79.4)
B4.1	Gr. 70 - HAZ	90.9	(67.0)
B4.2	Gr. 70 - HAZ	101	(74.2)
B4.3	Gr. 70 - HAZ	107	(79.0)

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 - 2004 edition and latest addenda. Material information has been provided by the Customer whose name appears on this report.

Samples associated with this report will be discarded in 30 days.

Laboratory Test Conducted By: _____

Natashua Collier, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: G.L.M. Industries L.P.
1508 - 8 Street
Nisku, AB
T9E 7S6

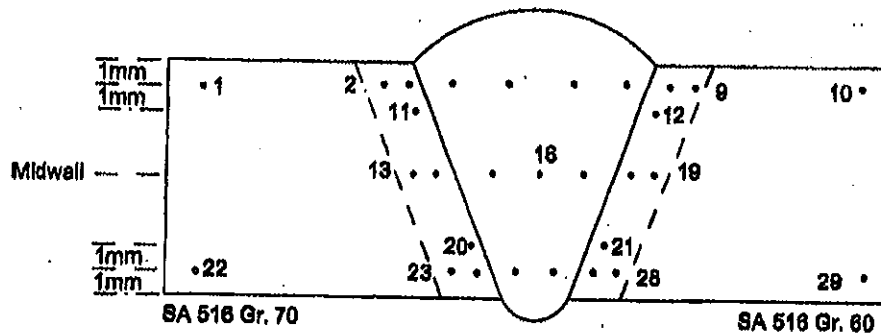
Laboratory Test No.: E06-1029.2
Date: January 9, 2007

Attention: Wilber Davie

PQR No.: 1-1-051-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Vickers
LOAD: 10 kg
INSTRUMENT TYPE: Leco V-100-C1



1) 164 HV	7) 171 HV	13) 179 HV	19) 167 HV	25) 169 HV
2) 188 HV	8) 203 HV	14) 181 HV	20) 171 HV	26) 168 HV
3) 192 HV	9) 199 HV	15) 173 HV	21) 180 HV	27) 181 HV
4) 175 HV	10) 156 HV	16) 172 HV	22) 165 HV	28) 168 HV
5) 165 HV	11) 173 HV	17) 166 HV	23) 169 HV	29) 160 HV
6) 162 HV	12) 199 HV	18) 176 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: _____

Natashua Collier, C.E.T.

WELDING PROCEDURE SPECIFICATION NO.: 2-1-129A (Rev.2)

WELDING PROCEDURE QUALIFICATION RECORD NO.(S): 2-1-129-1, 2-1-129-4
2-1-129-3

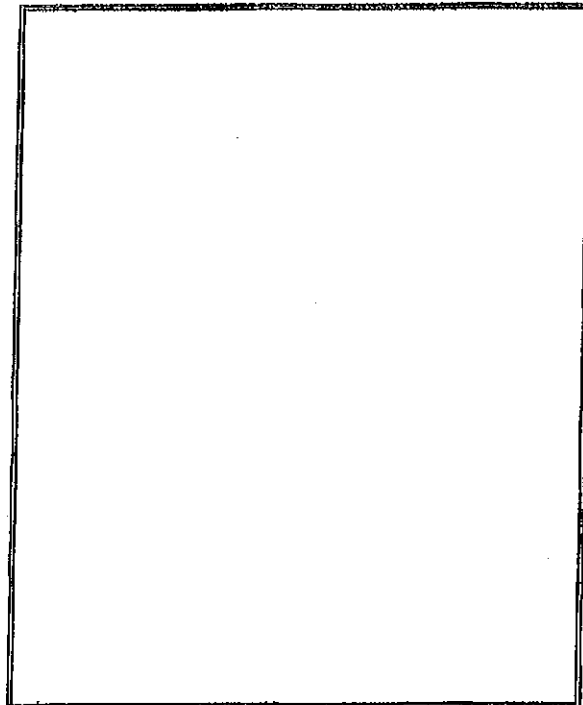
QUALIFIED FOR

Restricted Applications: API 12D, 12F, 620 & 650 Welded Storage Tank Fabrication
Base Metal (Typical): P1 Groups 1 & 2 to P1 Groups 1 & 2
(SA 333 Gr.6, SA 350 Gr.LF2, SA 420 WPL6, SA 516 Gr.70 etc.)
Process(es): SAW Weld Types: GROOVE & FILLET
Position: FLAT & HORIZONTAL Diameter: ALL DIAMETERS
Filler Metal: F7A2-EM12K

BASE METAL CONDITIONS & GROOVE THICKNESS RANGE QUALIFIED;
NOTCH TOUGHNESS APPLICATIONS TO -29°C AS WELDED
BASE METAL THICKNESS RANGE 4.8 to 38.1 mm (0.188 to 1.50 in.) Inclusive

COMBINED DEPOSITED WELD METAL THICKNESS
ASME SECTION IX 38.1 mm (1.50 in.) maximum

AXA	
SAFETY CODES ACT - PROVINCE OF ALBERTA WELDING PROCEDURE	
Reg. No. WP	8632
Spec. No.	2-1-129A (REV2)
Weld Process	SAW
Matl. Gr. P No.	1 Gr 12
to P No.	1 Gr 12
Elec. Gr. F No.	6
AND	1
Th. Qual. For	H 8 to 38 mm P.W.H.T.
	NO
	CVN - 29°C
WELDED STORAGE TANK FABRICATION	
Y.O.K. No. 98	By 26 Signed
H. ROSEBERG, P.E.C. WELDING SPECIALIST	
PROVINCIAL REGISTRATION	



QW-482 WELDING PROCEDURE SPECIFICATION (WPS)

Company Name G.L.M. INDUSTRIES L.P.
Welding Procedure Specification No. 2-1-129A (Rev.2) Date August 6, 2008
Revision(s) Rev.2: Essential - addition of PQR# 2-1-129-4, deletion of PQR# 2-1-129-2.
Rev.2: Nonessential - updated to latest code requirements.
WPS No. formerly 2-1-129A (Rev.1)
Supporting PQR No.(s) 2-1-129-1, 2-1-129-4, 2-1-129-3
Welding Process(es) SAW Type(s) Machine

JOINTS (QW-402)

Joint Design All ASME groove & fillet, reference construction drawing for joint details.
Where joint details are not specified, refer to figures 1 to 15 attached
Root Opening As per attached typical groove designs, see figures 1 to 15 attached
Backing With or without Retainers Not required

BASE METALS (QW-403)

P-Number P1 Groups 1 & 2 To P-Number P1 Groups 1 & 2
Thickness Range: Groove See cover page for thickness qualified by governing code
Fillet All base metal thicknesses
Pipe Diameter Ranges: Groove All diameters
Fillet All diameters
Deposited Weld Metal (Per Pass) 12.7 mm (0.50 in.) maximum

FILLER METALS (QW-404)

SAW
Specification No. (SFA) SFA 5.17
AWS No. (Class) F7A2-EM12K
F-No. F6
A-No. A1
Size 5/64 to 3/16 in. inclusive
Supplemental Filler Metal Without
Wire Trade Name & Designation Lincoln Electric L61 wire
Flux Trade Name & Designation Lincoln Electric 860 flux
Flux Type Neutral
Recrushed Slag Must be tested and meet ASME Section II, Part C SFA 5.17 requirements
Deposited Weld Metal Thickness Range:
Groove 38.1 mm (1.50 in.) max.
Fillet All fillet sizes

POSITION (QW-405)

Position of Groove Flat & Horizontal Position of Fillet Flat & Horizontal
Weld Progression N/A

PREHEAT (QW-406)

Preheat Temperature (Minimum) See attached preheat sheet
Interpass Temperature (Maximum) 232°C (450°F)
Preheat Maintenance See attached preheat sheet prior to welding. Preheat maintenance is not required if welding is interrupted or after the completion of welding unless required by the code of construction.

WPS NO. 2-1-129A (Rev.2)

POST WELD HEAT TREATMENT (QW-407)

Temperature Range N/A Time Range N/A

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
 Amps See Table #1 Volts See Table #1

Maximum Heat Input

Base Metal Thickness Range	SAW
0.188 - 0.374 in.	27,477 J/in.
0.375 - 0.624 in.	33,150 J/in.
0.625 - 1.50 in.	46,500 J/in.

TECHNIQUE (QW-410)

String or Weave String Travel Speed See Table #1
 Contact Tube to Work Distance 12.7 mm (0.50 in.) to 38.1 mm (1.50 in.)
 Initial & Interpass Cleaning Brushing, chipping or grinding as required
 Method of Back Gouging Air carbon arc, back-grind as required
 Oscillation N/A
 Closed to Out Chamber N/A
 Multiple or Single Pass Per Side Multiple
 Multiple or Single Electrodes Single
 Peening Not required
 Use of Thermal Process N/A

TABLE 1 - WELDING PARAMETERS

Process	Filler Metal	Diameter mm (in.)	Current Type & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (i.p.m.)
SAW	F7A2-EM12K	2.0 (5/64)	DCRP	200 - 450	26 - 32	164 - 750 (6.5 - 30)
SAW	F7A2-EM12K	2.4 (3/32)	DCRP	250 - 600	25 - 33	205 - 812 (8.1 - 32)
SAW	F7A2-EM12K	3.2 (1/8)	DCRP	300 - 600	26 - 34	256 - 890 (10.1 - 35)
SAW	F7A2-EM12K	4.0 (5/32)	DCRP	400 - 700	26 - 34	341 - 1015 (13.5 - 40)
SAW	F7A2-EM12K	5.0 (3/16)	DCRP	500 - 1000	28 - 36	459 - 1270 (18.1 - 50)

Note: Welding parameters shall be adjusted to insure that the maximum heat input value specified in QW-409 above is not exceeded.

Heat Input (joules per inch) = (Amperage X Voltage X 60) / Travel Speed (inches per minute)

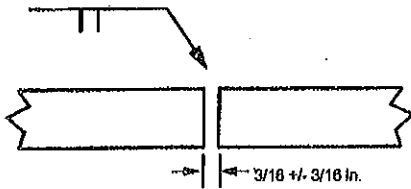
TYPICAL JOINT DESIGNS

Figure 1
Single Square Butt

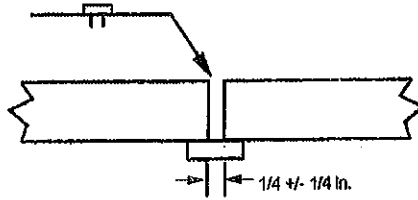


Figure 2
Single Square Butt with Backing Strip

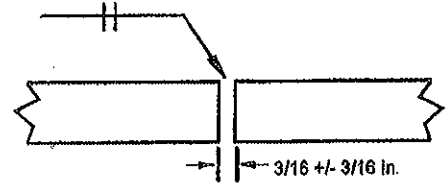


Figure 3
Double Square Butt

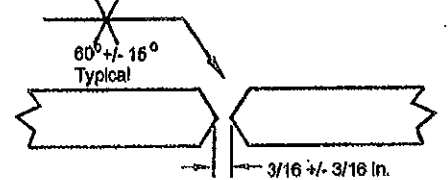
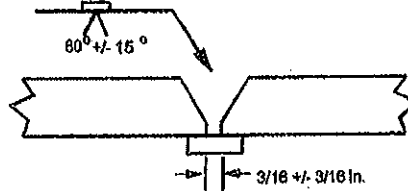
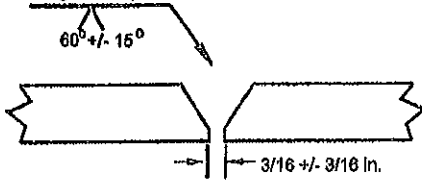


Figure 4
Single Vee Butt

Figure 5
Single Vee Butt with Backing Strip

Figure 6
Double Vee Butt

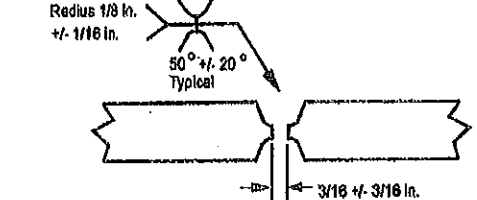
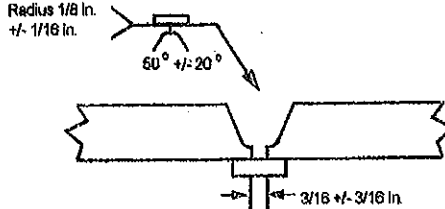
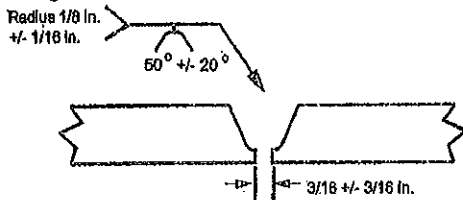


Figure 7
Single U Butt

Figure 8
Single U Butt with Backing Strip

Figure 9
Double U Butt

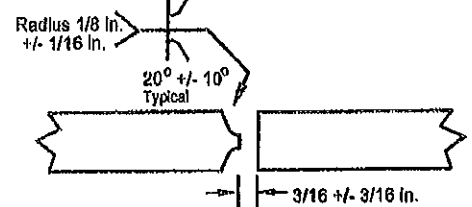
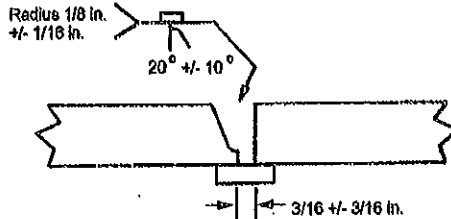
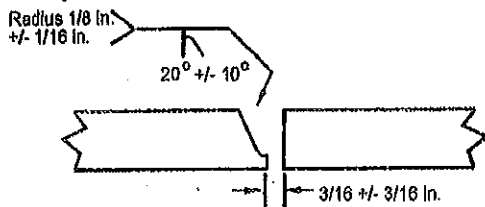


Figure 10
Single J Butt

Figure 11
Single J Butt with Backing Strip

Figure 12
Double J Butt

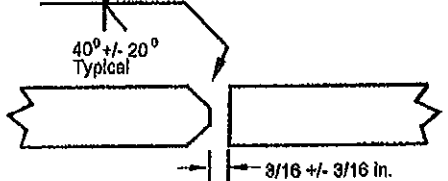
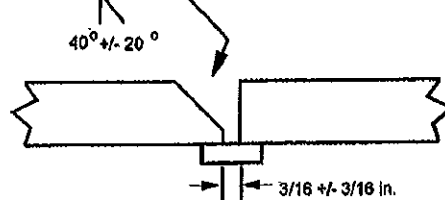
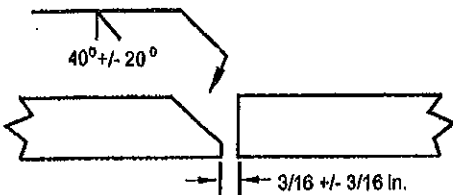


Figure 13
Single Bevel Butt

Figure 14
Single Bevel Butt with Backing Strip

Figure 15
Double Bevel Butt

Or as per the joint design on the approved construction drawing.

PREHEAT

P-No. 1

1. Welds joining pressure parts or attachments shall be preheated to not less than the minimum preheat temperatures stated in paragraph 5.
2. The preheat temperature shall be maintained during welding.
3. If welding is interrupted, the weld joint and adjacent areas shall be reheated to the minimum preheat temperature stated in paragraph 5, prior to the start of welding.
4. Preheat temperatures shall be checked by the welder or inspector, using temperature indicating crayons or other reputable methods.
5. Minimum preheating temperatures shall be as follows:

NOMINAL WALL THICKNESS	MINIMUM PREHEAT TEMPERATURE
0 to 32 mm (0 to 1.25 in)	10°C (50°F)
Over 32 mm (Over 1.25 in.)	95°C (200°F)

- The preheat zone shall extend at least 76 mm (3.0 in.) beyond each edge of the weld.

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

Company Name G.L.M. INDUSTRIES L.P.
Procedure Qualification Record No. 2-1-129-1 Date August 22, 2000
Welding Procedure Specification No. 2-1-129A (Rev.2)
PQR Revision Format update & Editorial update.
WPS No. formerly 2-1-129A (Rev.1), August 6, 2008
Welding Process(es) SAW Type(s) Machine

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 36 to SA 516 Type or Grade N/A to Gr.70
P-No. P1 Grp.1 To P-No. P1 Grp.2 Thickness 6.32 mm (0.249 in.)
Diameter N/A Other Plate Product Form m/c to 0.249 in.

FILLER METALS (QW-404)

Specification No. (SFA) SFA 5.17
AWS No. (Class) E7A2-EM12K
Filler Metal F-No. F6
Filler Metal A-No. A1
Supplemental Filler Metal Without
Flux Type Neutral
Size of Electrode See attached sketch
Deposited Weld Metal Thickness 6.32 mm (0.249 in.)

POSITION (QW-405)

Position of Groove 1G Weld Progression N/A

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 200°C (392°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A Time N/A

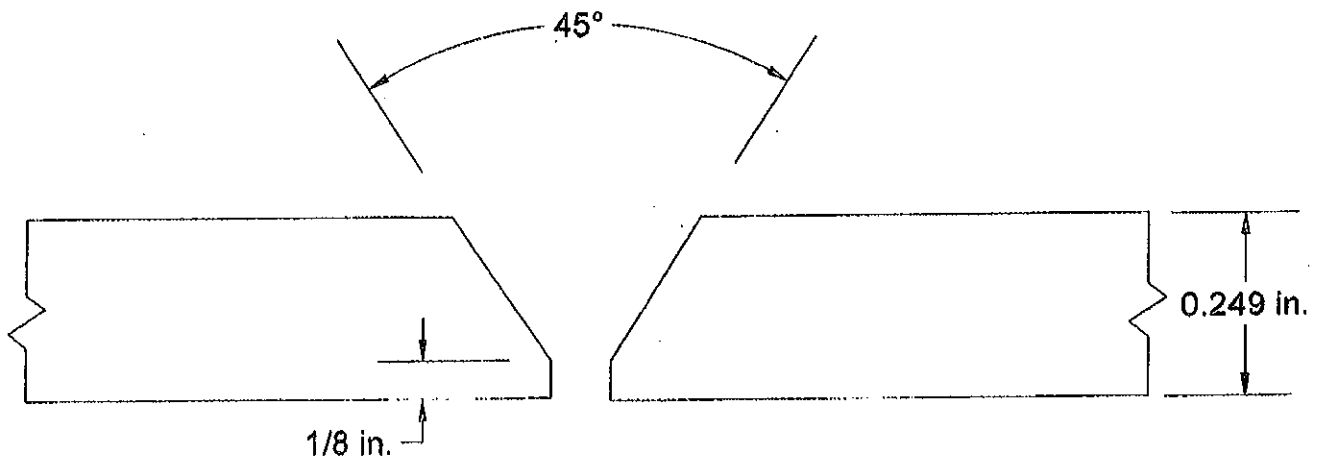
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
Amps See next page Volts See next page
Heat Input F6: 27.477 J/in. maximum

TECHNIQUE (QW-410)

String or Weave String Travel Speed See next page
Multiple or Single Pass Per Side Multiple
Multiple or Single Electrodes Single

PQR NO. 2-1-129-1



Pass	Process	Filler Metal	Diameter mm (In.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (I.p.m.)
All	SAW	F7A2-EM12K	2.4 (3/32)	DCRP	325	31	559 (22)

PQR NO. 2-1-129-1

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -54° C (-65° F) Specimen Size 10 X 4 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)
A2.1	Weld Metal within 1/16 in. of root	20.3 (15.0)
A2.2	Weld Metal within 1/16 in. of root	21.7 (16.0)
A2.3	Weld Metal within 1/16 in. of root	21.7 (16.0)
A3.1	SA 36 - HAZ	9.5 (7.0)
A3.2	SA 36 - HAZ	23.1 (17.0)
A3.3	SA 36 - HAZ	19.0 (14.0)
A4.1	Gr. 70 - HAZ	13.3 (9.8)
A4.2	Gr. 70 - HAZ	13.6 (10.0)
A4.3	Gr. 70 - HAZ	13.6 (10.0)

OTHER TESTS

Rockwell Hardness - see attached laboratory test report

Welders Name Cliff Debrule Stamp No. CD
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E00-598.1

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

Manufacturer G.L.M INDUSTRIES L.P.

Date 08/19/08 Signed 

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

Company Name G.L.M. INDUSTRIES L.P.
Procedure Qualification Record No. 2-1-129-4 Date August 7, 2008
Welding Procedure Specification No. 2-1-129A (Rev.2)
Welding Process(es) SAW Type(s) Machine

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 516 to SA 516 Type or Grade Gr.60 to Gr.70
P-No. P1 Grp.1 To P-No. P1 Grp.2 Thickness 9.52 mm (0.375 in.)
Heat Number 297420 - 65196 Carbon Equivalent 0.36 %
Diameter N/A Other Plate Product Form

FILLER METALS (QW-404)

Specification No. (SFA) SFA 5.17
AWS No. (Class) F7A2-EM12K*
Filler Metal F-No. F6
Filler Metal A-No. A1
Supplemental Filler Metal Without
Flux Type Neutral
Size of Electrode See attached sketch
Deposited Weld Metal Thickness 9.52 mm (0.375 in.)
Other * Lincoln Electric L61 Wire
* Lincoln Electric 860 Flux

POSITION (QW-405)

Position of Groove 1G Weld Progression N/A

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 200°C (392°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A Time N/A

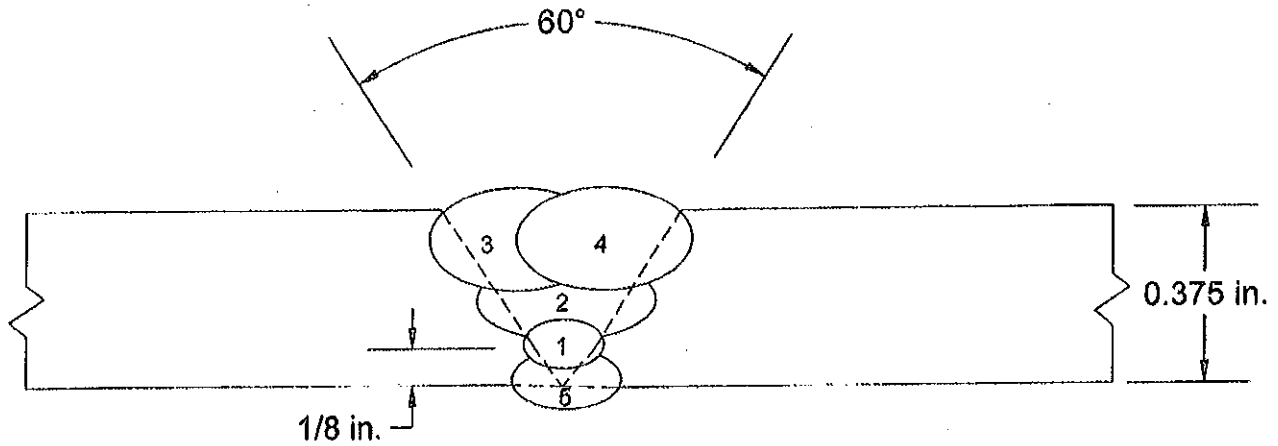
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
Amps See next page Volts See next page
Heat Input F6: 33,150 J/in. maximum

TECHNIQUE (QW-410)

String or Weave String Travel Speed See next page
Multiple or Single Pass Per Side Both
Multiple or Single Electrodes Single

PQR NO. 2-1-129-4



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (l.p.m.)
1*	SAW	F7A2-EM12K	2.4 (3/32)	DCRP	300	29	523 (20.6)
2*	SAW	F7A2-EM12K	2.4 (3/32)	DCRP	300	29	523 (20.6)
3*	SAW	F7A2-EM12K	2.4 (3/32)	DCRP	340	30	469 (18.5)
4*	SAW	F7A2-EM12K	2.4 (3/32)	DCRP	340	30	469 (18.5)
5*	SAW	F7A2-EM12K	2.4 (3/32)	DCRP	340	30	469 (18.5)

* Recorded welding parameters provided by G.L.M. INDUSTRIES L.P.

PQR NO. 2-1-129-4

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -46° C (-50° F) Specimen Size 10 X 8 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)
L2.1	Weld Metal within 1/16 in. of surface	41.5 (30.6)
L2.2	Weld Metal within 1/16 in. of surface	27.4 (20.2)
L2.3	Weld Metal within 1/16 in. of surface	29.0 (21.4)
L3.1	Gr. 60 - HAZ	93.8 (69.2)
L3.2	Gr. 60 - HAZ	87.9 (64.8)
L3.3	Gr. 60 - HAZ	83.8 (61.8)
N3.1	Gr. 70 - HAZ	160 (118)
N3.2	Gr. 70 - HAZ	>163 (>120)
N3.3	Gr. 70 - HAZ	>163 (>120)

OTHER TESTS

Vickers Hardness - see attached laboratory test report

Welders Name Merlin Grabia Certificate File No. N/A
 Tests Conducted By Ludwig Associates Ltd.
 Laboratory Test No. E08-617.2

Manufacturer G.L.M INDUSTRIES L.P.

Date 8/19/08 Signed [Signature]

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

Company Name G.L.M. INDUSTRIES L.P.
Procedure Qualification Record No. 2-1-129-3 Date August 22, 2000
Welding Procedure Specification No. 2-1-129A (Rev.2)
PQR Revision Format update & Editorial update,
WPS No. formerly 2-1-129A (Rev.1), August 7, 2008
Welding Process(es) SAW Type(s) Machine

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 36 to SA 516 Type or Grade N/A to Gr.70
P-No. P1 Grp.1 To P-No. P1 Grp.2 Thickness 19.1 mm (0.750 in.)
Diameter N/A Other Plate Product Form

FILLER METALS (QW-404)

Specification No. (SFA) SFA 5.17
AWS No. (Class) F7A2-EM12K
Filler Metal F-No. F6
Filler Metal A-No. A1
Supplemental Filler Metal Without
Flux Type Neutral
Size of Electrode See attached sketch
Deposited Weld Metal Thickness 19.1 mm (0.750 in.)

POSITION (QW-405)

Position of Groove 1G Weld Progression N/A

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 200°C (392°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A Time N/A

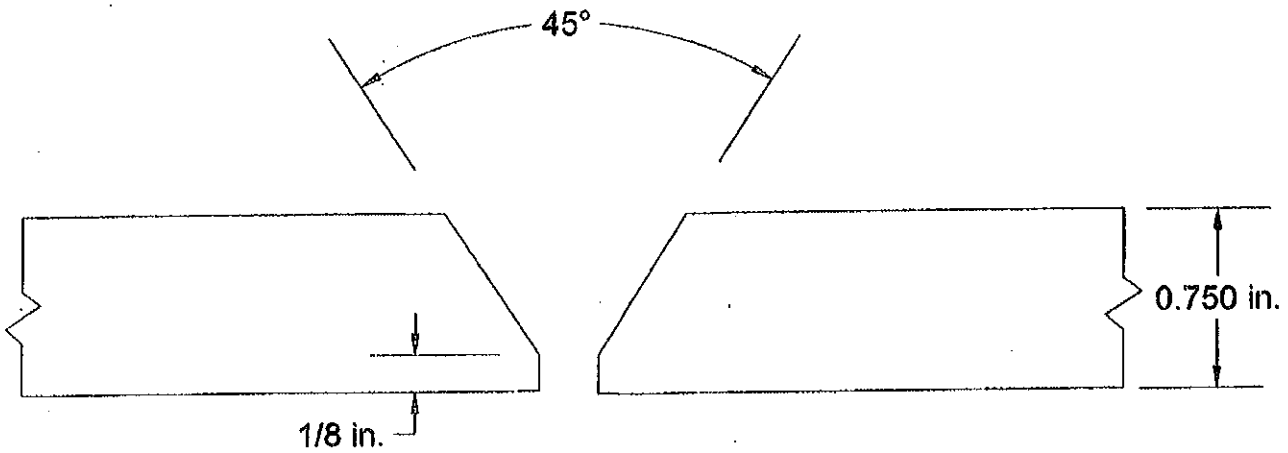
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
Amps See next page Volts See next page
Heat Input F6: 46,500 J/in. maximum

TECHNIQUE (QW-410)

String or Weave String Travel Speed See next page
Multiple or Single Pass Per Side Multiple
Multiple or Single Electrodes Single

PQR NO. 2-1-129-3



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (l.p.m.)
All	SAW	F7A2-EM12K	2.4 (3/32)	DCRP	425	31	432 (17)

PQR NO. 2-1-129-3**TENSILE TEST (QW-150)**

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbs.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	19.0 (0.748)	16.0 (0.630)	304 (0.471)	160 200 (36,020)	527 (76,400)	Partial Cup & Cone Parent Metal (SA 516 Gr. 70)
T2	19.0 (0.748)	16.0 (0.630)	304 (0.471)	15 600 (35,900)	525 (76,100)	Partial Cup & Cone Parent Metal (SA 36)

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.2, TSB - S1	Pass	QW-462.2, TSB - S3	Pass
QW-462.2, TSB - S2	Pass	QW-462.2, TSB - S4	Pass

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -46° C (-50° F) Specimen Size 10 X 10 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)
C2.1	Weld Metal within 1/16 in. of root	33.9 (25.0)
C2.2	Weld Metal within 1/16 in. of root	34.2 (25.2)
C2.3	Weld Metal within 1/16 in. of root	41.0 (30.2)
C3.1	SA 36 - HAZ	20.3 (15.0)
C3.2	SA 36 - HAZ	38.2 (28.2)
C3.3	SA 36 - HAZ	31.2 (23.0)
C4.1	Gr. 70 - HAZ	155 (114)
C4.2	Gr. 70 - HAZ	121 (89.0)
C4.3	Gr. 70 - HAZ	115 (85.0)

OTHER TESTS

Rockwell Hardness - see attached laboratory test report

Welders' Name Cliff Debrule Stamp No. CD
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E00-598.3

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

Manufacturer G.L.M INDUSTRIES L.P.Date 8/19/08



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment
1508 - 8 Street
Nisku, Alberta
T9E 7S6

Laboratory Test No.: E00-598.1
Date: August 22, 2000

Attention: Wilber Davie

PQR Number: 2-1-129-1
Material: SA 36 to SA 516 Gr. 70
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

NOTCH-TOUGHNESS TEST

TYPE OF TEST: Charpy V-Notch
TEST TEMPERATURE: -54°C (-65°F)

ORIENTATION: Transverse
SPECIMEN SIZE: 10 x 4 mm

Specimen Number	Notch Location	Impact Values	
		Joules	(ft.lbs)
A2.1	Weld Metal within 1/16" of surface	20.3	(15.0)
A2.2	Weld Metal within 1/16" of surface	21.7	(16.0)
A2.3	Weld Metal within 1/16" of surface	21.7	(16.0)
A3.1	SA 36 - HAZ	9.5	(7.0)
A3.2	SA 36 - HAZ	23.1	(17.0)
A3.3	SA 36 - HAZ	19.0	(14.0)
A4.1	Gr. 70 - HAZ	13.3	(9.8)
A4.2	Gr. 70 - HAZ	13.6	(10.0)
A4.3	Gr. 70 - HAZ	13.6	(10.0)

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, 1998 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: _____

Karen Koens
Karen Koens, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment
1508 - 8 Street
Nisku, Alberta
T9E 7S6

Laboratory Test No.: E00-598.1
Date: August 22, 2000

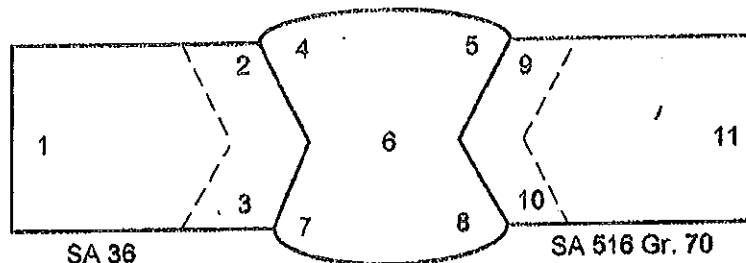
Attention: Wilber Davie

PQR Number: 2-1-129-1
Material: SA 36 to SA 516 Gr. 70
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Rockwell
INSTRUMENT TYPE: Wilson

SCALE: B



1)	73 HRB	5)	85 HRB	9)	74 HRB
2)	74 HRB	6)	84 HRB	10)	87 HRB
3)	80 HRB	7)	82 HRB	11)	83 HRB
4)	82 HRB	8)	87 HRB		

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E18 - 98. 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: Karen Koens
Angela Sultanlah/Karen Koens, C.E.T.

4027 - 14 Street S.E., CALGARY, ALBERTA T2G 3K6 PHONE: (403) 262-7072 FAX: (403) 266-3169

7925 Davies Road, EDMONTON, ALBERTA T6E 4N1 PHONE: (780) 468-3030 FAX: (780) 468-3032



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment
1508 - 8 Street
Nisku, Alberta
T9E 7S6

Laboratory Test No.: E00-598.2
Date: August 22, 2000

Attention: Wilber Davie

PQR Number: 2-1-129-2
Material: SA 36 to SA 516 Gr. 70
Thickness: 9.52 mm (0.375 in.)
Thermal Condition: As Welded

NOTCH-TOUGHNESS TEST

TYPE OF TEST: Charpy V-Notch
TEST TEMPERATURE: -50°C (-58°F)

ORIENTATION: Transverse
SPECIMEN SIZE: 10 x 7 mm

Specimen Number	Notch Location	Impact Values	
		Joules	(ft.lbs)
B2.1	Weld Metal within 1/16" of surface	47.7	(35.2)
B2.2	Weld Metal within 1/16" of surface	49.1	(36.2)
B2.3	Weld Metal within 1/16" of surface	39.6	(29.2)
B3.1	SA 36 - HAZ	33.9	(25.0)
B3.2	SA 36 - HAZ	16.3	(12.0)
B3.3	SA 36 - HAZ	31.2	(23.0)
B4.1	Gr. 70 - HAZ	15.2	(11.2)
B4.2	Gr. 70 - HAZ	13.6	(10.0)
B4.3	Gr. 70 - HAZ	23.6	(17.4)

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, 1998 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: _____

Karen Koens
Karen Koens, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment
1508 - 8 Street
Nisku, Alberta
T9E 7S6

Laboratory Test No.: E00-598.2
Date: August 22, 2000

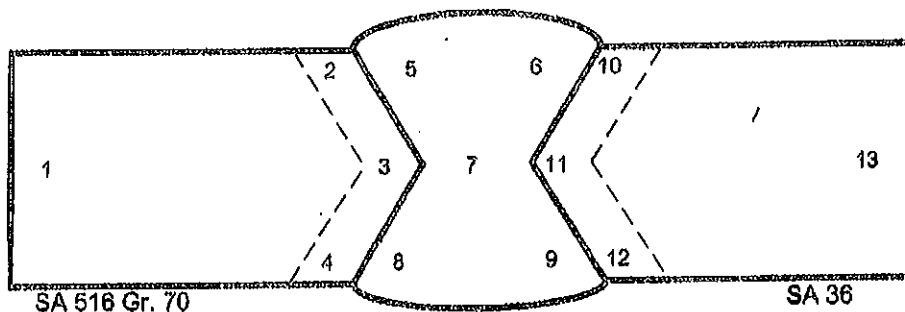
Attention: Wilber Davie

PQR Number: 2-1-129-2
Material: SA 36 to SA 516 Gr. 70
Thickness: 9.52 mm (0.375 in.)
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Rockwell
INSTRUMENT TYPE:

SCALE: B



1) 80 HRB	6) 90 HRB	11) 84 HRB
2) 88 HRB	7) 88 HRB	12) 85 HRB
3) 90 HRB	8) 90 HRB	13) 73 HRB
4) 89 HRB	9) 86 HRB	
5) 90 HRB	10) 85 HRB	

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E18 - 98. 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:

Karen Koens

Angela Sultanjan/Karen Koens, C.E.T.

4027 - 14 Street S.E., CALGARY, ALBERTA T2C 3K6 PHONE: (403) 262-7072 FAX: (403) 266-3169

7925 Davies Road, EDMONTON, ALBERTA T6E 4N1 PHONE: (780) 468-3030 FAX: (780) 468-3032



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment
1508 - 8 Street
Nisku, Alberta
T9E 7S6

Laboratory Test No.: E00-598.3
Date: August 22, 2000

Attention: Wilber Davie

PQR Number: 2-1-129-3
Material: SA 36 to SA 516 Gr. 70
Thickness: 19.1 mm (0.750 in.)
Thermal Condition: As Welded

TENSILE TEST QW-150

SAMPLE NUMBER	T1	QW-462.1(a)	T2	QW-462.1(a)
WIDTH mm (in)	19.0	(0.748)	19.0	(0.748)
THICKNESS mm (in)	16.0	(0.630)	16.0	(0.630)
AREA sq mm (sq in)	304	(0.471)	304	(0.471)
ULTIMATE LOAD N (lbs)	160 200	(36,020)	15 500	(35,900)
UTS MPa (psi)	527	(76,400)	525	(76,100)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal (SA 516 Gr. 70)		Parent Metal (SA 36)	

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	9.52 mm (0.375 in.)	SAMPLE THICKNESS:	19.1 mm (0.750 in.)
PLUNGER SIZE:	38.1 mm (1.50 in.)	YOKE SIZE:	60.3 mm (2.375 in.)
QW-462.2	Side Bend	Side Bend	Side Bend
SAMPLE NUMBER(S)	S1	S2	S3
RESULTS	Pass	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 ASME Section IX - 98. 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: _____

Karen Koens
Karen Koens, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment
1508 - 8 Street
Nisku, Alberta
T9E 7S6

Laboratory Test No.: E00-598.3
Date: August 22, 2000

Attention: Wilber Davie

PQR Number: 2-1-129-3
Material: SA 36 to SA 516 Gr. 70
Thickness: 19.1 mm (0.750 in.)
Thermal Condition: As Welded

NOTCH-TOUGHNESS TEST

TYPE OF TEST: Charpy V-Notch
TEST TEMPERATURE: -46°C (-50°F)

ORIENTATION: Transverse
SPECIMEN SIZE: 10 x 10 mm

Specimen Number	Notch Location	Impact Values	
		Joules	(ft.lbs)
C2.1	Weld Metal within 1/16" of surface	33.9	(25.0)
C2.2	Weld Metal within 1/16" of surface	34.2	(25.2)
C2.3	Weld Metal within 1/16" of surface	41.0	(30.2)
C3.1	SA 36 - HAZ	20.3	(15.0)
C3.2	SA 36 - HAZ	38.2	(28.2)
C3.3	SA 36 - HAZ	31.2	(23.0)
C4.1	Gr. 70 - HAZ	155	(114)
C4.2	Gr. 70 - HAZ	121	(89.0)
C4.3	Gr. 70 - HAZ	115	(85.0)

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, 1998 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: _____

Karen Koens
Karen Koens, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment
1508 - 8 Street
Nisku, Alberta
T9E 7S6

Laboratory Test No.: E00-598.3

Date: August 22, 2000

Attention: Wilber Davie

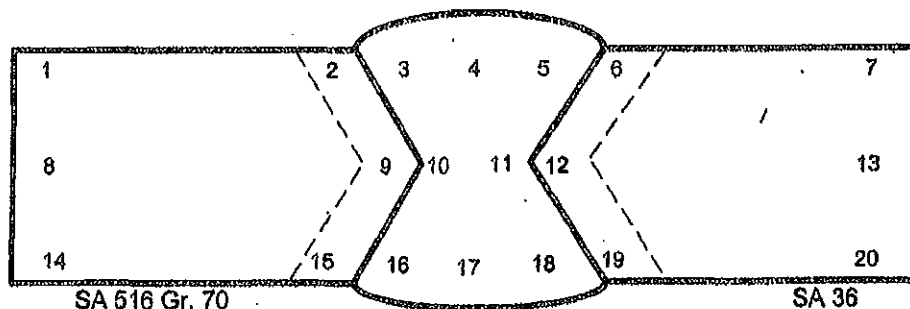
PQR Number: 2-1-129-3
Material: SA 36 to SA 516 Gr. 70
Thickness: 19.1 mm (0.750 in.)
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Rockwell

SCALE: B

INSTRUMENT TYPE: Willson



1) 82 HRB	6) 92 HRB	11) 85 HRB	16) 90 HRB
2) 98 HRB	7) 80 HRB	12) 87 HRB	17) 86 HRB
3) 89 HRB	8) 78 HRB	13) 79 HRB	18) 91 HRB
4) 85 HRB	9) 89 HRB	14) 84 HRB	19) 93 HRB
5) 89 HRB	10) 86 HRB	15) 89 HRB	20) 82 HRB

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E18 - 98. 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: _____

Karen Koens
Angela Sultanian/Karen Koens, C.E.T.

QW-482 WELDING PROCEDURE SPECIFICATION (WPS)

G.L.M. Industries L.P.

Welding Procedure Specification No. 3-8-168A (Rev.2) Date September 26, 2006
Revision Rev. 2 (Nonessential) Corporate name change (formerly GLM Tanks &
Equipment Ltd.) WPS No. formerly 3-8-168A (Rev.1)
Supporting PQR No. (s) 3-8-168
Welding Process(es) GMAW (STT) / GMAW Type(s) Semi-automatic

JOINTS (QW-402)

Joint Design All ASME groove & fillet, reference construction drawing for joint details.
Where joint details are not specified, refer to figures 1 to 15 attached
Root Opening As per attached typical groove designs, see figures 1 to 15 attached
Backing With or without Retainers Not required

BASE METALS (QW-403)

P-Number P8 To P-Number P8
Thickness Range: Groove See cover page for thickness qualified by governing code
Fillet All base metal thicknesses
Pipe Diameter Ranges: Groove All diameters
Fillet All diameters
Deposited Weld Metal (Per Pass) GMAW (STT): 2.79 mm (0.110 in.) maximum
GMAW: 6.63 mm (0.261 in.) maximum

FILLER METALS (QW-404)

	GMAW (STT)	GMAW
Specification No. (SFA)	<u>SFA 5.9</u>	<u>SFA 5.9</u>
AWS No. (Class)	<u>ER308LSI, ER316LSI</u>	<u>ER3XX(L)(Si)*</u>
F-No.	<u>F6</u>	<u>F6</u>
A-No.	<u>A8</u>	<u>A8</u>
Size	<u>.030 to .045 in. inclusive</u>	<u>0.030 to 0.045 in. inclusive</u>
Filler Metal Product Form	<u>Solid wire</u>	<u>Solid wire</u>
Supplemental Filler Metal	<u>Without</u>	<u>Without</u>
Deposited Weld Metal Thickness Range:		
Groove	<u>2.79 mm (0.110 in.) max.**</u>	<u>6.63 mm (0.261 in.) max.**</u>
Fillet	<u>All fillet sizes</u>	<u>All fillet sizes</u>
Other	<u>* Match filler metal chemical composition to base metal being welded</u>	
	<u>** Combined deposited weld metal thickness shall not exceed 9.42 mm (0.371 in.)</u>	
	<u>for ASME B31.1, B31.3 and for ASME Section VIII, Div.1</u>	

POSITION (QW-405)

Position of Groove All positions Position of Fillet All positions
Weld Progression GMAW (STT): Vertical down GMAW: Vertical up

PREHEAT (QW-406)

Preheat Temperature (Minimum) 10°C (50°F)
Interpass Temperature (Maximum) 177°C (350°F)
Preheat Maintenance 10°C prior to welding. Preheat maintenance is not required if welding is
interrupted or after the completion of welding unless required by the
code of construction.

WPS NO. 3-8-168A (Rev.2)

POST WELD HEAT TREATMENT (QW-407)

Temperature Range N/A Time Range N/A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-HeAC-7.5/2.5
 Shielding 90% Helium, 7.5% Argon, 2.5% Carbon Dioxide, 10-25 liters per minute (20-50 cfph)
 Backing Not Required Trailing Not Required

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
 Amps See Table #1 Volts See Table #1
 Mode of Metal Transfer GMAW (STT): Short circuiting
 Mode of Metal Transfer GMAW: Pulsating Arc (SPRAY)

TECHNIQUE (QW-410)

String or Weave Either Travel Speed See Table #1
 Orifice or Gas Cup Size 9.52 mm (0.375 in.) to 19.1 mm (0.750 in.)
 Initial & Interpass Cleaning Brushing, chipping or grinding as required with equipment that will not contaminate
 Method of Back Gouging Air carbon arc, back-grind as required with equipment that will not contaminate
 Oscillation N/A
 Contact Tube to Work Distance GMAW (STT): 6.35 mm (0.250 in.) to 19.1 mm (0.750 in.)
 Contact Tube to Work Distance GMAW: 12.7 mm (0.500 in.) to 25.4 mm (1.00 in.)
 Multiple or Single Pass Per Side GMAW (STT): Single, root pass only GMAW: Either
 Multiple or Single Electrodes Single
 Electrode Spacing N/A
 Peening Not permitted

TABLE 1 - WELDING PARAMETERS

Process	Filler Metal	Diameter mm (In.)	Current Type & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (l.p.m.)
GMAW - STT	ER308LSi	0.8 (0.030)	DCRP	70 - 130	12 - 21	38 - 250 (1.5 - 10)
GMAW - STT	or	0.9 (0.035)	DCRP	80 - 200	13 - 22	50 - 600 (2.0 - 25)
GMAW - STT	ER316LSi	1.1 (0.045)	DCRP	100 - 250	14 - 23	75 - 900 (3.0 - 35)
GMAW	ER3XX(L)(Si)	0.8 (0.030)	DCRP	60 - 130	14 - 29	38 - 250 (1.5 - 10)
GMAW	ER3XX(L)(Si)	0.9 (0.035)	DCRP	70 - 200	15 - 30	50 - 600 (2.0 - 25)
GMAW	ER3XX(L)(Si)	1.1 (0.045)	DCRP	70 - 250	16 - 30	75 - 900 (3.0 - 35)

Note: Size of electrode, filler metal, number of passes, voltage, amperage, and travel speed will vary with position, joint thickness, joint type etc. Match filler metal chemical composition to base metal being welded.

TYPICAL JOINT DESIGNS

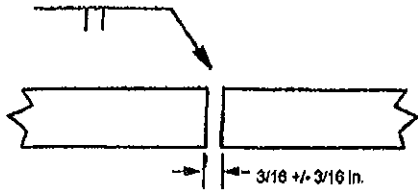


Figure 1
Single Square Butt

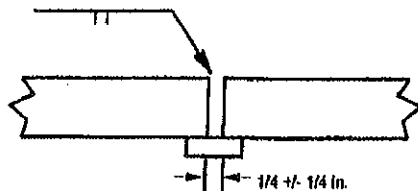


Figure 2
Single Square Butt with Backing Strip

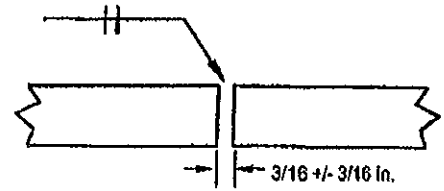


Figure 3
Double Square Butt

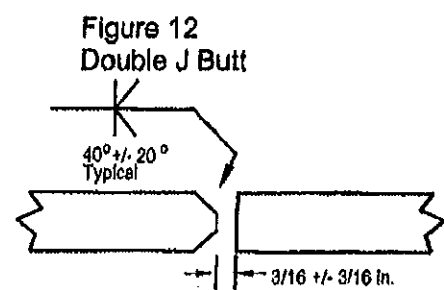
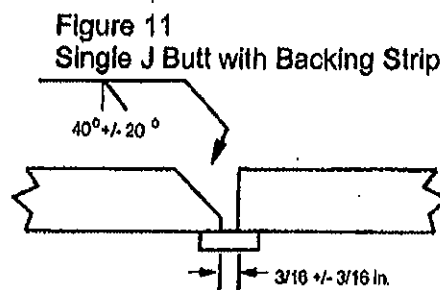
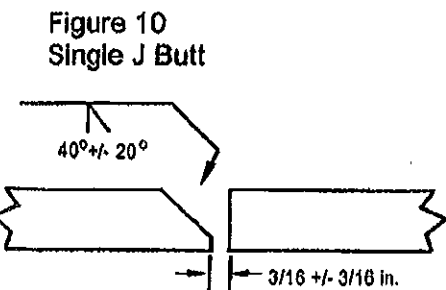
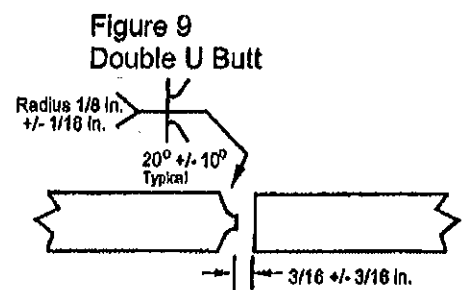
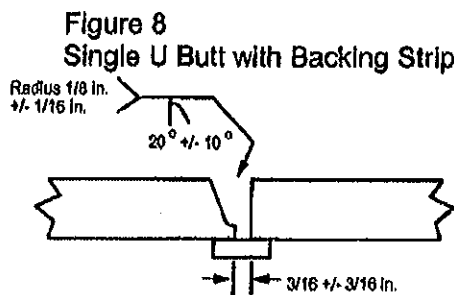
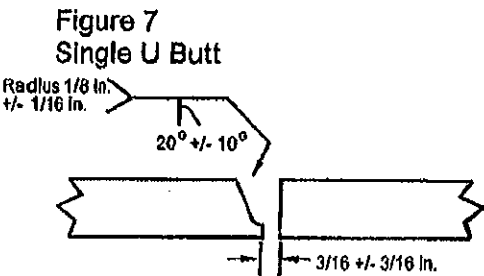
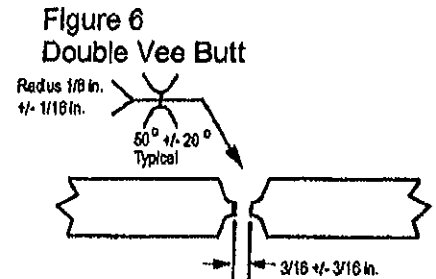
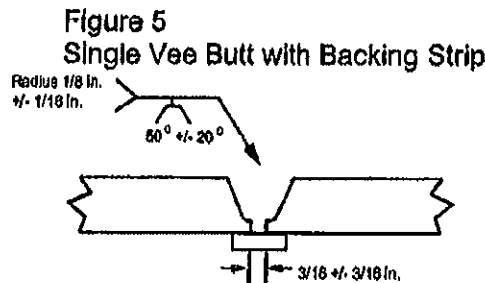
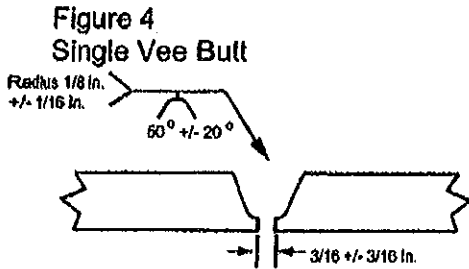
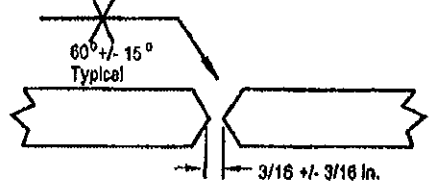
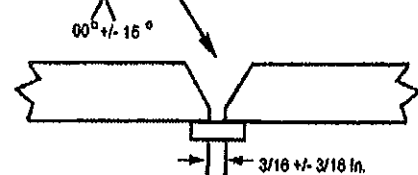
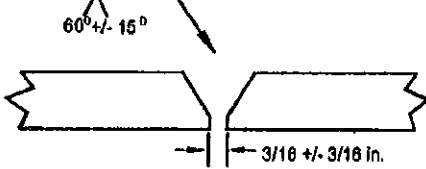


Figure 13
Single Bevel Butt

Figure 14
Single Bevel Butt with Backing Strip

Figure 15
Double Bevel Butt

Or as per the joint design on the approved construction drawing.

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

G.L.M. Industries L.P.

Procedure Qualification Record No. 3-8-168 Date December 9, 2003
PQR Revision Corporate name change (formerly GLM Tanks & Equipment Ltd.),
September 26, 2006
Welding Procedure Specification No. 3-8-168A (Rev.2)
Welding Process(es) GMAW - STT / GMAW Type(s) Semi-automatic

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 312 Type or Grade Type 304L
P-No. P8 To P-No. P8 Thickness 8.56 mm (0.337 in.)
Diameter 114.3 mm (4.50 in.) O.D. Other Schedule 80

FILLER METALS (QW-404)

	GMAW - STT	GMAW
Specification No. (SFA)	<u>SFA 5.9</u>	<u>SFA 5.9</u>
AWS No. (Class)	<u>ER308LSI</u>	<u>ER308LSI</u>
Filler Metal F-No.	<u>F6</u>	<u>F6</u>
Filler Metal A-No.	<u>A8</u>	<u>A8</u>
Size of Electrode	<u>See attached sketch</u>	
Deposited Weld Metal Thickness	<u>2.54 mm (0.100 in.)</u>	<u>6.02 mm (0.237 in.)</u>

POSITION (QW-405)

Position of Groove 5G
Weld Progression GMAW - STT: Vertical down GMAW: Vertical up

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 177°C (350°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A Time N/A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-HeAC-7.5/2.5
Shielding 90% Helium, 7.5% Argon, 2.5% Carbon Dioxide, 17.5 liters per minute (35 cfm)
Backing N/A

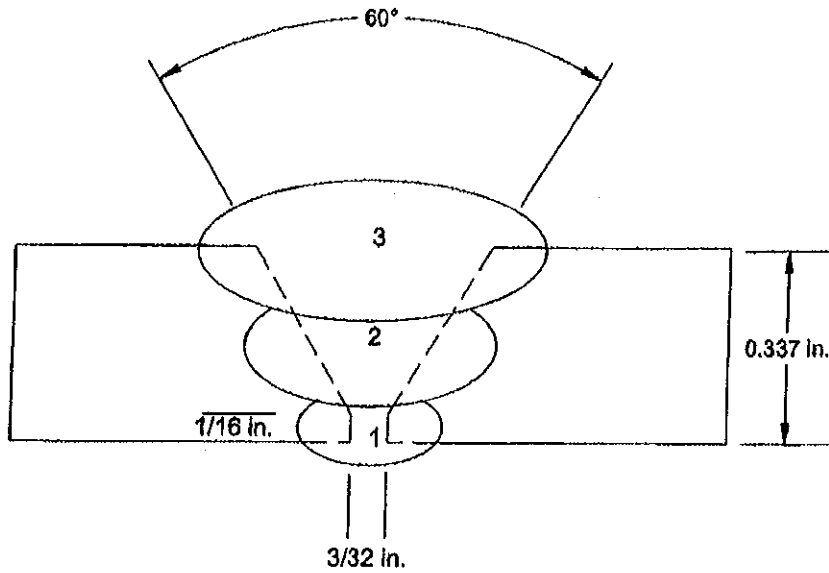
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
Amps See next page Volts See next page
Mode of Metal Transfer GMAW - STT: Short circuiting arc
Mode of Metal Transfer GMAW: Pulsating Arc

TECHNIQUE (QW-410)

String or Weave GMAW - STT: Weave GMAW: Weave
Travel Speed See next page
Multiple or Single Pass Per Side GMAW - STT: Single GMAW: Multiple
Multiple or Single Electrodes Single

PQR NO. 3-8-168



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (i.p.m.)
1	GMAW	ER308LSi	1.1 (0.045)	DCRP	95 - 100	16 - 18	167 (6.6)
2	GMAW	ER308LSi	1.1 (0.045)	DCRP	85 - 90	23 - 26	79 (3.1)
3	GMAW	ER308LSi	1.1 (0.045)	DCRP	80 - 85	23 - 26	56 (2.2)

PQR NO. 3-8-168**TENSILE TEST (QW-150)**

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbs.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	18.7	7.15	134	72 800	544	Partial Cup & Cone
	(0.736)	(0.281)	(0.207)	(16,400)	(79,000)	Parent Metal
T2	18.9	6.69	126	68 000	538	Partial Cup & Cone
	(0.744)	(0.263)	(0.196)	(15,300)	(78,000)	Parent Metal

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.3a, TRB - R1	Pass	QW-462.3a, TFB - F1	Pass
QW-462.3a, TRB - R2	Pass	QW-462.3a, TFB - F2	Pass

OTHER TESTSVickers Hardness - see attached laboratory test report

Welders Name Dwayne Huber Certificate File No. W-17511
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E03-1087.1

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

Manufacturer G.L.M. INDUSTRIES L.P.

Date Oct 5/06 Signed 



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E03-1087.1
Date: December 11, 2003

Attention: Wilber Davie

PQR No.: 3-8-168
Material: SA 312 Type 304L
Size: 114.3 mm (4.50 in.) O.D. x 8.56 mm (0.337 in.) w.t.
Thermal Condition: As Welded

TENSILE TEST QW-150

SAMPLE NUMBER	T1	QW-462.1(b)	T2	QW-462.1(b)
WIDTH mm (in.)	18.7	(0.736)	18.9	(0.744)
THICKNESS mm (in.)	7.15	(0.281)	6.69	(0.263)
AREA sq. mm (sq. in.)	134	(0.207)	126	(0.196)
ULTIMATE LOAD N (lbs)	72 800	(16,400)	68 000	(15,300)
UTS MPa (psi)	544	(79,000)	538	(78,000)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal		Parent Metal	

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	19.1 mm (0.750 in.)	SAMPLE THICKNESS:	8.56 mm (0.337 in.)
PLUNGER SIZE:	31.8 mm (1.25 in.)	YOKE SIZE:	54.5 mm (2.15 in.)
QW-462.3 (a)	Face Bend	Root Bend	Face Bend
SAMPLE NUMBER(S)	F1	R1	F2
RESULTS	Pass	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 ASME Section IX, 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: _____

Natashua Collier, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

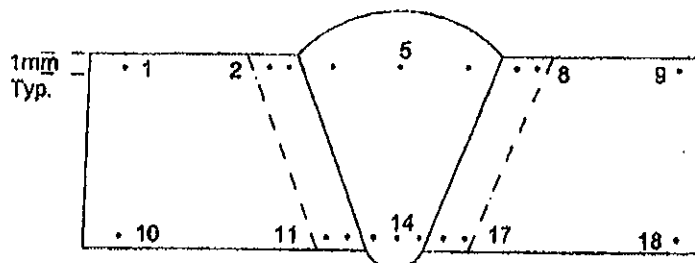
Laboratory Test No.: E03-1087.1
Date: December 11, 2003

Attention: Wilber Davie

PQR No.: 3-8-168
Material: SA 312 Type 304L
Size: 114.3 mm (4.50 in.) O.D. x 8.56 mm (0.337 in.) w.t.
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Vickers
LOAD: 500g
INSTRUMENT TYPE: Leco V-100-C1



1) 189 HV	6) 202 HV	11) 212 HV	16) 210 HV
2) 173 HV	7) 208 HV	12) 194 HV	17) 203 HV
3) 196 HV	8) 203 HV	13) 215 HV	18) 174 HV
4) 192 HV	9) 187 HV	14) 202 HV	
5) 213 HV	10) 204 HV	15) 207 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 E384 - 99. 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: _____

Natashua Collier, C.E.T.

WELDING PROCEDURE SPECIFICATION NO.: 31-1-066A (Rev.4)

WELDING PROCEDURE QUALIFICATION RECORD NO.(S): 31-1-066-1, 31-1-66-2,
31-1-066-3

QUALIFIED FOR

Base Metal (Typical): P1 Groups 1 & 2 to P1 Groups 1 & 2
(SA 333 Gr.6, SA 350 Gr.LF2, SA 420 WPL6, SA 516 Gr.70, etc.)
Process(es): GMAW / SMAW Weld Types: GROOVE & FILLET
Position: ALL POSITIONS Diameter: ALL DIAMETERS
Filler Metal: ER70S-6, E7018-1

BASE METAL CONDITIONS & GROOVE THICKNESS RANGE QUALIFIED:

NOTCH TOUGHNESS APPLICATIONS TO -46°C AS WELDED

BASE METAL THICKNESS RANGE 3.2 to 25.4 mm (0.125 to 1.0 in.) inclusive

COMBINED DEPOSITED WELD METAL THICKNESS

ASME B31.1	<u>19.1 mm (0.750 in.) maximum</u>
ASME B31.3	<u>19.1 mm (0.750 in.) maximum</u>
ASME SECTION VIII, DIVISION 1	<u>23.1 mm (0.910 in.) maximum</u>

ABSA	
SAFETY CODES ACT - PROVINCE OF ALBERTA	
WELDING PROCEDURE	
Reg. No. WP	<u>863.2</u>
Spec. No.	<u>31-1-066A (REV 4)</u>
Weld Process	<u>GMAW / SMAW</u>
Mall. Gr. P No.	<u>1 Gr 1 & 2</u> to P No. <u>1 Gr 1 & 2</u>
Elec. Gr. F No.	<u>6 + 4</u> AND <u>* + 1</u>
Th. Qual. For	<u>3.2 to 25.4 mm P.W.H.T.</u> <u>NO</u>
<u>CVN-46°C</u>	
<u>* ER 70S-6</u>	
Yr. <u>05</u> Mo. <u>07</u> Day <u>28</u> Signed	<u>R. ROSEBERG, PENG</u>
	WELDING SPECIALIST

PROVINCIAL REGISTRATION

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QW-482 WELDING PROCEDURE SPECIFICATION (WPS)

Company Name G.L.M. INDUSTRIES L.P.
Welding Procedure Specification No. 31-1066A (Rev. 4) Date July 7, 2008
Revision(s) Rev.4: Essential - addition of PQR# 31-1-066-3,
WPS No. formerly 31-066A (Rev.3)
Supporting PQR No.(s) 31-1-066-1, 31-1-066-2, 31-1-066-3
Welding Process(es) GMAW / SMAW Type(s) Semi-automatic / Manual

JOINTS (QW-402)

Joint Design All ASME groove & fillet, reference construction drawing for joint details.
Where joint details are not specified, refer to figures 1 to 15 attached
Root Opening As per attached typical groove designs, see figures 1 to 15 attached
Backing With or without Retainers Not required

BASE METALS (QW-403)

P-Number P1 Groups 1 & 2 To P-Number P1 Groups 1 & 2
Thickness Range: Groove See cover page for thickness qualified by governing code
Fillet All base metal thicknesses
Pipe Diameter Ranges: Groove All diameters
Fillet All diameters
Deposited Weld Metal (Per Pass) 12.7mm (0.50 in) maximum

FILLER METALS (QW-404)

	GMAW	SMAW
Specification No. (SFA)	<u>SFA 5.18</u>	<u>SFA 5.1</u>
AWS No. (Class)	<u>ER70S-6</u>	<u>E7018-1</u>
F-No.	<u>F6</u>	<u>F4</u>
A-No.	<u>*</u>	<u>A1</u>
Size	<u>0.030 to 0.045 in. Inclusive</u>	<u>3/32 to 1/4 in. inclusive</u>
Filler Metal Product Form	<u>Solid wire</u>	<u>N/A</u>
Supplemental Filler Metal	<u>Without</u>	<u>N/A</u>
Deposited Weld Metal Thickness Range:		
Groove	<u>2.8 mm (0.110 in.) max.**</u>	<u>20.3 mm (0.80 in.) max.**</u>
Fillet	<u>All fillet sizes</u>	<u>All fillet sizes</u>

Other *Chemical composition shall meet the requirements of ASME Section II, Part C
SFA 5.18 for ER70S-6
** Combined deposited weld metal thickness shall not exceed 19.1 mm (0.750 in.)
for ASME B31.1 & B31.3 and 23.1 mm (0.910 in.) for ASME Section VIII, Div.1

POSITION (QW-405)

Position of Groove Flat & Horizontal Position of Fillet Flat & Horizontal
Weld Progression N / A

PREHEAT (QW-406)

Preheat Temperature (Minimum) 10 °C (50°F)
Interpass Temperature (Maximum) 260°C (500°F)
Preheat Maintenance 10 °C (50°F) prior to welding. Preheat maintenance is not required if
welding is interrupted or after the completion of welding unless required
by the code of construction.

WPS NO. 31-1066A (Rev. 4)

POST WELD HEAT TREATMENT (QW-407)

Temperature Range N/A Time Range N/A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-AC-25
 Shielding 75% Argon, 25% CO₂, 10 - 25 liters per minute (20 - 50 ft³/hr)
 Backing Not Required Trailing Not Required

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
 Amps See Table #1 Volts See Table #1
 Mode of Metal Transfer GMAW: Short circuiting arc
 Maximum Heat Input

Base Metal Thickness Range	GMAW	SMAW
0.125 - 0.499 in.	21,700 J/in.	40,650 J/in.
0.50 - 1.0 in.	27,440 J/in.	46,190 J/in.

TECHNIQUE (QW-410)

String or Weave Either Travel Speed See Table #1
 Orifice or Gas Cup Size 9.52 mm (0.375 in.) to 19.1 mm (0.750 in.)
 Initial & Interpass Cleaning Brushing, chipping or grinding as required
 Method of Back Gouging Air carbon arc, back-grind as required
 Contact Tube to Work Distance 6.35 mm (0.250 in.) to 19.1 mm (0.750 in.)
 Multiple or Single Pass Per Side GMAW: Single, root pass only SMAW: Multiple
 Multiple or Single Electrodes Single
 Peening Not permitted
 Use of Thermal Process N/A

TABLE 1 - WELDING PARAMETERS

Process	Filler Metal	Diameter mm (in.)	Current Type & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (i.p.m.)
GMAW	ER70S-6	0.8 (0.030)	DCRP	70 - 130	14 - 20	54 - 250 (2.1 - 10)
GMAW	ER70S-6	0.9 (0.035)	DCRP	80 - 180	15 - 22	67 - 600 (2.6 - 25)
GMAW	ER70S-6	1.1 (0.045)	DCRP	100 - 225	16 - 23	89 - 900 (3.5 - 35)
SMAW	E7018-1	2.4 (3/32)	DCRP	60 - 110	18 - 24	36 - 300 (1.4 - 12)
SMAW	E7018-1	3.2 (1/8)	DCRP	90 - 160	18 - 26	53 - 350 (2.1 - 14)
SMAW	E7018-1	4.0 (5/32)	DCRP	110 - 220	19 - 28	69 - 400 (2.7 - 16)
SMAW	E7018-1	5.0 (3/16)	DCRP	160 - 300	20 - 30	106 - 500 (4.2 - 20)
SMAW	E7018-1	5.5 (7/32)	DCRP	240 - 340	20 - 32	158 - 550 (6.2 - 22)
SMAW	E7018-1	6.4 (1/4)	DCRP	275 - 360	21 - 32	191 - 550 (7.5 - 22)

Note: Welding parameters shall be adjusted to insure that the maximum heat input value specified in QW-409 above is not exceeded.
 Heat Input (joules per inch) = (Amperage X Voltage X 60) / Travel Speed (Inches per minute)

TYPICAL JOINT DESIGNS

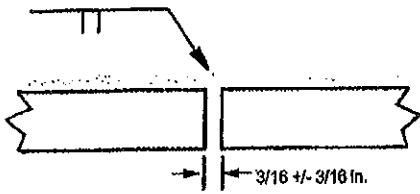


Figure 1
Single Square Butt

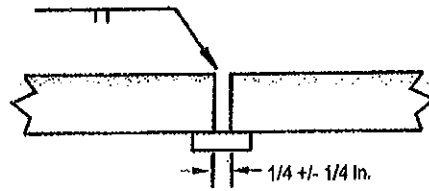


Figure 2
Single Square Butt with Backing Strip

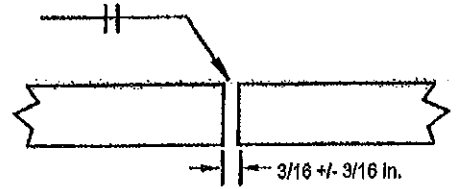


Figure 3
Double Square Butt

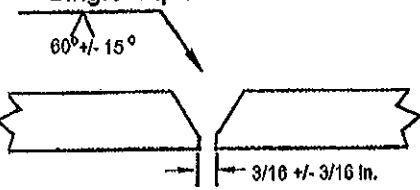


Figure 4
Single Vee Butt

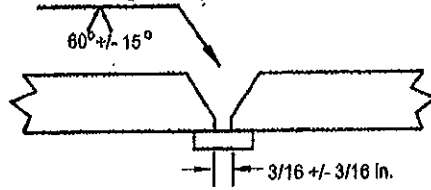


Figure 5
Single Vee Butt with Backing Strip

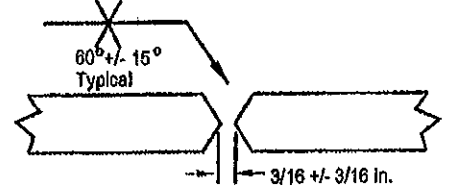


Figure 6
Double Vee Butt

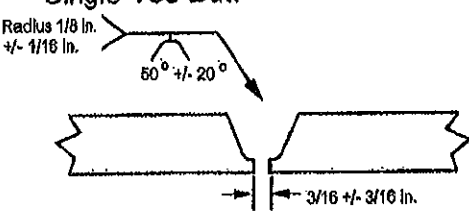


Figure 7
Single U Butt

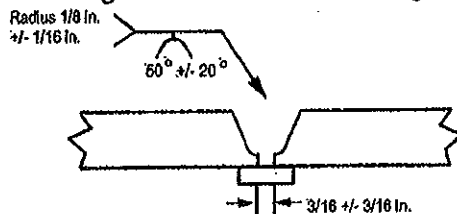


Figure 8
Single U Butt with Backing Strip

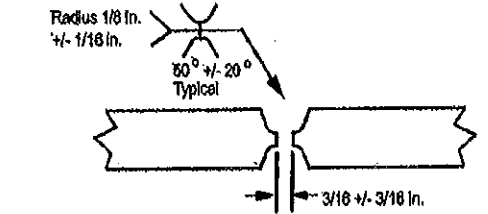


Figure 9
Double U Butt

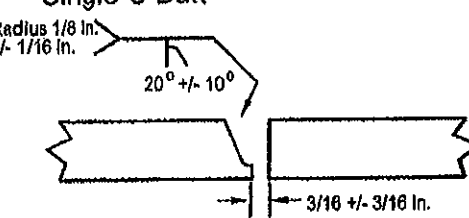


Figure 10
Single J Butt

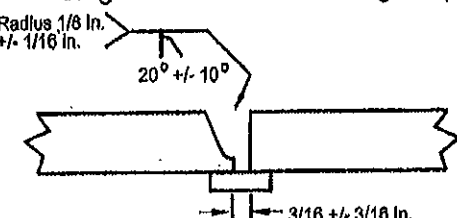


Figure 11
Single J Butt with Backing Strip

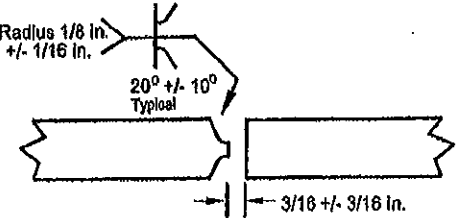


Figure 12
Double J Butt

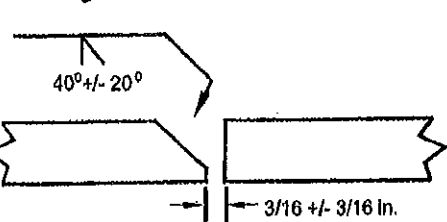


Figure 13
Single Bevel Butt

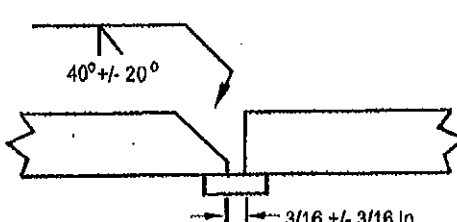


Figure 14
Single Bevel Butt with Backing Strip

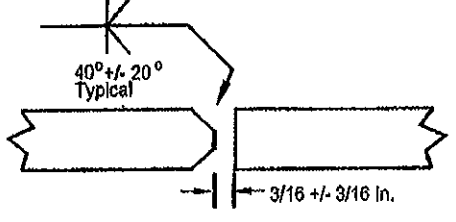


Figure 15
Double Bevel Butt

Or as per the joint design on the approved construction drawing.

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

Company Name G.I.M. INDUSTRIES L.P.
Procedure Qualification Record No. 31-1-066-1 Date May 3, 1993
Welding Procedure Specification No. 31-1-066A (Rev.4)
PQR Revision Format update, WPS No. formerly 31-1-066A (Rev.3), July 7, 2008
Welding Process(es) GMAW / SMAW Type(s) Semi-automatic / Manual

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 333 to SA 516 Type or Grade Gr. 6 to Gr. 70
P-No. P1 Grp.1 To P-No. P1 Grp.2 Thickness 6.32 mm (0.249 in.)

FILLER METALS (QW-404)

	GMAW	SMAW
Specification No. (SFA)	<u>SFA 5.18</u>	<u>SFA 5.1</u>
AWS No. (Class)	<u>ER70S-6</u>	<u>E7018-1</u>
Filler Metal F-No.	<u>F6</u>	<u>F4</u>
Filler Metal A-No.	<u>*</u>	<u>A1</u>
Filler Metal Product Form	<u>Solid wire</u>	<u>N / A</u>
Supplemental Filler Metal	<u>Without</u>	<u>N / A</u>
Size of Electrode	<u>See attached sketch</u>	
Deposited Weld Metal Thickness	<u>2.54 mm (0.10 in.)</u>	<u>3.78 mm (0.149 in.)</u>
Other	<u>* Chemical composition meets the requirements of ASME Section II, Part C</u>	
	<u>SFA 5.18 for ER70S-6</u>	

POSITION (QW-405)

Position of Groove 1G
Weld Progression N / A

PREHEAT (QW-406)

Preheat Temperature 21°C (70°F) Interpass Temp. (Max.) 204°C (400°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N / A Time N / A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-AC-25
Shielding 75% Argon, 25% CO₂, 10 liters per minute (20 ft³/hr)
Backing Without Trailing Without

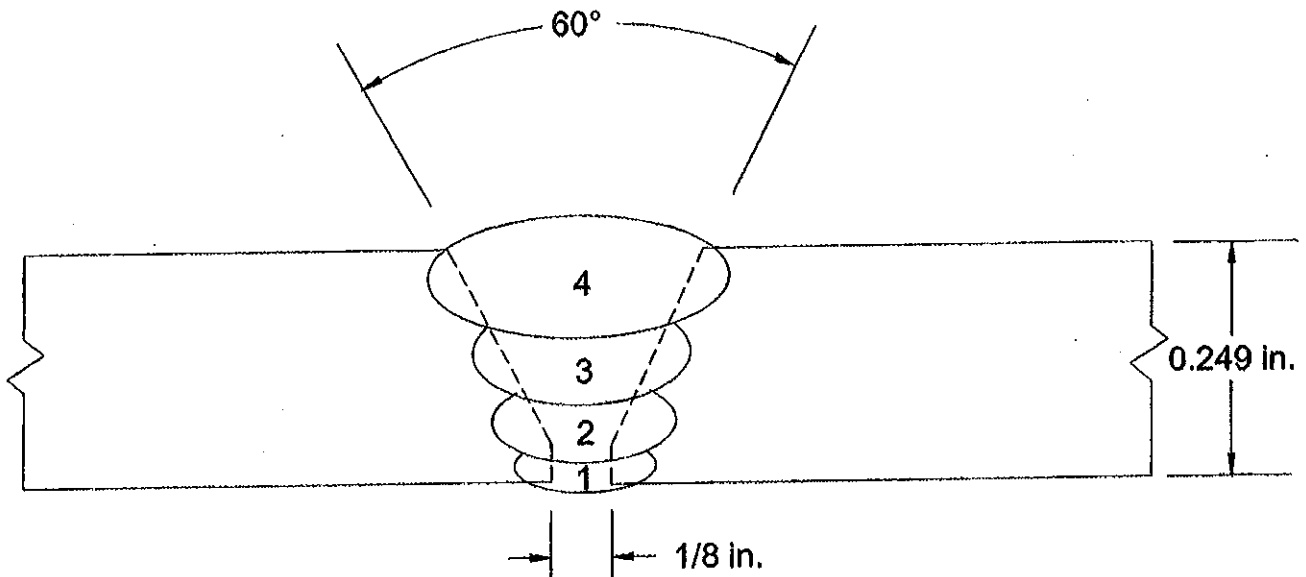
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
Amps See next page Volts See next page
Heat Input F6: 21,700 J/in. maximum F4: 40,650 J/in. maximum
Mode of Metal Transfer Short circuiting arc

TECHNIQUE (QW-410)

String or Weave Weave Travel Speed See next page
Multiple or Single Pass Per Side GMAW: Single SMAW: Multiple
Multiple or Single Electrodes Single

PQR NO. 31-1-066-1



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (l.p.m.)
1	GMAW	ER70S-6	0.9 (0.035)	DCRP	70 - 85	15 - 17	93 (3.7)
2	SMAW	E7018-1	3.2 (1/8)	DCRP	116 - 126	21 - 23	107 (4.5)
3 & 4	SMAW	E7018-1	4.0 (5/32)	DCRP	175 - 185	22 - 24	150 - 208 (6.0 - 8.2)

PQR NO. 31-1-066-1

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -46° C (-50° F) Specimen Size 10 X 6 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)
B2.1	Weld Metal	34.6 (25.5)
B2.2	Weld Metal	42.0 (31.0)
B2.3	Weld Metal	59.6 (44.0)
B3.1	P1 Grp.1 - HAZ	75.2 (55.5)
B3.2	P1 Grp.1 - HAZ	98.9 (73.0)
B3.3	P1 Grp.1 - HAZ	55.6 (41.0)
B4.1	P1 Grp.2 - HAZ	23.7 (17.5)
B4.2	P1 Grp.2 - HAZ	12.2 (9.0)
B4.3	P1 Grp.2 - HAZ	33.9 (25.0)

OTHER TESTS

Welders Name Brad Ludwig Certificate File No. N/A
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E93-146.2

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

Manufacturer G.L.M. INDUSTRIES L.P.

Date July 14/2008 Signed [Signature]



LUDWIG & ASSOCIATES LTD.

Welding Consulting and Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM TANKS & EQUIPMENT LTD.
PO Box 24
Nisku, AB
T0C 2G0

Laboratory Test No.: E93-146.2
Date: May 4, 1993

Attention: Mr. Wiber Davie

Material: SA 333 Gr. 6 to SA 516-70
Thickness: 6.35 mm (0.249 in.)
Thermal Condition: As Welded.

PQR No.: 31-1-066-1
Size: 323.9 mm (12.75 in.)
Process: GMAW/SMAW

TOUGHNESS TEST

Type of Test Charpy V-Notch
Orientation Transverse

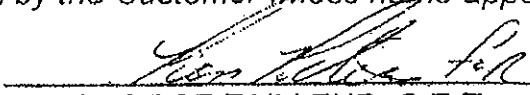
Test Temperature -46°C (-50°F)
Specimen Size 10mm x 6mm

SPECIMEN NO.	NOTCH LOCATION	IMPACT VALUES J (ft. lbs.)	SHEAR %
B2.1	Weld	34.6 (25.5)	19
B2.2	Weld	42.0 (31.0)	26
B2.3	Weld	59.6 (44.0)	38
B3.1	Grp.1 HAZ	75.2 (55.5)	54
B3.2	Grp.1 HAZ	98.9 (73.0)	88
B3.3	Grp.1 HAZ	55.6 (41.0)	48
B4.1	Grp.2 HAZ	23.7 (17.5)	17
B4.2	Grp.2 HAZ	12.2 (9.0)	8
B4.3	Grp.2 HAZ	33.9 (25.0)	22

Hammer Velocity at Impact 5.18 m/sec.
Energy at Impact 406.7 Joules (300 ft. lb.)

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 - 1992 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


GEORGE TAILLEUR, C.E.T.

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

Company Name G.L.M. INDUSTRIES L.P.
Procedure Qualification Record No. 31-1-066-2 Date December 11, 1994
Welding Procedure Specification No. 31-1-066A (Rev.4)
PQR Revision Format update, WPS No. formerly 31-1-066A (Rev.3), July 7, 2008
Welding Process(es) GMAW / SMAW Type(s) Semi-automatic / Manual

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 516 to SA 516 Type or Grade Gr. 70
P-No. P1 To P-No. P1 Thickness 9.52 mm (0.375 in.)

FILLER METALS (QW-404)

	GMAW	SMAW
Specification No. (SFA)	<u>SFA 5.18</u>	<u>SFA 5.1</u>
AWS No. (Class)	<u>ER70S-6</u>	<u>E7018-1</u>
Filler Metal F-No.	<u>F6</u>	<u>F4</u>
Filler Metal A-No.	<u>*</u>	<u>A1</u>
Filler Metal Product Form	<u>Solid wire</u>	<u>N / A</u>
Supplemental Filler Metal	<u>Without</u>	<u>N / A</u>
Size of Electrode	<u>See attached sketch</u>	
Deposited Weld Metal Thickness	<u>2.54 mm (0.10 in.)</u>	<u>6.98 mm (0.275 in.)</u>
Other	<u>* Chemical composition meets the requirements of ASME Section II, Part C</u>	
	<u>SFA 5.18 for ER70S-6</u>	

POSITION (QW-405)

Position of Groove 1G
Weld Progression N / A

PREHEAT (QW-406)

Preheat Temperature 21°C (70°F) Interpass Temp. (Max.) 204°C (400°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N / A Time N / A

GAS (QW-408)

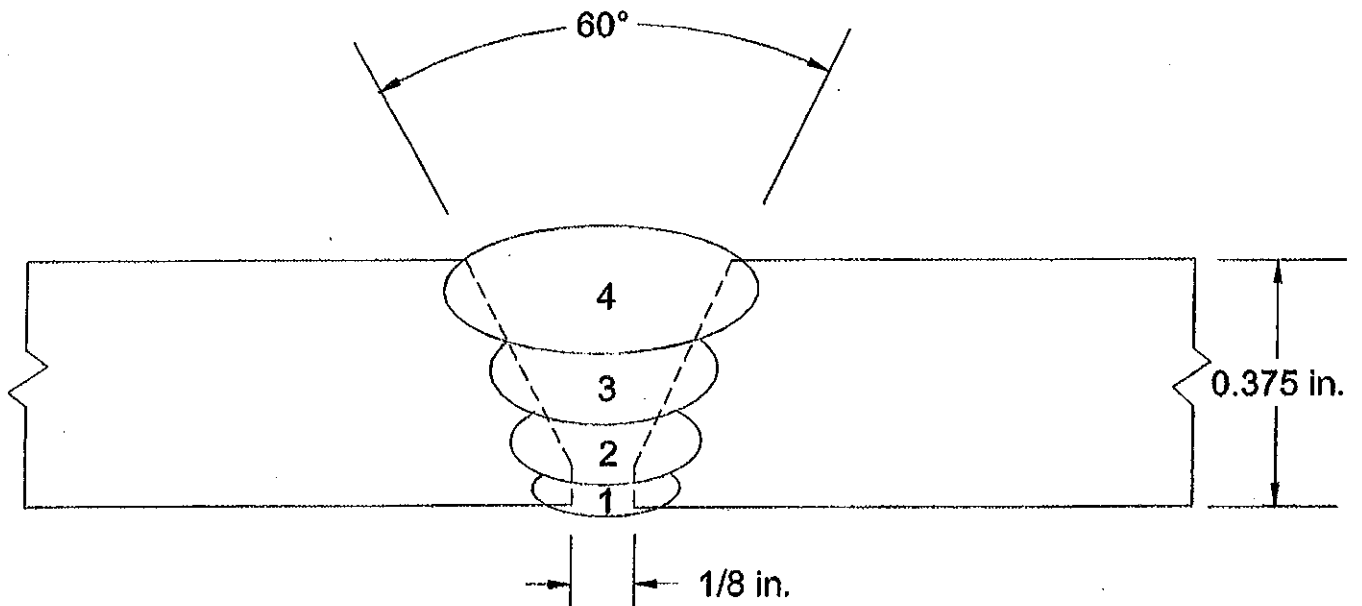
Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-AC-25
Shielding 75% Argon, 25% CO₂, 10 liters per minute (20 ft³/hr)
Backing Without Trailing Without

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
Amps See next page Volts See next page
Mode of Metal Transfer Short circuiting arc

TECHNIQUE (QW-410)

String or Weave Weave Travel Speed See next page
Multiple or Single Pass Per Side GMAW: Single SMAW: Multiple
Multiple or Single Electrodes Single



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (l.p.m.)
1	GMAW	ER70S-6	0.9 (0.035)	DCRP	70 - 85	15 - 17	90 (3.5)
2	SMAW	E7018-1	3.2 (1/8)	DCRP	115 - 125	21 - 23	100 (4.0)
3 & 4	SMAW	E7018-1	5.0 (3/16)	DCRP	210 - 225	22 - 24	125 - 190 (5.0 - 7.5)

TENSILE TEST (QW-150)

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbs.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	18.9 (0.744)	8.43 (0.332)	159 (0.247)	76,900 (17,300)	483 (69,990)	Partial Cup & Cone Parent Metal
T2	19.0 (0.748)	8.37 (0.330)	159 (0.247)	76,600 (17,240)	482 (69,840)	Partial Cup & Cone Parent Metal

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.2, TSB - S1	Pass	QW-462.2, TSB - S3	Pass
QW-462.2, TSB - S2	Pass	QW-462.2, TSB - S4	Pass

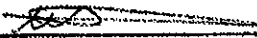
OTHER TESTS

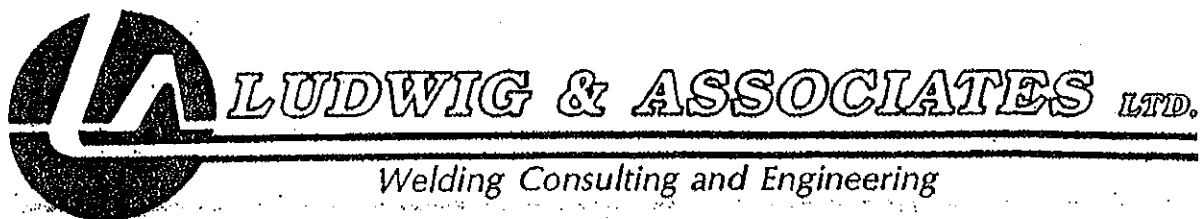
Vickers Hardness - see attached laboratory test report

Welders Name Brad Ludwig Certificate File No. N/A
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E94-490.1

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

Manufacturer G.L.M. INDUSTRIES L.P.

Date July 14/2003 Signed 



LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
P.O. Box 24
Nisku, AB
T0C 2G0

Laboratory Test No.: E94-490
Date: December 13, 1994

Attention: Wilber Davie

Material: SA 516 Gr.70
Process: GMAW / SMAW
Thermal Condition: As Welded

PQR No.: 31-1-066-2
Thickness: 9.53mm (0.375 in.)

TENSILE TEST (QW-150)

SAMPLE NUMBER	T1	T2
WIDTH mm (in)	18.9 (0.744)	19.0 (0.748)
THICKNESS mm (in)	8.43 (0.332)	8.37 (0.330)
AREA sq mm (sq in)	159 (0.247)	159 (0.247)
ULT. LOAD N (lbs)	76 900 (17,300)	76 600 (17,240)
UTS MPa (psi)	483 (69,990)	482 (69,840)
FRACTURE TYPE	Partial Cup & Cone	Partial Cup & Cone
FRACTURE LOCATION	Parent Metal	Parent Metal

GUIDED-BEND TEST (QW-160)

SAMPLE WIDTH	9.53 mm (0.375 in.)		
SAMPLE THICKNESS	9.53 mm (0.375 in.)		
PLUNGER SIZE	38.1 mm (1.50 in.)		
YOKE SIZE	60.3 mm (2.375 in.)		
SAMPLE TYPE	Side Bend	Side Bend	Side Bend
SAMPLE NUMBER(S)	S1	S2	S3
RESULTS	Pass	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 ASME Section IX, 1992 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

Kelly Frey, C.E.T.

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
P.O. Box 24
Nisku, AB T0C 2G0

Laboratory Test No.: E94-49
Date: December 12, 1994

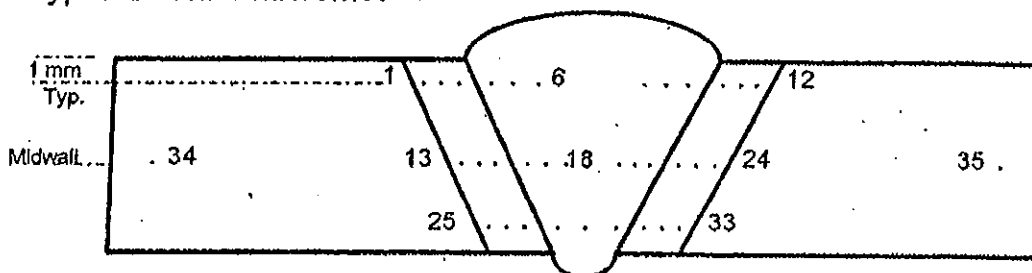
Attention: Wilber Davie

Material: SA 516 Gr.70
Process: GMAW / SMAW
Thermal Condition: As Welded

PQR No.: 31-1-066-2
Thickness: 9.53mm (0.375 in.)

HARDNESS TEST

Test Method: Vickers
Load: 500 g.
Machine Type: Buehler Micromet



1) 173 HV	10) 199 HV	19) 181 HV	28) 169 HV
2) 170 HV	11) 191 HV	20) 174 HV	29) 174 HV
3) 186 HV	12) 182 HV	21) 173 HV	30) 169 HV
4) 180 HV	13) 178 HV	22) 191 HV	31) 182 HV
5) 196 HV	14) 168 HV	23) 192 HV	32) 181 HV
6) 191 HV	15) 177 HV	24) 189 HV	33) 177 HV
7) 181 HV	16) 181 HV	25) 158 HV	34) 174 HV
8) 187 HV	17) 187 HV	26) 173 HV	35) 183 HV
9) 190 HV	18) 182 HV	27) 159 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 E384-1993 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

Kelly Frey
Kelly Frey, C.E.T.

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

Company Name G.L.M. INDUSTRIES L.P.
Procedure Qualification Record No. 31-1-066-3 Date June 9, 2008
Welding Procedure Specification No. 31-1-066A (Rev. 4)
Welding Process(es) GMAW / SMAW Type(s) Semi-automatic / Manual

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 516 to SA 516 Type or Grade Gr. 60 to Gr. 70
P-No. P1 Grp.1 To P-No. P1 Grp.2 Thickness 12.7 mm (0.50 in.)
Heat Number 288533-99787 Carbon Equivalent 0.39
Diameter N/A Other Plate Product Form

FILLER METALS (QW-404)

	GMAW	SMAW
Specification No. (SFA)	<u>SFA 5.18</u>	<u>SFA 5.1</u>
AWS No. (Class)	<u>ER70S-6</u>	<u>E7018-1</u>
Filler Metal F-No.	<u>F6</u>	<u>F4</u>
Filler Metal A-No.	<u>*</u>	<u>A1</u>
Filler Metal Product Form	<u>Solid wire</u>	<u>N/A</u>
Supplemental Filler Metal	<u>Without</u>	<u>N/A</u>
Size of Electrode	<u>See attached sketch</u>	
Deposited Weld Metal Thickness	<u>25.4 mm (0.10 in.)</u>	<u>10.2 mm (0.40 in.)</u>
Other	<u>* Chemical composition meets the requirements of ASME Section II, Part C</u> <u>SFA 5.18 for ER70S-6</u>	

POSITION (QW-405)

Position of Groove 3G
Weld Progression GMAW: Vertical down SMAW: Vertical Up

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 260°C (500°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A Time N/A

GAS (QW-408)

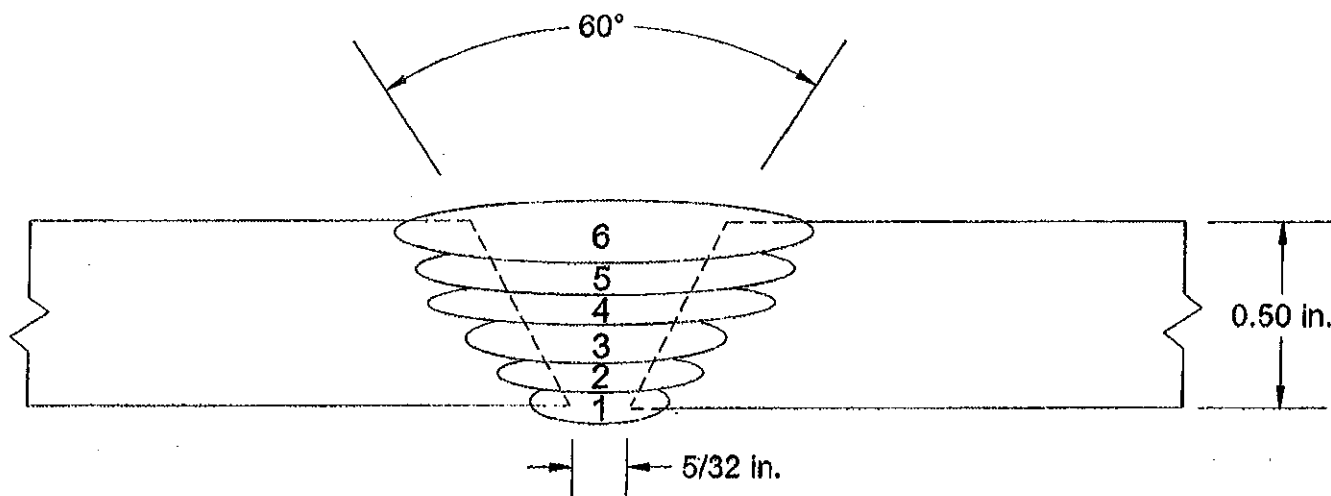
Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-AC-25
Shielding 75% Argon, 25% CO₂, 13 liters per minute (28 ft³/hr)
Backing Without Trailing Without

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
Amps See next page Volts See next page
Heat Input F6: 27,440 J/in. maximum F4: 46,190 J/in. maximum
Mode of Metal Transfer Short circuiting arc

TECHNIQUE (QW-410)

String or Weave Weave Travel Speed See next page
Multiple or Single Pass Per Side GMAW: Single SMAW: Multiple
Multiple or Single Electrodes Single



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (l.p.m.)
1	GMAW	ER70S-6	1.1 (0.045)	DCRP	167-169	17-18	163 (6.4)
2	SMAW	E7018-1	2.4 (3/32)	DCRP	98-100	22-23	133 (5.3)
3	SMAW	E7018-1	2.4 (3/32)	DCRP	103-104	22-23	129 (5.1)
4	SMAW	E7018-1	2.4 (3/32)	DCRP	103-104	22-23	77 (3.0)
5	SMAW	E7018-1	2.4 (3/32)	DCRP	102-103	22-23	120 (4.7)
6	SMAW	E7018-1	2.4 (3/32)	DCRP	97-98	22-23	89 (3.5)

TENSILE TEST (QW-150)

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbs.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	19.0 (0.748)	11.3 (0.445)	215 (0.333)	112 020 (25,200)	522 (75,700)	Partial Cup & Cone Parent Metal (SA 516 Gr. 60)
T2	19.1 (0.752)	11.5 (0.453)	220 (0.340)	113 618 (25,500)	529 (76,800)	Partial Cup & Cone Parent Metal (SA 516 Gr. 70)

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.2, TSB - S1	Pass	QW-462.2, TSB - S3	Pass
QW-462.2, TSB - S2	Pass	QW-462.2, TSB - S4	Pass

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -46° C (-50° F) Specimen Size 10 X 10 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)
B2.1	Weld Metal	131 (96.4)
B2.2	Weld Metal	>163 (>120)
B2.3	Weld Metal	118 (86.8)
B3.1	P1 Grp.1 - HAZ	>163 (>120)
B3.2	P1 Grp.1 - HAZ	145 (107)
B3.3	P1 Grp.1 - HAZ	114 (84.4)
B4.1	P1 Grp.2 - HAZ	>163 (>120)
B4.2	P1 Grp.2 - HAZ	122 (89.8)
B4.3	P1 Grp.2 - HAZ	113 (83.0)

OTHER TESTS

Vickers Hardness - see attached laboratory test report

Welders Name John Langoz Certificate File No. W-23997
 Tests Conducted By Ludwig Associates Ltd.
 Laboratory Test No. E08-522.1

We certify 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 G.L.M INDUSTRIES L.P.

Date July 14/2009 Signed [Signature]



LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

Customer: G.L.M. Industries L.P.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E08-522.1
Date: June 19, 2008

Attention: Wilber Davie

PQR No.:	31-1-066-3	Heat No.:	288533-99787
Material:	SA 516 Gr. 60 to SA 516 Gr. 70		
Thickness:	12.7 mm (0.500 in.)		
Thermal Condition:	As Welded		

TENSILE TEST QW-150

SAMPLE NUMBER	T1	QW-462.1(a)	T2	QW-462.1(a)
WIDTH mm (in.)	19.0	(0.748)	19.1	(0.752)
THICKNESS mm (in.)	11.3	(0.445)	11.5	(0.453)
AREA sq. mm (sq. in.)	215	(0.333)	220	(0.340)
ULTIMATE LOAD N (lbs)	112 020	(25,200)	113 618	(25,500)
UTS MPa (psi)	522	(75,700)	529	(76,800)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal (SA 516 Gr. 60)		Parent Metal (SA 516 Gr. 70)	

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	9.52 mm (0.375 in.)	SAMPLE THICKNESS:	12.7 mm (0.500 in.)
PLUNGER SIZE:	38.1 mm (1.50 in.)	YOKE SIZE:	60.3 mm (2.375 in.)
QW-462.2	Side Bend	Side Bend	Side Bend
SAMPLE NUMBER(S)	S1	S2	S3
RESULTS	Pass	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 ASME Section IX, 2007 edition and latest addenda. Material information has been provided by the Customer whose name appears on this report.

Samples associated with this report will be discarded in 30 days.

Laboratory Test Conducted By: _____

Eric Dacyk, T.T. / Karen Koens, R.E.T.



LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

Customer: G.L.M. Industries L.P.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E08-522.1
Date: June 19, 2008

Attention: Wilber Davle

PQR No.: 31-1-066-3
Material: SA 516 Gr. 60 to SA 516 Gr. 70
Thickness: 12.7 mm (0.500 in.)
Thermal Condition: As Welded

Heat No.: 288533-99787

NOTCH-TOUGHNESS TEST

TYPE OF TEST: Charpy V-Notch
TEST TEMPERATURE: -46°C (-50°F)

ORIENTATION: Transverse
SPECIMEN SIZE: 10 x 10 mm

Specimen Number	Notch Location	Impact Values	
		Joules	(ft. lbs)
B2.1	Weld Metal within 1/16" of root	131	(96.4)
B2.2	Weld Metal within 1/16" of root	>163	(>120)
B2.3	Weld Metal within 1/16" of root	118	(86.8)
B3.1	Gr. 60 HAZ	>163	(>120)
B3.2	Gr. 60 HAZ	145	(107)
B3.3	Gr. 60 HAZ	114	(84.4)
B4.1	Gr. 70 HAZ	>163	(>120)
B4.2	Gr. 70 HAZ	122	(89.8)
B4.3	Gr. 70 HAZ	113	(83.0)

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 - 2007 edition and latest addenda. Material information has been provided by the Customer whose name appears on this report.

Samples associated with this report will be discarded in 30 days.

Laboratory Test Conducted By: _____

Eric Dacyk, T.T. / Karen Koens, R.E.T.



LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

Customer: G.L.M. Industries L.P.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E08-522.1
Date: July 4, 2008

Attention: Wilber Davle

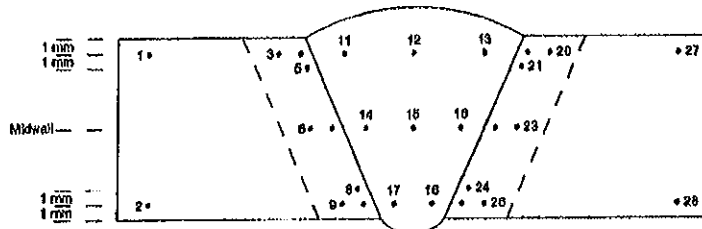
PQR No.: 31-1-066-3
Material: SA 516 Gr. 60 to SA 516 Gr. 70
Thickness: 12.7 mm (0.500 in.)
Thermal Condition: As Welded

Heat No.: 288533-99787

HARDNESS TEST

Type of Test: Vickers 10kg (HV10)

Instrument: Leco V-100-C1



Parent Metal		HAZ		Weld Metal		HAZ		Parent Metal	
1	149	3	169	11	196	19	203	27	152
2	156	4	197	12	187	20	180	28	156
		5	200	13	195	21	199		
		6	170	14	181	22	182		
		7	180	15	185	23	172		
		8	175	16	179	24	173		
		9	166	17	165	25	172		
		10	170	18	163	26	170		

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). Material information has been provided by the Customer whose name appears on this report.
Samples associated with this report will be discarded in 30 days

Laboratory Test Conducted By: _____

Eric Dacyk, T.T. / Karen Koens, R.E.T.



WELDING PROCEDURE SPECIFICATION NO.: 41-1-144A (Rev.2)

WELDING PROCEDURE QUALIFICATION RECORD NO.(S): 41-1-134, 41-1-134-2

QUALIFIED FOR

Base Metal (Typical): P1 Groups 1 & 2 to P1 Groups 1 & 2
(SA 333 Gr.6, SA 350 Gr.LF2, SA 420 WPL6, SA 516 Gr.70, etc.)
Process(es): GTAW / SMAW Weld Types: GROOVE & FILLET
Position: ALL POSITIONS Diameter: ALL DIAMETERS
Filler Metal: ER70S-2, E7018-1

BASE METAL CONDITIONS & GROOVE THICKNESS RANGE QUALIFIED:

NOTCH TOUGHNESS APPLICATIONS TO -46°C AS WELDED
BASE METAL THICKNESS RANGE 3.2 to 25.4 mm (0.125 to 1.00 in.) inclusive

COMBINED DEPOSITED WELD METAL THICKNESS

ASME B31.1 19.1 mm (0.750 in.) maximum
ASME B31.3 19.1 mm (0.750 in.) maximum
ASME SECT. VIII, DIV.1 25.4 mm (1.00 in.) maximum

ALBERTA BOILERS SAFETY ASSOCIATION

PROVINCE OF ALBERTA
SAFETY CODES ACT

WELDING PROCEDURE

Reg. No. WP 863.2
Spec No. 41-1-144A (REV 2)
Weld Process GTAW / SMAW
Mall. Gr. P No. 1 Gr. 1+2 to P No. 1 Gr. 1+2
Elec. Gr. F No. 6+4 A No. 1
Th. Qual. For 3.2 to 25.4 mm PWHT NO
CVN -46°C

Yr. 06 Mo. 09 Day 19 Signed [Signature]
R. ROSEBERG, P.ENG.
WELDING SPECIALIST

PROVINCIAL REGISTRATION

QW-482 WELDING PROCEDURE SPECIFICATION (WPS)

G.L.M. Industries L.P.

Welding Procedure Specification No. 41-1-144A (Rev.2) Date September 12, 2006
 Revision Rev. 2 (Nonessential) Corporate name change (formerly GLM Tanks &
 Equipment Ltd.) WPS No. formerly 41-1-144A (Rev.1)
 Supporting PQR No.(s) 41-1-134, 41-1-134-2
 Welding Process(es) GTAW / SMAW Type(s) Manual

JOINTS (QW-402)

Joint Design All ASME groove & fillet, reference construction drawing for joint details.
Where joint details are not specified, refer to figures 1 to 15 attached
 Root Opening As per attached typical groove designs, see figures 1 to 15 attached
 Backing With or without Retainers Not required

BASE METALS (QW-403)

P-Number P1 Groups 1 & 2 To P-Number P1 Groups 1 & 2
 Thickness Range: Groove See cover page for thickness qualified by governing code
 Fillet All base metal thicknesses
 Pipe Diameter Ranges: Groove All diameters
 Fillet All diameters
 Deposited Weld Metal (Per Pass) GTAW: 4.78 mm (0.188 in.) maximum
SMAW: 12.7 mm (0.500 in.) maximum

FILLER METALS (QW-404)

	GTAW	SMAW
Specification No. (SFA)	SFA 5.18	SFA 5.1
AWS No. (Class)	ER70S-2	E7018-1
F-No.	F6	F4
A-No.	A1	A1
Size	1/16 to 5/32 in. inclusive	3/32 to 1/4 in. inclusive
Consumable Inserts	Not required	N/A
Filler Metal Product Form	Solid wire	N/A
Flux	Without the addition of flux	N/A
Deposited Weld Metal Thickness Range:		
Groove	4.78 mm (0.188 in.) max.*	20.6 mm (0.812 in.) max.*
Fillet	All fillet sizes	All fillet sizes
Other	*Combined deposited weld metal thickness shall not exceed 19.1 mm (0.750 in.) for ASME B31.1 & B31.3 and 25.4 mm (1.00 in.) for ASME Section VIII, Div. 1	

POSITION (QW-405)

Position of Groove All positions Position of Fillet All positions
 Weld Progression GTAW: Vertical up or vertical down SMAW: Vertical up

PREHEAT (QW-406)

Preheat Temperature (Minimum) See attached preheat sheet
 Interpass Temperature (Maximum) 260°C (500°F)
 Preheat Maintenance See attached preheat sheet prior to welding. Preheat maintenance is not required if welding is interrupted or after the completion of welding unless required by the code of construction.

WPS NO. 41-1-144A (Rev. 2)

POST WELD HEAT TREATMENT (QW-407)

Temperature Range N/A Time Range N/A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-A
 Shielding 100% Argon, 5 - 20 liters per minute (10 - 40 cfph)
 Backing Not required Trailing Not required

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity GTAW: Straight SMAW: Reverse
 Amps See Table #1 Volts See Table #1
 Maximum Heat Input

Base Metal Thickness Range	GTAW	SMAW
0.125 - 0.499 in.	30,000 J/in.	30,130 J/in.
0.500 - 1.0 in.	52,570 J/in.	69,990 J/in.

Pulsing Current GTAW: With or without
 Tungsten Electrode 1/16 to 5/32 inch diameter
 Tungsten Classification EWTh-1, EWTh-2, EWCe-2, EWLa-1, EWLa-1.5, EWLa-2

TECHNIQUE (QW-410)

String or Weave Either Travel Speed See Table #1
 Orifice or Gas Cup Size 9.52 to 19.1 mm (0.375 to 0.750 in.)
 Initial & Interpass Cleaning Brushing, chipping or grinding as required
 Method of Back Gouging Air carbon arc, back-grind as required
 Oscillation N/A
 Closed or Out of Chamber N/A
 Multiple or Single Pass Per Side GTAW: Either SMAW: Multiple
 Multiple or Single Electrodes Single
 Electrode Spacing N/A
 Peening Not permitted

TABLE 1 - WELDING PARAMETERS

Process	Filler Metal	Diameter mm (in.)	Current Type & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (l.p.m.)
GTAW	ER70S-2	1.6 (1/16)	DCSP	50 - 140	6 - 14	9 - 300 (0.4 - 12)
GTAW	ER70S-2	2.4 (3/32)	DCSP	70 - 200	8 - 18	17 - 350 (0.7 - 14)
GTAW	ER70S-2	3.2 (1/8)	DCSP	100 - 285	9 - 20	27 - 400 (1.1 - 16)
GTAW	ER70S-2	4.0 (5/32)	DCSP	120 - 350	10 - 21	35 - 450 (1.4 - 18)
SMAW	E7018-1	2.4 (3/32)	DCRP	60 - 110	18 - 24	24 - 300 (1.0 - 12)
SMAW	E7018-1	3.2 (1/8)	DCRP	90 - 160	18 - 26	36 - 350 (1.4 - 14)
SMAW	E7018-1	4.0 (5/32)	DCRP	130 - 220	19 - 28	54 - 400 (2.2 - 16)
SMAW	E7018-1	5.0 (3/16)	DCRP	200 - 300	20 - 30	88 - 500 (3.5 - 20)
SMAW	E7018-1	5.5 (7/32)	DCRP	240 - 340	20 - 32	105 - 550 (4.2 - 22)
SMAW	E7018-1	6.4 (1/4)	DCRP	275 - 360	21 - 32	126 - 550 (5.0 - 22)

Note: Welding parameters shall be adjusted to insure that the maximum heat input value specified in QW-409 above is not exceeded.

$$\text{Heat Input (J/in.)} = \frac{\text{Volts} \times \text{Amps} \times 60}{\text{Travel Speed (ipm)}}$$

TYPICAL JOINT DESIGNS

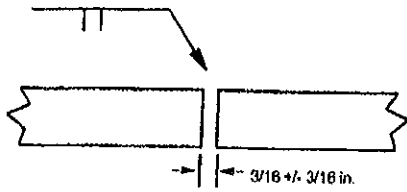


Figure 1
Single Square Butt

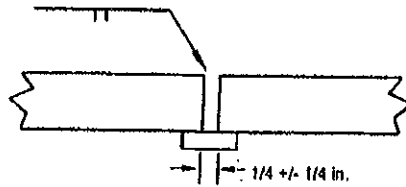


Figure 2
Single Square Butt with Backing Strip

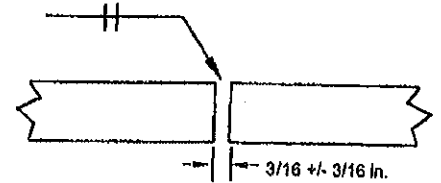


Figure 3
Double Square Butt

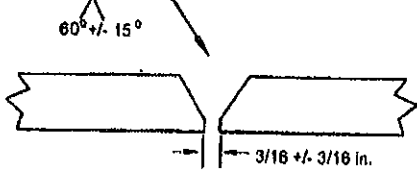


Figure 4
Single Vee Butt

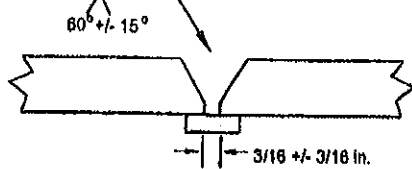


Figure 5
Single Vee Butt with Backing Strip

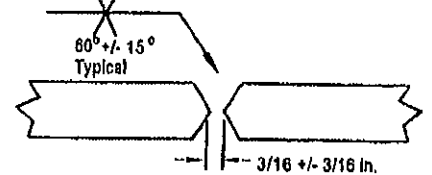


Figure 6
Double Vee Butt

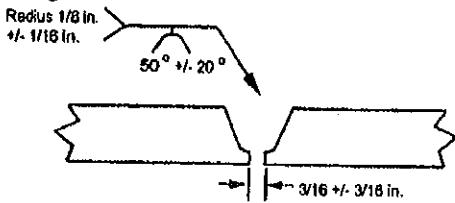


Figure 7
Single U Butt

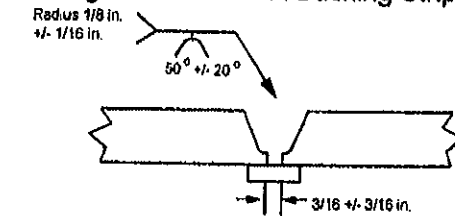


Figure 8
Single U Butt with Backing Strip

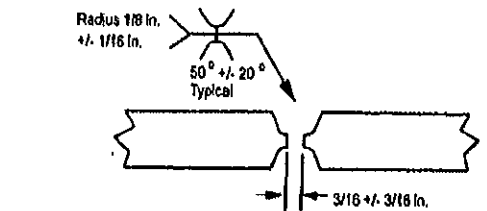


Figure 9
Double U Butt

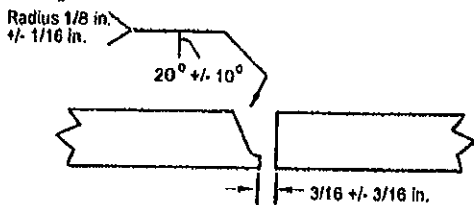


Figure 10
Single J Butt

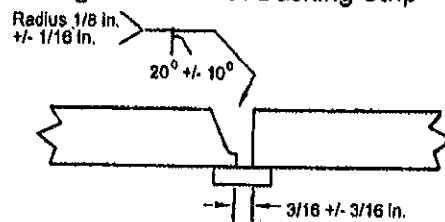


Figure 11
Single J Butt with Backing Strip

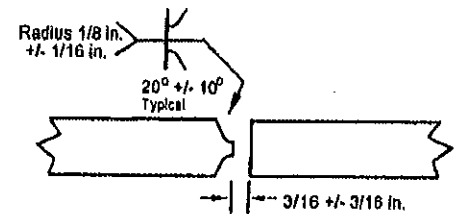


Figure 12
Double J Butt

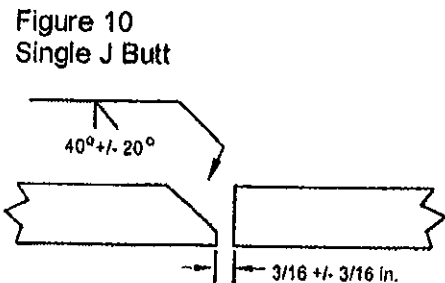


Figure 13
Single Bevel Butt

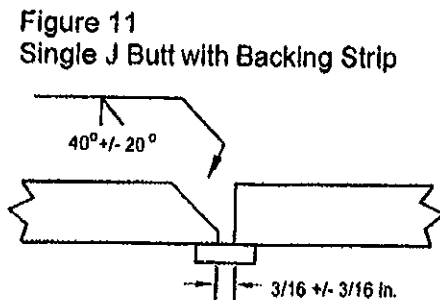


Figure 14
Single Bevel Butt with Backing Strip

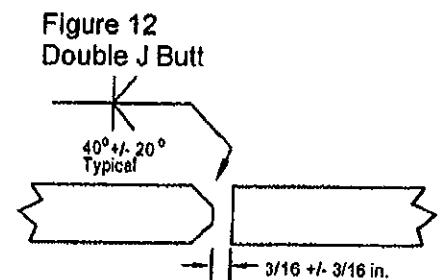


Figure 15
Double Bevel Butt

Or as per the joint design on the approved construction drawing.

PREHEAT**P-No. 1**

1. Welds joining pressure parts or attachments shall be preheated to not less than the minimum preheat temperatures stated in paragraph 5.
2. The preheat temperature shall be maintained during welding.
3. If welding is interrupted, the weld joint and adjacent areas shall be reheated to the minimum preheat temperature stated in paragraph 5, prior to the start of welding.
4. Preheat temperatures shall be checked by the welder or inspector, using temperature indicating crayons or other reputable methods.
5. Minimum preheating temperatures shall be as follows:

PRESSURE VESSELS IN ACCORDANCE WITH ASME SECTION VIII, DIV. 1

NOMINAL WALL THICKNESS	MINIMUM PREHEAT TEMPERATURE
0 to 32 mm (0 to 1.25 in.)	10°C (50°F)
Over 32 mm (Over 1.25 in.)	95°C (200°F)
Over 25 mm (1.0 in.) & specified maximum carbon content in excess of 0.30%.	79°C (175°F)

- The conditions of UW-30 shall apply for base metal temperatures below 0°C (32°F).
- The preheat zone shall extend at least 50 mm (2.0 in.) beyond each edge of the weld.

PROCESS PIPING IN ACCORDANCE WITH ASME B31.3

NOMINAL WALL THICKNESS	MINIMUM SPECIFIED BASE METAL TENSILE STRENGTH	MINIMUM PREHEAT TEMPERATURE
< 25 mm (1.0 in.)	< 490 MPa (71 ksi)	10°C (50°F)
≥ 25 mm (1.0 in.)	All	79°C (175°F)
All	> 490 MPa (71 ksi)	79°C (175°F)

- The preheat zone shall extend at least 25 mm (1.0 in.) beyond each edge of the weld.
- The interruption of welding shall be subject to the requirements of paragraph 330.2.4.

POWER PIPING IN ACCORDANCE WITH ASME B31.1

NOMINAL WALL THICKNESS	MINIMUM PREHEAT TEMPERATURE
Over 25 mm (1.0 in.) & specified maximum carbon content in excess of 0.30%.	80°C (175°F)
All others	10°C (50°F)

- The preheat zone shall extend beyond each edge of the weld for at least 76.2 mm (3.0 in.) or 1.5 times the base metal thickness (as defined in paragraph 131.4.1), whichever is greater.

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

G.L.M. Industries L.P.
Procedure Qualification Record No. 41-1-134 Date April 23, 2001
PQR Revision Corporate name change (formerly GLM Tanks & Equipment Ltd.),
September 12, 2006
Welding Procedure Specification No. 41-1-144A (Rev.2)
Welding Process(es) GTAW / SMAW Type(s) Manual

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 333 to SA 350 Type or Grade Gr. 6 to Gr. LF2
P-No. P1 Grp.1 To P-No. P1 Grp.2 Thickness 6.32 mm (0.249 in.)
Diameter 114.3 mm (4.50 in.) O.D. Other Schedule 80 m/c to 0.249 in.

FILLER METALS (QW-404)

	GTAW	SMAW
Specification No. (SFA)	<u>SFA 5.18</u>	<u>SFA 5.1</u>
AWS No. (Class)	<u>ER70S-2</u>	<u>E7018-1</u>
Filler Metal F-No.	<u>F6</u>	<u>F4</u>
Filler Metal A-No.	<u>A1</u>	<u>A1</u>
Size of Electrode	<u>See attached sketch</u>	
Deposited Weld Metal Thickness	<u>2.38 mm (0.094 in.)</u>	<u>3.94 mm (0.155 in.)</u>

POSITION (QW-405)

Position of Groove 5G
Weld Progression Vertical up

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 232°C (450°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A Time N/A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-A
Shielding 100% Argon 13 liters per minute (27 cfph)
Backing Without Trailing Without

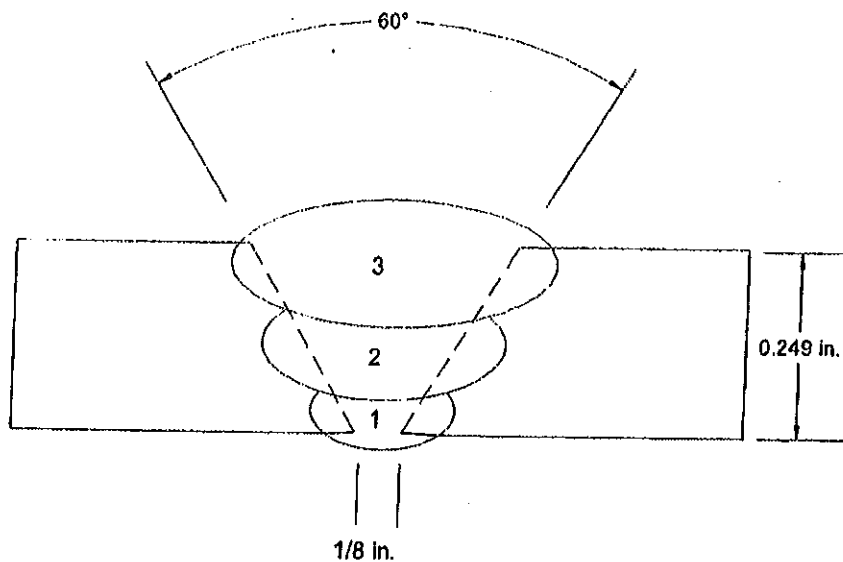
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity GTAW: Straight SMAW: Reverse
Amps See next page Volts See next page
Heat Input F6: 30,000 J/in. maximum F4: 52,570 J/in. maximum
Other 3/32 in. diameter 2% thoriated tungsten electrode, EWTh-2

TECHNIQUE (QW-410)

String or Weave Both Travel Speed See next page
Multiple or Single Pass Per Side GTAW: Single SMAW: Multiple
Multiple or Single Electrodes Single

PQR NO. 41-1-134



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (i.p.m.)
1	GTAW	ER70S-2	2.4 (3/32)	DCSP	100 - 110	9 - 10	56 (2.2)
2 - 3	SMAW	E7018-1	2.4 (3/32)	DCRP	72 - 75	20	53 - 127 (2.1 - 5.0)

PQR NO. 41-1-134**TENSILE TEST (QW-150)**

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbs.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	19.0 (0.748)	4.06 (0.160)	77.1 (0.120)	40 000 (8,990)	519 (75,200)	Partial Cup & Cone Parent Metal (SA 333 Gr. 6)
T2	19.2 (0.756)	4.15 (0.163)	79.7 (0.123)	40 900 (9,190)	513 (74,400)	Partial Cup & Cone Parent Metal (SA 333 Gr. 6)

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.3a, TRB - R1	Pass	QW-462.3a, TFB - F1	Pass
QW-462.3a, TRB - R2	Pass	QW-462.3a, TFB - F2	Pass

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -48°C (-55°F) Specimen Size 10 x 5 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)
A2.1	Weld Metal with 1/16" of root	31.5 (23.2)
A2.2	Weld Metal with 1/16" of root	39.3 (29.0)
A2.3	Weld Metal with 1/16" of root	41.0 (30.2)
A3.1	P1 Grp.1 - HAZ	55.6 (41.0)
A3.2	P1 Grp.1 - HAZ	96.5 (71.2)
A3.3	P1 Grp.1 - HAZ	83.3 (61.4)
A4.1	P1 Grp.2 - HAZ	44.7 (33.0)
A4.2	P1 Grp.2 - HAZ	25.8 (19.0)
A4.3	P1 Grp.2 - HAZ	50.2 (37.0)

OTHER TESTS

Vickers Hardness - see attached laboratory test report

Welders Name Robert Gottschlich Certificate File No. W-13480
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E01-283.1

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

Manufacturer G.L.M. INDUSTRIES L.P.

Date Sept 15/06 Signed J. R. Gottschlich

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

G.L.M. Industries L.P.
Procedure Qualification Record No. 41-1-134-2 Date February 25, 2002
PQR Revision _____ Corporate name change (formerly GLM Tanks & Equipment Ltd.),
September 12, 2006
Welding Procedure Specification No. 41-1-144A (Rev.2)
Welding Process(es) GTAW / SMAW Type(s) Manual

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 333 to SA 350 Type or Grade Gr. 6 to Gr. LF2
Heat No. 81042 to 38493 CE. 0.27 to 0.39
P-No. P1 Grp.1 To P-No. P1 Grp.2 Thickness 12.7 mm (0.500 in.)
Diameter 219.1 mm (8.625 in.) O.D. Other N/A

FILLER METALS (QW-404)

	GTAW	SMAW
Specification No. (SFA)	<u>SFA 5.18</u>	<u>SFA 5.1</u>
AWS No. (Class)	<u>ER70S-2*</u>	<u>E7018-1**</u>
Filler Metal F-No.	<u>F6</u>	<u>F4</u>
Filler Metal A-No.	<u>A1</u>	<u>A1</u>
Size of Electrode	<u>See attached sketch</u>	
Deposited Weld Metal Thickness	<u>2.38 mm (0.094 in.)</u>	<u>10.3 mm (0.406 in.)</u>
Other	<u>*Lincoln Electric Co.: Lincoln ER70S-2</u> <u>**Lincoln Electric Co.: Excalibur E7018-1</u>	

POSITION (QW-405)

Position of Groove 5G
Weld Progression Vertical up

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 232°C (450°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A Time N/A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-A
Shielding 100% Argon 13 liters per minute (27 cfph)
Backing Without Trailing Without

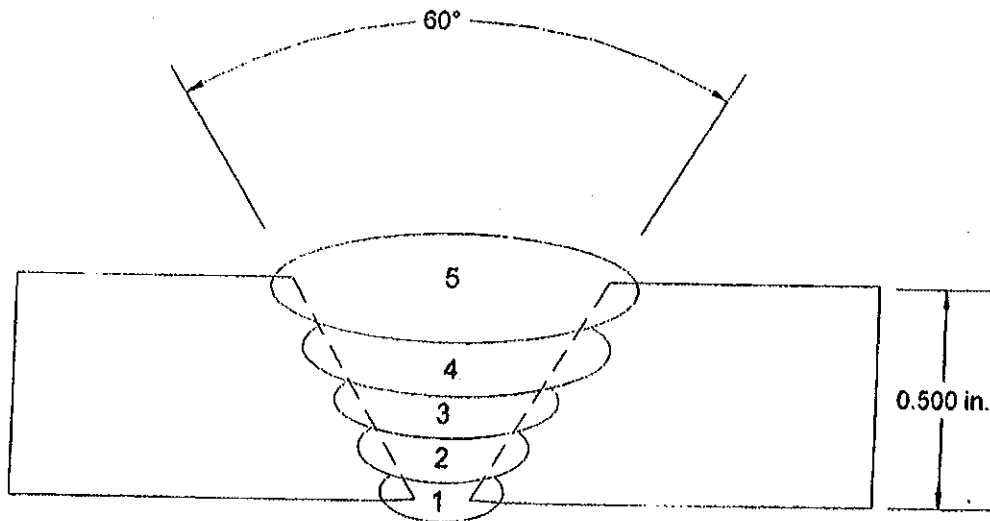
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity GTAW: Straight SMAW: Reverse
Amps See next page Volts See next page
Heat Input F6: 63,820 J/in. maximum F4: 69,990 J/in. maximum
Other 3/32 in. diameter 2% thoriated tungsten electrode, EWTh-2

TECHNIQUE (QW-410)

String or Weave Both Travel Speed See next page
Multiple or Single Pass Per Side GTAW: Single SMAW: Multiple
Multiple or Single Electrodes Single

PQR NO. 41-1-134-2



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (i.p.m.)
1	GTAW	ER70S-2	2.4 (3/32)	DCSP	110	10	26 (1.0)
2	SMAW	E7018-1	2.4 (3/32)	DCRP	80	20	84 (3.3)
3 - 5	SMAW	E7018-1	3.2 (1/8)	DCRP	110	20	48 - 74 (1.9 - 2.9)

PQR NO. 41-1-134-2**TENSILE TEST (QW-150)**

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbs.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	18.9	11.6	219	94 400	431	Partial Cup & Cone
	(0.744)	(0.457)	(0.340)	(21,200)	(62,400)	Parent Metal (SA 333 Gr. 6)
T2	19.0	9.82	187	81 200	435	Partial Cup & Cone
	(0.748)	(0.387)	(0.289)	(18,300)	(63,100)	Parent Metal (SA 333 Gr. 6)

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.2, TSB - S1	Pass	QW-462.2, TSB - S3	Pass
QW-462.2, TSB - S2	Pass	QW-462.2, TSB - S4	Pass

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -46°C (-50°F) Specimen Size 10 x 10 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)
R2.1	Weld Metal within 1/16" of root	124 (91.2)
R2.2	Weld Metal within 1/16" of root	129 (95.4)
R2.3	Weld Metal within 1/16" of root	67.8 (50.0)
R3.1	P1 Grp.1 - HAZ	>260 (>192)
R3.2	P1 Grp.1 - HAZ	>260 (>192)
R3.3	P1 Grp.1 - HAZ	>260 (>192)
R4.1	P1 Grp.2 - HAZ	40.1 (29.6)
R4.2	P1 Grp.2 - HAZ	44.5 (32.8)
R4.3	P1 Grp.2 - HAZ	41.2 (30.4)

OTHER TESTS

Rockwell Hardness - see attached laboratory test report
Vickers Hardness - see attached laboratory test report
Brinell Hardness - see attached laboratory test report

Welders Name Don Johnson Certificate File No. N/A
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E02-150.15

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

Manufacturer G.L.M. INDUSTRIES L.P.

Date Sept 15/06 Signed [Signature]



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E01-283.1
Date: April 23, 2001

Attention: Wilber Davie

PQR No.: 41-1-134
Material: SA 333 Gr. 6 to SA 350 Gr. LF2
Size: 114.3 mm (4.50 in.) O.D. x 6.32 mm (0.249 in.) w.t.
Thermal Condition: As Welded

TENSILE TEST QW-150

SAMPLE NUMBER	T1	QW-462.1(b)	T2	QW-462.1(b)
WIDTH mm (in)	19.0	(0.748)	19.2	(0.756)
THICKNESS mm (in)	4.06	(0.160)	4.15	(0.163)
AREA sq mm (sq in)	77.1	(0.120)	79.7	(0.123)
ULTIMATE LOAD N (lbs)	40 000	(8,990)	40 900	(9,190)
UTS MPa (psi)	519	(75,200)	513	(74,400)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal (SA 333 Gr. 6)		Parent Metal (SA 333 Gr. 6)	

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	19.1 mm (0.750 in.)	SAMPLE THICKNESS:	6.32 mm (0.249 in.)
PLUNGER SIZE:	22.2 mm (0.875 in.)	YOKE SIZE:	41.1 mm (1.619 in.)
QW-462.3(a)	Face Bend	Root Bend	Face Bend
SAMPLE NUMBER(S)	F1	R1	F2
RESULTS	Pass	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 ASME Section IX, 1998 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: _____

Andrew Elash / Ron Peters, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E01-283.1
Date: April 23, 2001

Attention: Wilber Davie

PQR No.: 41-1-134
Material: SA 333 Gr. 6 to SA 350 Gr. LF2
Size: 114.3 mm (4.50 in.) O.D. x 6.32 mm (0.249 in.) w.t.
Thermal Condition: As Welded

NOTCH-TOUGHNESS TEST

TYPE OF TEST: Charpy V-Notch
TEST TEMPERATURE: -48°C (-55°F)

ORIENTATION: Transverse
SPECIMEN SIZE: 10 x 5 mm

Specimen Number	Notch Location	Impact Values	
		Joules	(ft.lbs)
A2.1	Weld Metal within 1/16" of root	31.5	(23.2)
A2.2	Weld Metal within 1/16" of root	39.3	(29.0)
A2.3	Weld Metal within 1/16" of root	41.0	(30.2)
A3.1	Gr. 6 - HAZ	55.6	(41.0)
A3.2	Gr. 6 - HAZ	96.5	(71.2)
A3.3	Gr. 6 - HAZ	83.3	(61.4)
A4.1	Gr. LF2 - HAZ	44.7	(33.0)
A4.2	Gr. LF2 - HAZ	25.8	(19.0)
A4.3	Gr. LF2 - HAZ	50.2	(37.0)

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. 1, UG-84, 1998 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: _____

Andrew Elash / Ron Peters, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E01-283.1
Date: April 23, 2001

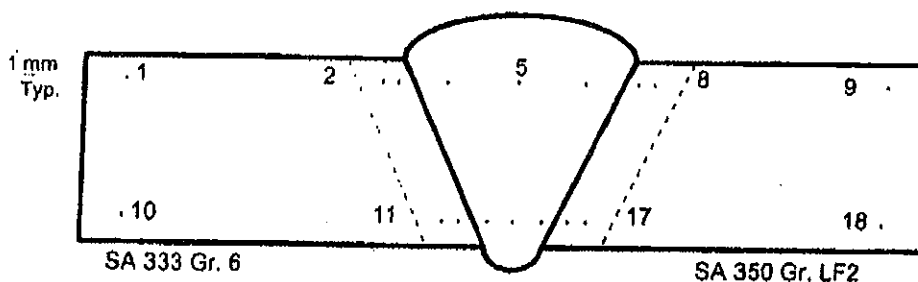
Attention: Wilber Davie

PQR No.: 41-1-134
Material: SA 333 Gr. 6 to SA 350 Gr. LF2
Size: 114.3 mm (4.50 in.) O.D. x 6.32 mm (0.249 in.) w.t.
Thermal Condition: As Welded

HARDNESS TEST

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

LOAD: 500 g



1) 144 HV	6) 185 HV	11) 185 HV	16) 189 HV
2) 173 HV	7) 180 HV	12) 183 HV	17) 182 HV
3) 185 HV	8) 177 HV	13) 155 HV	18) 150 HV
4) 205 HV	9) 147 HV	14) 164 HV	
5) 193 HV	10) 150 HV	15) 157 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 E384 - 99. 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: _____

Andrew Elash / Ron Peters, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-150.15
Date: March 1, 2002

Attention: Wilber Davie

PQR No.: 41-1-134-2
Material: SA 333 Gr. 6 to SA 350 Gr. LF2
Size: 219.1 mm (8.625 in.) O.D. x 12.7 mm (0.500 in.) w.t.
Thermal Condition: As Welded

TENSILE TEST QW-150

SAMPLE NUMBER	T1	QW-462.1(b)	T2	QW-462.1(b)
WIDTH mm (in)	18.9	(0.744)	19.0	(0.748)
THICKNESS mm (in)	11.6	(0.457)	9.82	(0.387)
AREA sq mm (sq in)	219	(0.340)	187	(0.289)
ULT. LOAD N (lbs)	94 400	(21,200)	81 200	(18,300)
UTS MPa (psi)	431	(62,400)	435	(63,100)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal (SA 333 Gr. 6)		Parent Metal (SA 333 Gr. 6)	

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	9.52 mm (0.375 in.)	SAMPLE THICKNESS:	12.7 mm (0.500 in.)
PLUNGER SIZE:	38.1 mm (1.50 in.)	YOKE SIZE:	60.3 mm (2.375 in.)
QW-462.2	Side Bend	Side Bend	Side Bend
SAMPLE NUMBER(S)	S1	S2	S3
RESULTS	Pass	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 ASME Section IX, 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:

Karen Koenig

Chris Lachuk / Karen Koenig, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-150.15
Date: March 1, 2002

Attention: Wilber Davie

PQR No.: 41-1-134-2
Material: SA 333 Gr. 6 to SA 350 Gr. LF2
Size: 219.1 mm (8.625 in.) O.D. x 12.7 mm (0.500 in.) w.t.
Thermal Condition: As Welded

NOTCH-TOUGHNESS TEST

TYPE OF TEST: Charpy V-Notch
TEST TEMPERATURE: -46°C (-50°F)

ORIENTATION: Transverse
SPECIMEN SIZE: 10 x 10 mm

Specimen Number	Notch Location	Impact Values	
		Joules	(ft.lbs)
R2.1	Weld Metal within 1/16" of root	124	(91.2)
R2.2	Weld Metal within 1/16" of root	129	(95.4)
R2.3	Weld Metal within 1/16" of root	67.8	(50.0)
R3.1	Gr. 6 - HAZ	>260	(>192)
R3.2	Gr. 6 - HAZ	>260	(>192)
R3.3	Gr. 6 - HAZ	>260	(>192)
R4.1	Gr. LF2 - HAZ	40.1	(29.6)
R4.2	Gr. LF2 - HAZ	44.5	(32.8)
R4.3	Gr. LF2 - HAZ	41.2	(30.4)

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: _____

Chris Lachuk / Karen Koens, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-150.15
Date: March 1, 2002

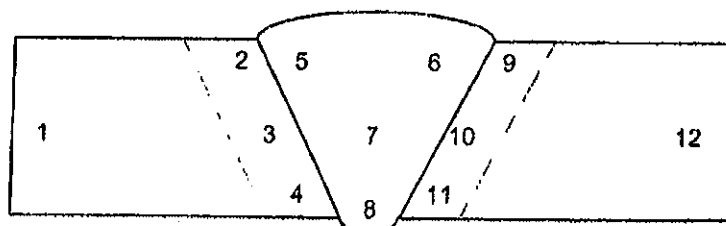
Attention: Wilber Davie

PQR No.: 41-1-134-2
Material: SA 333 Gr. 6 to SA 350 Gr. LF2
Size: 219.1 mm (8.625 in.) O.D. x 12.7 mm (0.500 in.) w.t.
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Rockwell
INSTRUMENT TYPE: NewAge Digital Versitron

SCALE: B



SA 350 Gr. LF2			SA 333 Gr. 6		
1)	78 HRB	5)	90 HRB	9)	84 HRB
2)	87 HRB	6)	89 HRB	10)	79 HRB
3)	88 HRB	7)	84 HRB	11)	79 HRB
4)	86 HRB	8)	78 HRB	12)	71 HRB

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E18 - 98. 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: _____

Chris Lachuk / Karen Koens, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

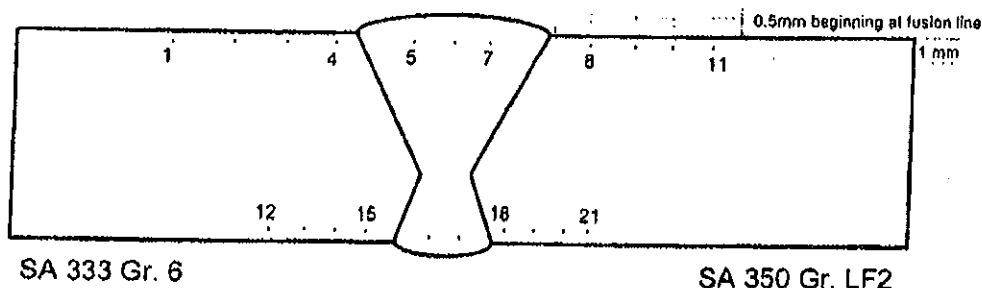
Laboratory Test No.: E02-150.15
Date: March 1, 2002

Attention: Wilber Davie

PQR No.: 41-1-134-2
Material: SA 333 Gr. 6 to SA 350 Gr. LF2
Size: 219.1 mm (8.625 in.) O.D. x 12.7 mm (0.500-in.) w.t.
Thermal Condition: As Welded

HARDNESS TEST

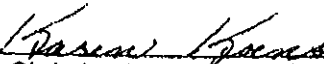
TYPE OF TEST: Vickers
LOAD: 10kg
INSTRUMENT TYPE: Mitutoyo AVK-C1



1) 136 HV	6) 177 HV	11) 167 HV	16) 138 HV
2) 143 HV	7) 185 HV	12) 143 HV	17) 159 HV
3) 146 HV	8) 196 HV	13) 148 HV	18) 174 HV
4) 147 HV	9) 180 HV	14) 150 HV	19) 169 HV
5) 172 HV	10) 174 HV	15) 154 HV	20) 167 HV
			21) 160 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 1997). 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:


Chris Lachuk / Karen Koens, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-150.15
Date: March 1, 2002

Attention: Wilber Davie

PQR No.: 41-1-134-2
Material: SA 333 Gr. 6 to SA 350 Gr. LF2
Size: 219.1 mm (8.625 in.) O.D. x 12.7 mm (0.500 in.) w.t.
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Brinell
LOAD: 3000kg., 10 mm ball
INSTRUMENT TYPE: Brown Bayley

WELD CAP HARDNESS

174 BHN

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E10-00. 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: _____

Karen Koens
Chris Lachuk / Karen Koens, C.E.T.

4027 - 14 Street S.E., CALGARY, ALBERTA T2C 3K6 PHONE: (403) 262-7072 FAX: (403) 266-3169

7925 Davies Road, EDMONTON, ALBERTA T6E 4N1 PHONE: (780) 468-3030 FAX: (780) 468-3032



WELDING PROCEDURE SPECIFICATION NO.: 41-8/1-163A (Rev.2)

WELDING PROCEDURE QUALIFICATION RECORD NO.(S): 41-1/8-163-1

QUALIFIED FOR

Base Metal (Typical): P1 Groups 1 & 2 to P8 Group 1
(SA 333 Gr.6, SA 350 Gr.LF2, SA 420 WPL6, SA 516 Gr.70, etc. to
SA 182, SA 240, SA 312, Types 304, 304L, 316, 316L, 321, etc.)
Process(es): GTAW / SMAW Weld Types: GROOVE & FILLET
Position: ALL POSITIONS Diameter: ALL DIAMETERS
Filler Metal: ER309L, E309L-15/16/17

BASE METAL CONDITIONS & GROOVE THICKNESS RANGE QUALIFIED:

NOTCH TOUGHNESS APPLICATIONS TO -46°C AS WELDED
BASE METAL THICKNESS RANGE 3.2 to 12.7 mm (0.125 to 0.500 in.) inclusive

COMBINED DEPOSITED WELD METAL THICKNESS

ASME B31.1	<u>12.7 mm (0.500 in.) maximum</u>
ASME B31.3	<u>12.7 mm (0.500 in.) maximum</u>
ASME SECT. VIII, DIV.1	<u>12.7 mm (0.500 in.) maximum</u>

ALBERTA BOILERS SAFETY ASSOCIATION
PROVINCE OF ALBERTA
SAFETY CODES ACT
WELDING PROCEDURE

Reg. No. WP 8632
Spec No. 41-8/1-163A (REV2)
Weld Process GTAW / SMAW
Matl. Gr. P No. 1 Gr. 1 to P No. 8 Gr. 1
Elec. Gr. F No. 6 & 5 A No. 8
Th. Qual. For 3.2 to 12.7 mm PWHt NO
CVN -46°C

Yr. 06 Mo. 10 Day 23 Signed [Signature]
R. ROSEBERG, P.ENG.
WELDING SPECIALIST

PROVINCIAL REGISTRATION

QW-482 WELDING PROCEDURE SPECIFICATION (WPS)

G.L.M. Industries L.P.

Welding Procedure Specification No. 41-8 / 1-163A (Rev.2) Date September 26, 2006
 Revision Rev. 2 (Nonessential) Corporate name change (formerly GLM Tanks &
Equipment Ltd.) WPS No. formerly 41-8 / 1-163A (Rev.1)
 Supporting PQR No.(s) 41-1 / 8-163-1
 Welding Process(es) GTAW / SMAW Type(s) Manual

JOINTS (QW-402)

Joint Design All ASME groove & fillet, reference construction drawing for joint details.
Where joint details are not specified, refer to figures 1 to 15 attached
 Root Opening As per attached typical groove designs, see figures 1 to 15 attached
 Backing With or without Retainers Not required

BASE METALS (QW-403)

P-Number P1 Groups 1 & 2 To P-Number P8 Group 1
 Thickness Range: Groove See cover page for thickness qualified by governing code
 Fillet All base metal thicknesses
 Pipe Diameter Ranges: Groove All diameters
 Fillet All diameters
 Deposited Weld Metal (Per Pass) GTAW: 4.78 mm (0.188 in.) maximum
SMAW: 7.92 mm (0.312 in.) maximum

FILLER METALS (QW-404)

	GTAW	SMAW
Specification No. (SFA)	<u>SFA 5.9</u>	<u>SFA 5.4</u>
AWS No. (Class)	<u>ER309L</u>	<u>E309L-15/16/17</u>
F-No.	<u>F6</u>	<u>F5</u>
A-No.	<u>A8</u>	<u>A8</u>
Size	<u>1/16 to 5/32 in. inclusive</u>	<u>3/32 to 3/16 in. inclusive</u>
Consumable Inserts	<u>Not Required</u>	<u>N/A</u>
Filler Metal Product Form	<u>Solid wire</u>	<u>N/A</u>
Flux	<u>Without the addition of flux</u>	<u>N/A</u>
Deposited Weld Metal Thickness Range:		
Groove	<u>4.78 mm (0.188 in.) max.*</u>	<u>7.92 mm (0.312 in.) max.*</u>
Fillet	<u>All fillet sizes</u>	<u>All fillet sizes</u>
Other	<u>* Combined deposited weld metal thickness shall not exceed 12.7 mm (0.500 in.) for ASME B31.1 & B31.3 and for ASME Section VIII, Div.1</u>	

POSITION (QW-405)

Position of Groove All positions Position of Fillet All positions
 Weld Progression GTAW: Vertical up or vertical down SMAW: Vertical up

PREHEAT (QW-406)

Preheat Temperature (Minimum) 10°C (50°F)
 Interpass Temperature (Maximum) 177°C (350°F)
 Preheat Maintenance 10°C prior to welding. Preheat maintenance is not required if welding is
 interrupted or after the completion of welding unless required by the
 code of construction.

WPS NO. 41-8 / 1-163A (Rev.2)

POST WELD HEAT TREATMENT (QW-407)

Temperature Range N/A Time Range N/A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-A
 Shielding 100% Argon, 5 - 20 liters per minute (10 - 40 cfph)
 Backing 100% Argon, 3 - 10 liters per minute (6 - 20 cfph)
 Trailing Not Required

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity GTAW: Straight SMAW: Reverse
 Amps See Table #1 Volts See Table #1
 Maximum Heat Input

Base Metal Thickness Range	GTAW	SMAW
0.125 - 0.500 in.	51,830 J/in.	21,920 J/in.

Pulsing Current GTAW: With or without
 Tungsten Electrode 1/16 to 5/32 inch diameter
 Tungsten Classification EWTh-1, EWTh-2, EWCe-2, EWLa-1, EWLa-1.5, EWLa-2

TECHNIQUE (QW-410)

String or Weave Either Travel Speed See Table #1
 Orifice or Gas Cup Size 9.52 to 19.1 mm (0.375 to 0.750 in.)
 Initial & Interpass Cleaning Brushing, chipping or grinding as required
 Method of Back Gouging Air carbon arc, back-grind as required
 Oscillation N/A
 Closed or Out of Chamber N/A
 Multiple or Single Pass Per Side GTAW: Either SMAW: Multiple
 Multiple or Single Electrodes Single
 Electrode Spacing N/A
 Peening Not permitted

TABLE 1 - WELDING PARAMETERS

Process	Filler Metal	Diameter mm (in.)	Current Type & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (l.p.m.)
GTAW	ER309L	1.6 (1/16)	DCSP	50 - 140	6 - 14	9 - 300 (0.4 - 12)
GTAW	ER309L	2.4 (3/32)	DCSP	70 - 200	8 - 18	17 - 350 (0.7 - 14)
GTAW	ER309L	3.2 (1/8)	DCSP	100 - 285	9 - 20	27 - 400 (1.1 - 16)
GTAW	ER309L	4.0 (5/32)	DCSP	120 - 350	10 - 21	36 - 450 (1.4 - 18)
SMAW	E309L-15/16/17	2.4 (3/32)	DCRP	50 - 80	16 - 27	56 - 300 (2.2 - 12)
SMAW	E309L-15/16/17	3.2 (1/8)	DCRP	70 - 120	17 - 28	83 - 350 (3.3 - 14)
SMAW	E309L-15/16/17	4.0 (5/32)	DCRP	100 - 170	18 - 29	126 - 400 (5.0 - 16)
SMAW	E309L-15/16/17	5.0 (3/16)	DCRP	140 - 220	20 - 30	195 - 500 (7.7 - 20)

Note: Welding parameters shall be adjusted to insure that the maximum heat input value specified in QW-409 above is not exceeded.

$$\text{Heat Input (J/in.)} = \frac{\text{Volts} \times \text{Amps} \times 60}{\text{Travel Speed (ipm)}}$$

TYPICAL JOINT DESIGNS

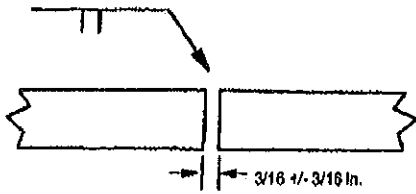


Figure 1
Single Square Butt

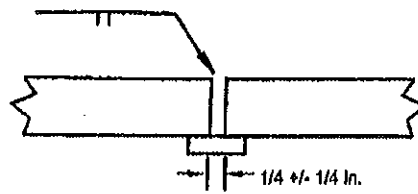


Figure 2
Single Square Butt with Backing Strip

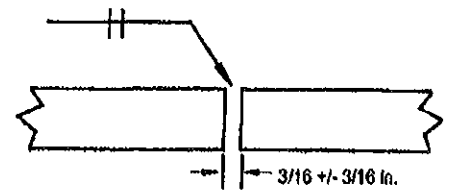


Figure 3
Double Square Butt

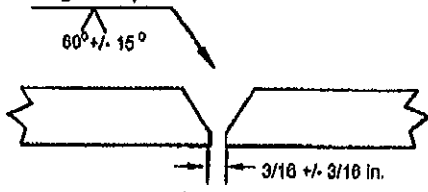


Figure 4
Single Vee Butt

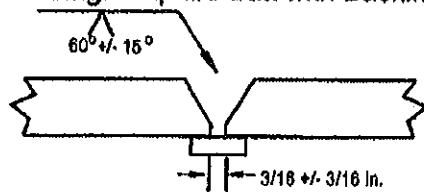


Figure 5
Single Vee Butt with Backing Strip

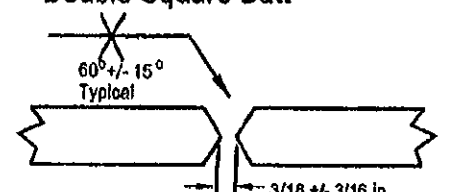


Figure 6
Double Vee Butt

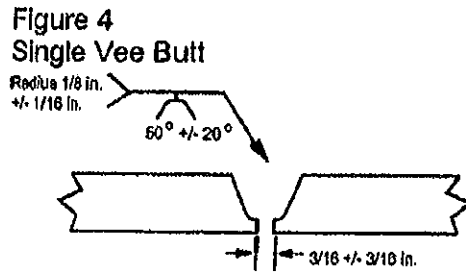


Figure 7
Single U Butt

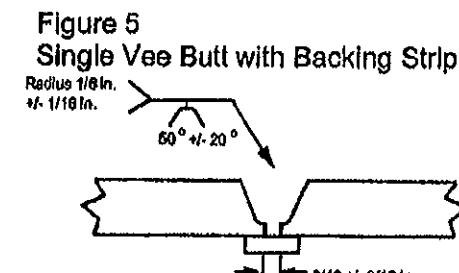


Figure 8
Single U Butt with Backing Strip

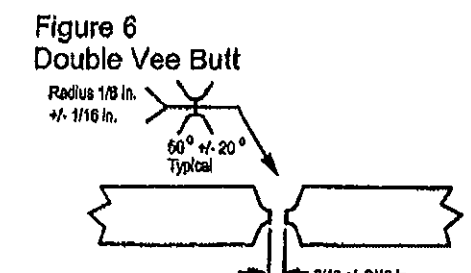


Figure 9
Double U Butt

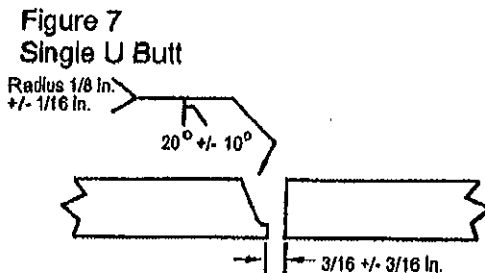


Figure 10
Single J Butt

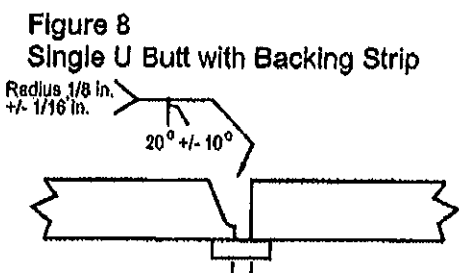


Figure 11
Single J Butt with Backing Strip

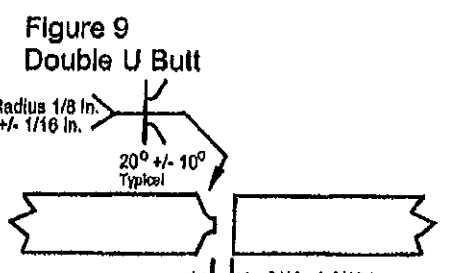


Figure 12
Double J Butt

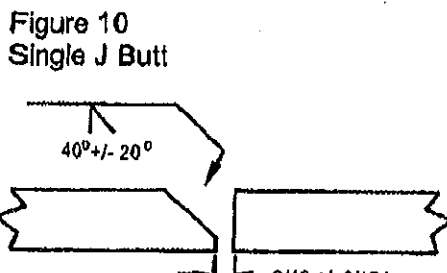


Figure 13
Single Bevel Butt

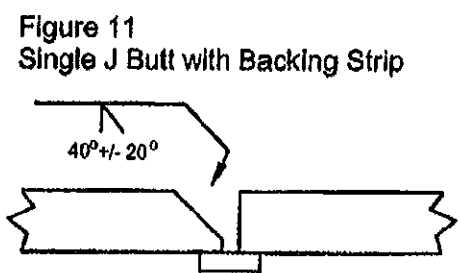


Figure 14
Single Bevel Butt with Backing Strip

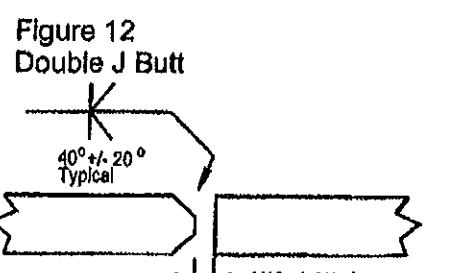


Figure 15
Double Bevel Butt

Or as per the joint design on the approved construction drawing.

QW-483 WELDING PROCEDURE RECORD (PQR)

G.L.M. Industries L.P.

Procedure Qualification Record No. 41-1 / 8-163-1 Date June 11, 2002
PQR Revision Corporate name change (formerly GLM Tanks & Equipment Ltd.),
September 26, 2006
Welding Procedure Specification No. 41-8 / 1-163A (Rev.2)
Welding Process(es) GTAW / SMAW Type(s) Manual

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 516 to SA 240 Type or Grade Gr.60 / 70 to Type 304L
P-No. P1 Grp.1 / 2 To P-No. P8 Grp.1 Thickness 6.32 mm (0.249 in.)
Diameter N/A Other Plate Product Form

FILLER METALS (QW-404)

	GTAW	SMAW
Specification No. (SFA)	<u>SFA 5.9</u>	<u>SFA 5.4</u>
AWS No. (Class)	<u>ER309L*</u>	<u>E309L-17**</u>
Filler Metal F-No.	<u>F6</u>	<u>F5</u>
Filler Metal A-No.	<u>A8</u>	<u>A8</u>
Size of Electrode	<u>See attached sketch</u>	
Deposited Weld Metal Thickness	<u>2.38 mm (0.094 in.)</u>	<u>3.94 mm (0.155 in.)</u>
Other	<u>*Avesta Welding Products: Avesta 309L</u> <u>**Avesta Welding Products: Avesta 309L-17</u>	

POSITION (QW-405)

Position of Groove 3G
Weld Progression Vertical Up

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 177°C (350°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature None Time N/A

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-A
Shielding 100% Argon, 12.5 liters per minute (25 cfph)
Backing 100% Argon, 7.5 liters per minute (15 cfph)
Trailing Without

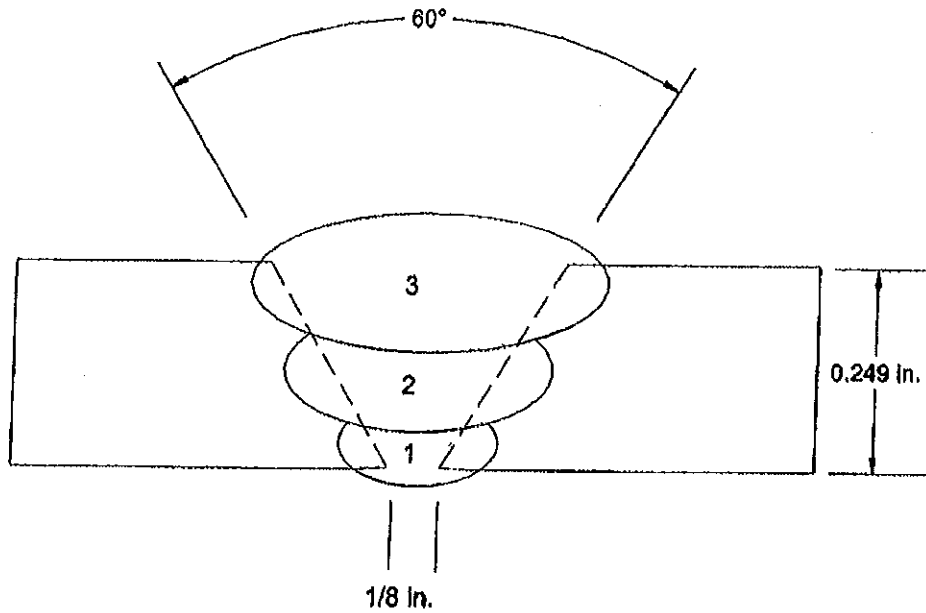
ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity GTAW: Straight SMAW: Reverse
Amps See next page Volts See next page
Heat Input F6: 51,830 J/in. maximum F5: 21,920 J/in. maximum
Other 1/8 in. diameter 2% thoriated tungsten electrode, EWTh-2

TECHNIQUE (QW-410)

String or Weave Weave Travel Speed See next page
Multiple or Single Pass Per Side GTAW: Single SMAW: Multiple
Multiple or Single Electrodes Single

PQR NO. 41-1/8-163-1



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (l.p.m.)
1	GTAW	ER309L	2.4 (3/32)	DCSP	80	10	24 (0.9)
2	SMAW	E309L-17	2.4 (3/32)	DCRP	50	22	76 (3.0)
3	SMAW	E309L-17	2.4 (3/32)	DCRP	50	22	79 (3.1)

PQR NO. 41-1/8-163-1**TENSILE TEST (QW-150)**

Specimen No.	Width mm (In.)	Thickness mm (In.)	Area Sq. mm (Sq. In.)	Ultimate Load N (lbs.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	19.1 (0.752)	4.90 (0.193)	93.6 (0.145)	51 500 (11,600)	550 (79,800)	Partial Cup & Cone Parent Metal (SA 516 Gr. 60/70)
T2	19.0 (0.748)	4.77 (0.188)	90.6 (0.140)	49 900 (11,200)	551 (79,900)	Partial Cup & Cone Parent Metal (SA 516 Gr. 60/70)

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.3a, TRB - R1	Pass	QW-462.3a, TFB - F1	Pass
QW-462.3a, TRB - R2	Pass	QW-462.3a, TFB - F2	Pass

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V Notch Orientation Transverse
 Test Temperature -48°C (-55°F) Specimen Size 10 x 5 mm

Specimen No.	Notch Location	Impact Values J (ft. lbs)	Lateral Expansion (inches)
B2.1	Weld Metal	38.2 (28.2)	0.042
B2.2	Weld Metal	36.6 (27.0)	0.040
B2.3	Weld Metal	46.1 (34.0)	0.043
B3.1	P1 Grp.1 / 2 - HAZ	99.3 (73.2)	N/A
B3.2	P1 Grp.1 / 2 - HAZ	64.3 (47.4)	N/A
B3.3	P1 Grp.1 / 2 - HAZ	94.9 (70.0)	N/A

OTHER TESTSRockwell Hardness - see attached laboratory test reportVickers Hardness - see attached laboratory test reportBrinell Hardness - see attached laboratory test report

Welders Name Don Johnson Certificate File No. N/A
 Tests Conducted By Ludwig & Associates Ltd.
 Laboratory Test No. E02-552.2

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

Manufacturer G.L.M. INDUSTRIES L.P.

Date Oct 5/06 Signed [Signature]



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-552.2
Date: June 21, 2002

Attention: Wilber Davie

PQR No.: 41-1/8-163-1
Material: SA 516 Gr. 60/70 to SA 240 Type 304L
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

TENSILE TEST QW-150

SAMPLE NUMBER	T1	QW-462.1(a)	T2	QW-462.1(a)
WIDTH mm (in)	19.1	(0.752)	19.0	(0.748)
THICKNESS mm (in)	4.90	(0.193)	4.77	(0.188)
AREA sq mm (sq in)	93.6	(0.145)	90.6	(0.140)
ULT. LOAD N (lbs)	51 500	(11,600)	49 900	(11,200)
UTS MPa (psi)	550	(79,800)	551	(79,900)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal (SA 516 Gr. 60/70)		Parent Metal (SA 516 Gr. 60/70)	

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	38.1 mm (1.50 in.)	SAMPLE THICKNESS:	6.32 mm (0.249 in.)
PLUNGER SIZE:	22.2 mm (0.875 in.)	YOKE SIZE:	41.1 mm (1.62 in.)
QW-462.3 (a)	Face Bend	Root Bend	Face Bend
SAMPLE NUMBER(S)	F1	R1	F2
RESULTS	Pass	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 ASME Section IX, 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: _____

Natashua Collier, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-552.2
Date: June 20, 2002

Attention: Wilber Davie

PQR No.: 41-1/8-163-1
Material: SA 516 Gr. 60/70 to SA 240 Type 304L
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

NOTCH-TOUGHNESS TEST

TYPE OF TEST: Charpy V-Notch
TEST TEMPERATURE: -48°C (-55°F)

ORIENTATION: Transverse
SPECIMEN SIZE: 10 x 5 mm

Specimen Number	Notch Location	Impact Values		Lateral Expansion
		Joules	(ft.lbs)	in.
B2.1	Weld Metal within 1/16" of root	38.2	(28.2)	0.042
B2.2	Weld Metal within 1/16" of root	36.6	(27.0)	0.040
B2.3	Weld Metal within 1/16" of root	46.1	(34.0)	0.043
B3.1	Gr. 60/70 - HAZ	99.3	(73.2)	
B3.2	Gr. 60/70 - HAZ	64.3	(47.4)	
B3.3	Gr. 60/70 - HAZ	94.9	(70.0)	

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. 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: _____

Natashua Collier, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-552.2
Date: June 24, 2002

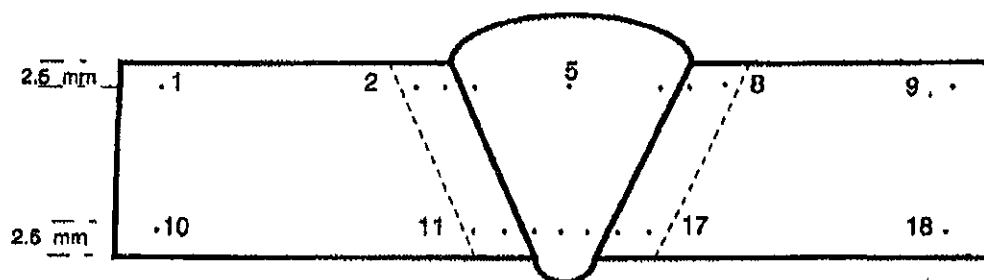
Attention: Wilber Davie

PQR No.: 41-1/8-163-1
Material: SA 516 Gr. 60/70 to SA 240 Type 304L
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

HARDNESS TEST

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

LOAD: 10 kg



SA 516 Gr. 60/70

SA 240 Type 304L

1) 164 HV	6) 197 HV	11) 206 HV	16) 179 HV
2) 186 HV	7) 186 HV	12) 223 HV	17) 184 HV
3) 198 HV	8) 187 HV	13) 177 HV	18) 164 HV
4) 197 HV	9) 171 HV	14) 165 HV	
5) 194 HV	10) 157 HV	15) 188 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 1997). 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: _____

Natashua Collier, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-552.2
Date: June 24, 2002

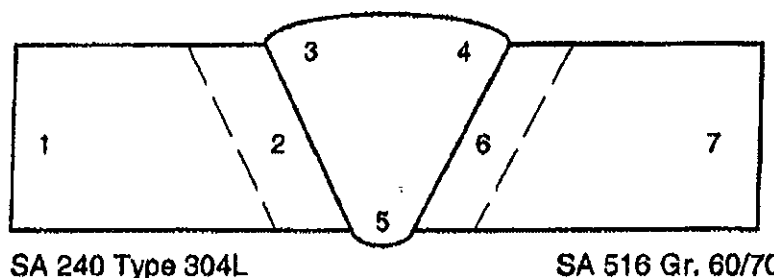
Attention: Wilber Davie

PQR No.: 41-1/8-163-1
Material: SA 516 Gr. 60/70 to SA 240 Type 304L
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Rockwell
INSTRUMENT TYPE: Wilson

SCALE: B



1) 81 HRB	4) 88 HRB	7) 84 HRB
2) 90 HRB	5) 84 HRB	
3) 90 HRB	6) 92 HRB	

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E18 - 98. 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: _____


Natashua Collier, C.E.T.



LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: GLM Tanks & Equipment Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-552.2
Date: June 24, 2002

Attention: Wilber Davie

PQR No.: 41-1/8-163-1
Material: SA 516 Gr. 60/70 to SA 240 Type 304L
Thickness: 6.32 mm (0.249 in.)
Thermal Condition: As Welded

HARDNESS TEST

TYPE OF TEST: Brinell
INSTRUMENT TYPE: King

LOAD: 3000 kg., 10 mm ball

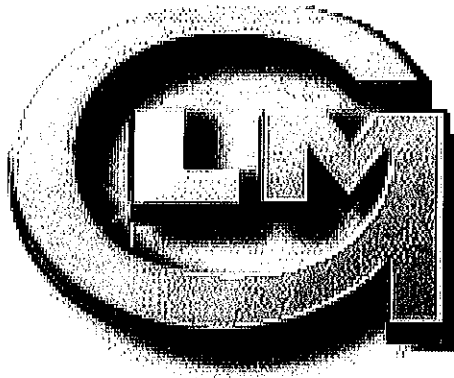
Location	Brinell Hardness (BHN)
Surface of Weld Cap	166
Surface of Weld Cap	170
Surface of Weld Cap	159

Average Brinell Hardness 165 BHN

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E10-00. 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: _____

Natashua Collier, C.E.T.



G.L.M. INDUSTRIES L.P.

SECTION 5

**QUALITY
CONTROL/INSPECTION
DATA**



G.L.M. INDUSTRIES L.P.

Fabrication Traveler / IIP # 3 - Checklist

Rev:

0

Serial Number:

10-797-2

Description:

12'-0" OD x 20'-0" HG SKIDDED TANK
HUSKY c/o EXCELSIOR ENGINEERING

Action By:

Customer:

Rev. Date:

30-Mar-11

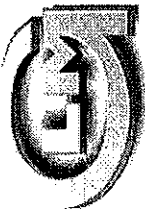
Initial & Date of Completion/Acceptance

Job Classification - 3: G.L.M. Standard Design / MTR Trace / 3rd Party Involvement / No Amendments to traveler.

	Ref. Documents or Standards (Where applicable)	Hold/Witness/Review			GLM	CQR
		HP	WP	RP		
PREP	Material / Nozzle / Flange mapping MTR TRACE? YES	Q-826 / Q-827				
	Material: Yard Selection / Rolling / Burning / Tacking / Marking	Drawings/BOM				
	Roof Fittings: Orientation	As per Drawings				
	Roof Fittings: Alignment / Projection (ISP & OSP)	As per Drawings				
	Shell Fittings: Orientation	As per Drawings				
	Shell Fittings: Elevation	As per Drawings				
	Shell Fittings: Alignment / Projection (ISP & OSP)	As per Drawings				
	Internal weld spatter / stray arcs and grinding suitable for internal coating		HP			
	External weld spatter / stray arcs and grinding suitable for external paint or primer		HP			
	Internals trial fit and verified.	As per Drawings				
	All welds and fittings visually inspected & Welders ID Verified (Metal Marker)	As per Drawings				
	Double wall construction?	NO				
	Complete floor vacuum / air tested					
	Repads air tested (15 psig)					
	Air/Soap Test	E-315 (API 650)				
	Hydro. Pressure Test	N/A				
	Heat Coil(s) (air/hydro test) (Non-Registered Coils ONLY)	N/A				
	IF Double Wall					
	Testing:					
	RT:					
	MT:					
	PT:					
	REQUIRED SHELL TO FLOOR					
	Release to Paint Shop					
	Painting / Coating / Insulation / Cladding					
	Final Fit Out & Touch Up Painting					
	Final Inspection verification and release					
	COMMENTS & NCRs ISSUED:					

* As per Plans & Fit-out Traveler

HP - No work past this point until approved/accepted.
WP - Witness of work - not to hold up production.
RP - Items in this category will be reviewed during the process - does not stop work/progress.



G.L.M. INDUSTRIES L.P.

API-650 HYDROSTATIC & AIR-SOAP LEAK TEST

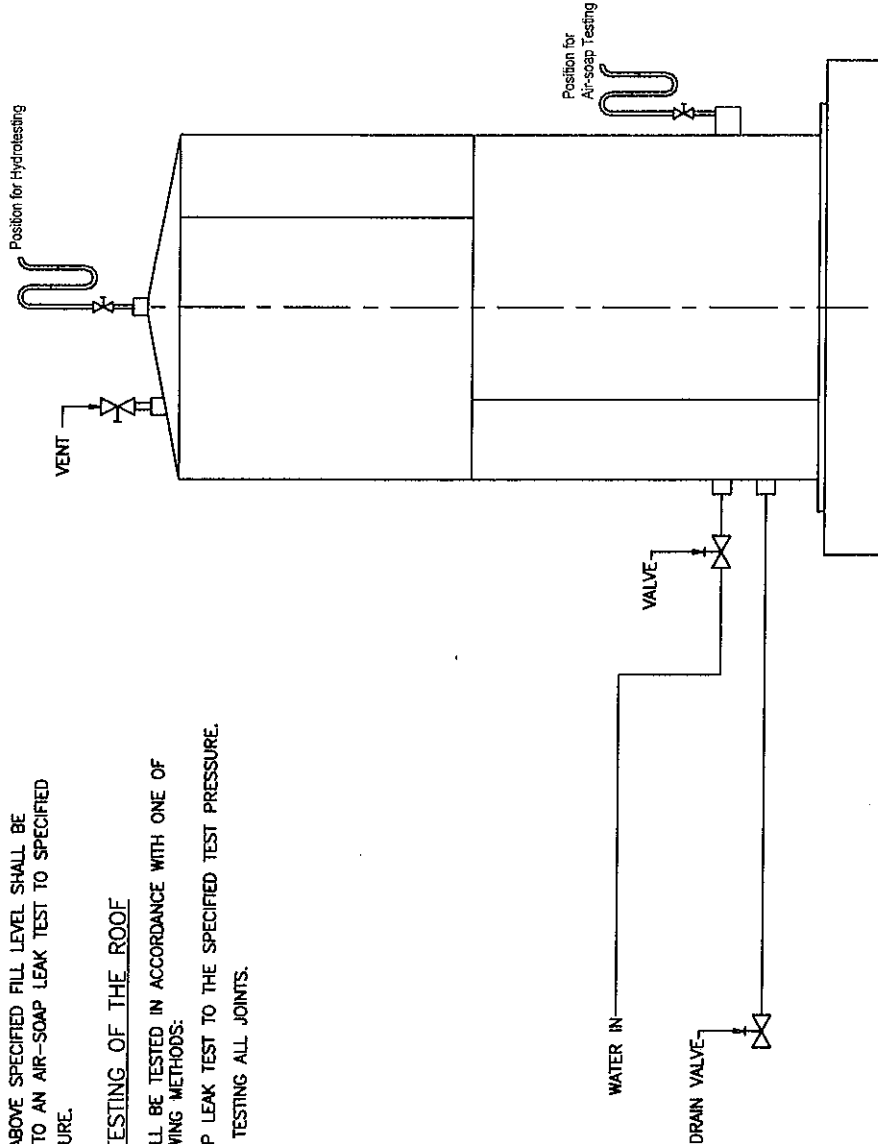
* Vital instructions required to complete this test are given in the drawing package. Refer to the drawings prior to performing any hydrostatic or pressure test.

TESTING OF THE SHELL

1. FILL TANK WITH WATER TO THE SPECIFIED FILL LEVEL.
2. IF "AIR TEST" IS SPECIFIED, FILL LEVEL IS NIL, SKIP TO #4
3. VISUALLY INSPECT ALL JOINTS FOR LEAKS.
4. JOINTS ABOVE SPECIFIED FILL LEVEL SHALL BE SUBJECTED TO AN AIR-SOAP LEAK TEST TO SPECIFIED TEST PRESSURE.

TESTING OF THE ROOF

- ROOF'S SHALL BE TESTED IN ACCORDANCE WITH ONE OF THE FOLLOWING METHODS:
1. AIR-SOAP LEAK TEST TO THE SPECIFIED TEST PRESSURE.
 2. VACUUM TESTING ALL JOINTS.



TANK DATA

GLM S/N: 10-797-2
CUSTOMER: HUSKY ENERGY
C/O: EXCELSIOR ENGINEERING LTD.
DESCRIPTION: 12'-0" O.D. X 20'-0" HIGH
SLOP TANK

TEST DATA

TEST PERFORMED: ☒ AIR/SOAP ☐ HYDROTEST
PRESSURE: 15.125 UNITS: in. H₂O
FILL LEVEL: N/A

MIN. HOLD TIME: 30 min.
GAUGE TYPE: ☒ MANOMETER ☐ PRESSURE
PRESS. GAUGE NO.: N/A
CALIBRATION DUE: N/A

TEST REPORT: ☒ Yes ☐ No
ACCEPTABLE: ☒ Yes ☐ No

COMMENTS: TANK ROOF & SHELL RECEIVED
AN AIR/SOAP LEAK TEST

WITNESS: GLM

CUSTOMER: (IF NECESSARY / REQUIRED)

DATE: April 7/2011

API-650 STORAGE TANK HYDRO TEST LAYOUT



G.L.M. INDUSTRIES L.P.

Head Office & Manufacturing

1508 - 8th Street
Nisku AB T9E 7S6
P: (780) 955-2233
F: (780) 955-2241
TF: (800) 661-9828



Calgary Sales

#900, 706 - 7th Avenue SW
Calgary AB T2P 0Z1
P: (403) 231-2730
F: (403) 234-8274
TF: (800) 661-9446



Grande Prairie Facility

9101 - 150th Avenue
Grande Prairie AB T8X 0B1
P: (780) 830-1474
F: (780) 830-1478
TF: (888) 830-1474



Saskatchewan Facility

14th Street & 5th Avenue
PO Box 1229
Battleford SK S0M 0E0
P: (306) 937-7785
F: (306) 937-7788
TF: (800) 663-7785



GLM Job #: 10-797-2
Date Tested: Mar 28/11
Customer:

Your Reference: Tag#:

RECORD OF VACUUM BOX TEST

This is to certify that the above project has been completed in compliance with all applicable drawings, engineering specifications provided, applicable regulatory bodies and jurisdictions. The following areas have been tested by vacuum box methods in accordance with API Standards:

Area Tested:	Floor seams @ 3.0 psig
Testing Medium:	Soap Film Solution
Ambient Temperature:	40 Deg. F minimum
Light Source Used:	Flashlight
Approximate Light Intensity:	N/A
Number of Defects Identified:	0
Retest Completed & Satisfactory:	yes

Merlin Grabia *Merlin Grabia*
Completed by (Print & Sign):

17
SERIAL No: 10-717-72

DATE

04-18-2011

DESCRIPTION

400 BBL

CUSTOMER:

Hickory, AL

THICKNESS:

211

VERIFIED BY:

WA

TEMPERATURE:

80°F

SUBSTRATE TEMP:

70°F

RELATIVE HUMIDITY:

40%

DEW POINT:

37°F

INSULATION PRODUCT NAME:

BASF

PRICE: \$

RESIN NUMBER:

R-2913

COUNTER READINGS:

START

0

FINISH

794

LOT NUMBER:

200338248

ISO NUMBER:

6000A

COUNTER READINGS:

START

0

FINISH

794

LOT NUMBER:

2003450910

SEALER:

TowerHem

PRICE: \$

CONSUMPTION (GALLONS)

20

COATING NAME:

TowerHem I

COATING NUMBER:

2001 Black

LOT NUMBER:

S10K2002

HEAT TAPE LOCATION:

n/a

SURFACE PREP:

shop primer

GLM ACCEPTANCE:

WA

GLM. INTERNAL/EXTERNAL COATING TRAVEL SHEET

ACCEPTANCE CRITERIA LOCATED ON QUALITY PLAN

SERIAL NO: 10-797-2 DESCRIPTION: 40060C
 CUSTOMER: Hart & Cooley CLIENT REP:
 Profile N/A mils Abrasive 60/100 Nozzle Size 8 Pressure 65 psi
 Ambient Temp. 61°F Substrate Temp. 62°F R.H. 15% Dewpoint 22°F pH Ref. No. _____
 Date 4/13 Mag. Base (where req'd) 5.0 Date: 4/13
 G.L.M. Final Substrate Inspection: G.A. (Initial) Date: 4/15
 CQR Final Substrate Inspection: _____ (Initial) Date: _____

Replicas or Min & Max Record

ANCHOR PROFILES

NOTE LOCATION:

APPLICATION (PART A)

Coat No.	Manufacturer & Product No.	Base Batch No.	Catalyst Batch No.	Gals. Used	Color
1	Choverdele Industrial Primer S11B3070			7	Grey
2	Choverdele Industrial Enamel S11B3197			2	Warming Grey
3					
4					

Coat No.	Thinning Agent		Mixing Method	Induction Time	Material Temp. °F	Initials	Date M/D
	Type	Amount %					
1			Mech	NA	74	GM	Apr 15/14
2			Mech	NA	74	GM	Apr 15/14
3							
4							

APPLICATION (PART B)

Coat No.	Areas Coated	ENVIRONMENT CONDITIONS				Application Method	Pump Size	Tip Size	AV DFT before coating	WFT		Initials	Date M/D
		Surf °F	Amb. °F	R.H. %	Dew Pt. °F					Min	Max		
1	Completed	77	78.4	10.9	19.6	Spray	60:1	415	0	4	6	GM	Apr 15/14
2	Protrusions	77	78.4	10.9	19.6	Spray	60:1	415	2.5	3	5	GM	Apr 15/14
3													
4													

G.L.M. INTERNAL/EXTERNAL COATING TRAVEL SHEET (PART 2)

INSPECTION & TESTING

INSPECTION:

Coat No.	Comments	DFT Min	DFT Max	DFT Avg	DFT Nozzles	Initials	Date M/D	Equipment I.D.	Comments	CQR Initial
1	Primer	1.8	4.0	2.6	1.5-3.0	GM	04-15	2007		
2	Firestop	3.5	5.6	4.5	3-4.5	GM	04-16	2007		
3										
4										

CURE HISTORY:

Temp Range	From	To	Total Time(hrs)	Ambient Air	Forced Air	Cure Test
Temp Range	From	To	Total Time(hrs)	Ambient Air	Forced Air	Cure Test
Temp Range	From	To	Total Time(hrs)	Ambient Air	Forced Air	Cure Test

DISCONTINUITY TESTING:

Test std.	Test by	Date	Area Tested	Equip. I.D.	Discon. & Loc'n:
Test std.	Test by	Date	Area Tested	Equip. I.D.	Discon. & Loc'n:
Test std.	Test by	Date	Area Tested	Equip. I.D.	Discon. & Loc'n:

Repair #	Areas Coated	Repair Proc #	Manufacturer & Product #	Base Batch #	Catalyst Batch #	Gals. Used	Color
1							
2							
3							

Repair #	Thinning Agent			Environment Conditions			Application Method		Cure History			G.L.M.		CQR	
	Type	Batch #	Amt. %	Surf °F	Amb. °F	R.H. %	Dew Pt. °F		Time	Temp	Sign	Date	Sign	Date	
1															
2															
3															

FINAL INSPECTIONS:

Visual by Wayne Antepenko Date 04-17-2011
 Discontinuity by NA Date _____
 Cure by Time & Temp Date 04-18-2011
 G.L.M. Acceptance [Signature] Date _____
 CQR Acceptance _____ Date _____

G.I.M. INTERNAL/EXTERNAL COATING TRAVEL SHEET
ACCEPTANCE CRITERIA LOCATED ON QUALITY PLAN

Serial No: 10-797-2 DESCRIPTION: 40066C

CUSTOMER: Husky Energy CLIENT REP: 105

SSPC/NACE NO. 30 Profile 30 mils Abrasive Barrett Grade 30 Nozzle Size 8 Pressure 105 psi

Ambient Temp. 61°F Substrate Temp. 61°F Dewpoint 22°F pH Ref. No.

Date 4/1/13 R.H. 18% Mag. Base (where req'd)

G.I.M. Final Substrate Inspection: 6.0. (Initial) Date: 4/1/13

CQR Final Substrate Inspection: (Initial) Date: 4/1/14

Surface accepted for Lining (Applicator) WA (Initial) Date: 4/1/14

Replicas or Min & Max Record

ANCHOR PROFILES

TESTEX PRESS-O-FILM™
NEWARK, DE 19715
USA
No. 30
Reading 2.0 mils
Gage less 2.0 mils
or 50 µm
X COARSE (1.5 to 4.5 mils) or (40 to 115 µm)

Made in USA

APPLICATION (PART A)				NOTE LOCATION:	
Coat No.	Manufacturer & Product No.	Base Batch No.	Catalyst Batch No.	Gals. Used	Color
1	Bulle 100	04948 HV1/H	59699 HV1/H	16	Gray
2					
3					
4					

Coat No.	Thinning Agent		Mixing Method	Induction Time	Material Temp. °F	Initials	Date M/D
	Type	Amount %					
1	HP		HP	HP	105	WA	04-14-11
2							
3							
4							

APPLICATION (PART B)															
Coat No.	Areas Coated	ENVIRONMENT CONDITIONS					Application Method	Pump Size	Tip Size	AV DFT before coating	WFT		Initials	Date M/D	
		Surf °F	Amb. °F	R.H. %	Dew Pt. °F	Min					Max				
1	INT	71°F	73°F	19%	28°F		SPAY	stream mix	423	HP	22	24	WA	04-14-11	
2															
3															
4															

G.L.M. INTERNAL/EXTERNAL COATING TRAVEL SHEET (PART 2) INSPECTION & TESTING

INSPECTION:

Coat No.	Comments	DFT Min	DFT Max	DFT Avg	DFT Nozzles	Initials	Date M/D	Equipment I.D.	Comments	CQR Initial
1	Debris Belly Back Flange + Neck's	14	45	26	7/9	WA	04-15-11			
2										
3										
4										

CURE HISTORY:

Temp Range	From	To	Total Time (hrs)	Ambient Air	Forced Air	Cure Test
Temp Range	From	To	Total Time (hrs)	Ambient Air	Forced Air	Cure Test
Temp Range	From	To	Total Time (hrs)	Ambient Air	Forced Air	Cure Test

DISCONTINUITY TESTING:

Test std. RPO 188	Test by AR	Date 04-16	Area Tested complete	Equip. I.D. New 8	Discon. & Loc'n: 0
Test std.	Test by	Date	Area Tested	Equip. I.D.	Discon. & Loc'n:
Test std.	Test by	Date	Area Tested	Equip. I.D.	Discon. & Loc'n:

Repair #	Areas Coated	Repair Proc #	Manufacturer & Product #	Base Batch #	Catalyst Batch #	Gals. Used	Color
1	Repairs	705-5-4	DI-VOL DI-EVANT 100	64948 HUIH	59699 HUIK	1/4	GRAY
2							
3							

Repair #	Thinning Agent			Environment Conditions				Application Method	Cure History		G.L.M.		CQR	
	Type	Batch #	Amt. %	Surf °F	Amb. °F	R.H. %	Dew Pt. °F		Time	Temp	Sign	Date	Sign	Date
1	—	—	—	72	74	29	35	Brush			AR	04-15		
2														
3														

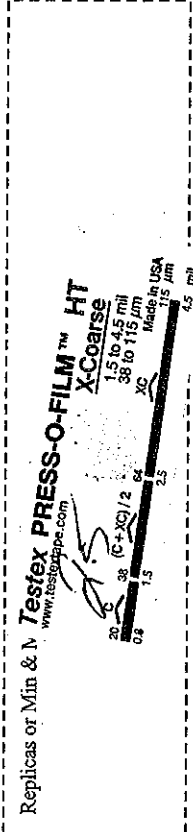
FINAL INSPECTIONS:

Visual by Wayne Antepenko	Date 04-16-2011	G.L.M. Acceptance	Signature
Discontinuity by Andrew Rose	Date 04-16-2011	CQR Acceptance	Signature
Cure by Timie 9 Temp	Date 04-17-2011		

G.L.M. INTERNAL/EXTERNAL COATING TRAVEL SHEET

ACCEPTANCE CRITERIA LOCATED ON QUALITY PLAN

Surface Preparation (Substrate):
Standard SSA-SP-10 Profile 3-5 mils Abrasive 60/100 Grade 30/60 Nozzle Size 8 Pressure 105 psi
Ambient Temp. 72°F Substrate Temp. 74/10°F R.H. 32/29% Dewpoint 49.20°F pH Ref. No. _____
Date 6/22 Mag. Base (where req'd) _____ Date: 6/22
G.L.M. Final Substrate Inspection: V.S. (Initial) _____ Date: 6/22
CQR Final Substrate Inspection: _____ (Initial) _____ Date: _____
Surface accepted for Lining (Applicator) V.A. (Initial) _____ Date: 6/22



APPLICATION (PART A)				NOTE LOCATION:			
Coat No.	Manufacturer & Product No.	Base Batch No.	Catalyst Batch No.	Gals. Used	Color		
1	DEVOL DEVTAR SA	APV 11A 30257	64643 HUIA	5 gal	BLACK		
2							
3							
4							

Coat No.	Thinning Agent		Mixing Method	Induction Time	Material Temp. °F	Initials	Date M/D
	Type	Amount %					
1	-	-	MECH	15 min	73°F	V.A.	6/22
2							
3							
4							

APPLICATION (PART B)														
Coat No.	Areas Coated	ENVIRONMENT CONDITIONS					Application Method	Pump Size	Tip Size	AV DFT before coating	WFT		Initials	Date M/D
		Surf °F	Amb. °F	R.H. %	Dew Pt. °F	Min					Max			
1	FLOOR	73°F	74°F	40%	54.8°F	Airless	56:1	4:21	—	16	18	V.A.	6/22	
2														
3														
4														

G.L.M. INTERNAL/EXTERNAL COATING TRAVEL SHEET (PART 2)

INSPECTION & TESTING

INSPECTION:

Coat No.	Comments	DFT Min	DFT Max	DFT Avg	DFT Nozzles	Initials	Date M/D	Equipment I.D.	Comments	CQR Initial
1	Bottom Floor	11.6	18.9	15.4	12/A	KL	06-25	N007		
2										
3										
4										

CURE HISTORY:

Temp Range	From	To	Total Time(hrs)	Ambient Air	Forced Air	Cure Test
Temp Range	From	To	Total Time(hrs)	Ambient Air	Forced Air	Cure Test
Temp Range	From	To	Total Time(hrs)	Ambient Air	Forced Air	Cure Test

DISCONTINUITY TESTING:

Test std.	Area Tested	Date	Test by	Area Tested	Date	Test by	Area Tested	Date	Test by
Test std.	Area Tested	Date	Test by	Area Tested	Date	Test by	Area Tested	Date	Test by
Test std.	Area Tested	Date	Test by	Area Tested	Date	Test by	Area Tested	Date	Test by

Repair #	Areas Coated	Repair Proc #	Manufacturer & Product #	Base Batch #	Catalyst Batch #	Gals. Used	Color
1							
2							
3							

Repair #	Thinning Agent			Environment Conditions				Application Method			Cure History			G.L.M.		CQR	
	Type	Batch #	Amt. %	Surf °F	Amb. °F	R.H. %	Dew Pt. °F				Time	Temp	Sign	Date	Sign	Date	
1																	
2																	
3																	

FINAL INSPECTIONS:

Visual by	Date	G.L.M. Acceptance
Visual by	Date	G.L.M. Acceptance
Discontinuity by	Date	CQR Acceptance
Cure by	Date	



GLV Logistics Inc.

FINAL FIT-OUT TRAVEL SHEET

DATE WRITTEN: April 21/11 REQUIRED BY: _____
CUSTOMER: Husky Energy
DESCRIPTION: 400 BBL
JOB NUMBER / SERIAL NUMBER: 10-797-2
WAREHOUSE ITEMS PULLED BY: _____ DATE: _____
FIT-OUT VERIFIED ITEMS RECEIVED FROM SHIPPING/RECEIVING: _____ DATE: _____

FIT-OUT

ITEM

Check for latest drawing revisions
Check all internals/lengths, gaskets, bolts, studs
Check internals for Teflon/nylon washers on coated flanges
Check external hardware (cages/ladders/hoops, gaskets, bolting, tape / dope & wired)
Check all openings are covered if required
Check gauge system & decals
Check blind flanges/installed/painted, and external hardware painted etc.
Visual inspection for cleanliness prior to installing manway cover
2 copies of Nameplate attached - forward to QC
Correct nameplate installed

Initials

FIT-OUT COMMENTS:

FINAL FIT-OUT RETURNED ITEMS TO SHIP-LOOSE:

QTY: DESCRIPTION:

GLM Final Fit-Out Inspect Complete:

Form received by QC:

Nameplate photo copies received by QC

Initial:

Date:

Initial:

Date:

Initial:

Date:

☐ Released for loading, 3rd party inspector to witness loading & tie down, **24 hours** notice required☐ Ship loose items 3rd party inspection required, **24 hours** notice required☒ Released for loading, 3rd party inspect after tie down, **24 hours** notice required

Form received from QC by S & R:

Initial & Date:

Above items included for transport:

Initial:

☐ Released for loading & shipping 3rd party inspection not required

Accessories ready for shipping:

Initial:

Date:

TRANSPORTATION TO CONFIRM CORRECT NAMEPLATE IS INSTALLED:

S/N:

Transportation:

Date:

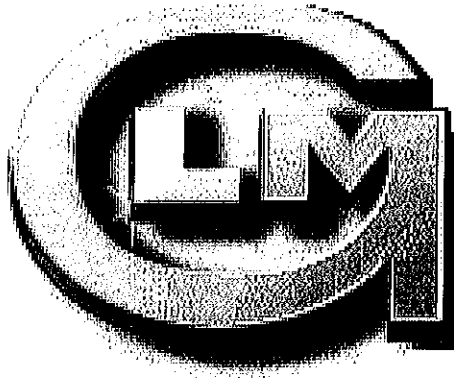
TRANSPORTATION TO REVIEW PRODUCT LOAD FOR TIE-DOWN:

Transportation:

Date:

PICTURE:

YES



G.L.M. INDUSTRIES L.P.

SECTION 6

NAMEPLATE FACSIMILE



12F 12 ADD 1200 X

10-797-2 2011

T-330

SLOP

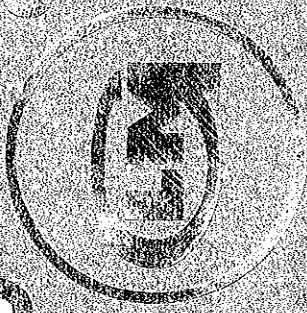
12.0	FT.	1/4	IN.
20.0	FT.	FLAT	
400	BBL	3/16	IN.
16.0	OZ.	NO	
1.0		20.0	FT.
11	'F	200	'F

SHEET THICKNESS

3/16"

MATERIAL

A-36



COLLIERIES L.L.C.

API 12 F. 12 ADD PP. 120 X
SERIAL NO. 10-7976-2 YEAR 2011
OWNER TAG NO. T-330

SERVICE SLOP

NOM DIA	12.0	FT	BIM THK	1/4	IN.
NOM HT	20.0	FT	BIM TYP	FLAT	
NOM CAP	400	DEG	ROD TYP	3/16	IN.
DEW RES	16.0	OZ	DEW HT	NO	
DEW G	1.0		DES HT	20.0	FT
WEIGHT	11	LB	MAX HT	200	FT

SHELL THICKNESS
3/16

MAX HT
20.0