



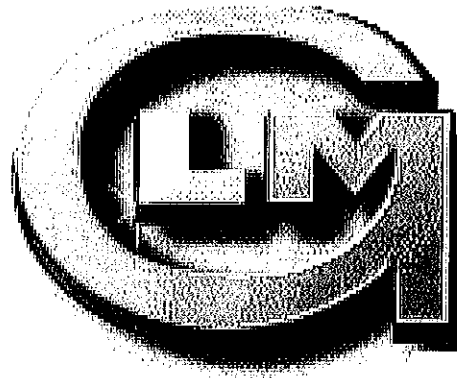
G.L.M. Industries L.P.

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

400 BBL SKIDDED WATER TANK

**Tag# T-320
P.O. #8400261587**

G.L.M. Job#: 10-797-1



G.L.M. INDUSTRIES L.P.

INDEX

SECTION "1" Drawings

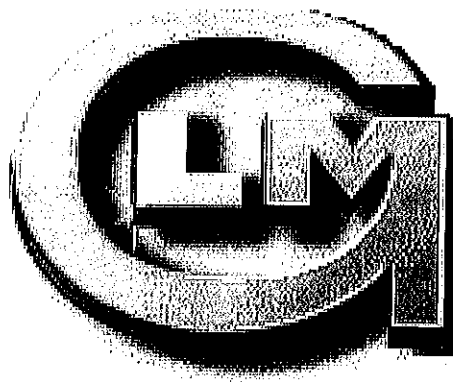
SECTION "2" Calculation Package

SECTION "3" Material Test Reports

SECTION "4" Weld Procedures

SECTION "5" Quality Control

SECTION "6" Nameplate Facsimile



G.L.M. INDUSTRIES L.P.

SECTION 1

DRAWINGS

TANK DATA SHEET

GENERAL NOTES

1. TANK DESIGNED IN NISKOL AB
2. THESE DRAWINGS HAVE BEEN REVIEWED FOR COMPLIANCE WITH GOOD INDUSTRY PRACTICES, REFERENCE AP-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 OHAS SPECIFICATIONS.

DESCRIPTION	REQUIRED	12-0 0.0 x 20-0 HIGH	01
CAPACITY (NORMAL)	REQUIRED (NORMAL)		
WATER TANK	430 BBL		
BASE	7200 LB		
DESIGNED	10233 LB		
FULL OF WATER	150737 LB		
OPERATING	160737 LB		
DESIGN CODES	AP-12F (MODIFIED) 12H EDITION		
STAMP REQUIREMENTS	GLM GOOD INDUSTRY PRACTICES		
SPECIFICATIONS	NONE		

DESIGN NOTES:

1. THIS TANK HAS BEEN DESIGNED FOR SIMULTANEOUS INTERNAL DESIGN PRESSURE AND WIND OVERTURNING.
2. THIS TANK MEETS THE VENTING REQUIREMENTS OF API-2000 WHEN EQUIPPED WITH THE VENTS SPECIFIED ON THE GENERAL ARRANGEMENT DRAWING.
3. LIFTING AND TAILING LUGS ARE FOR LIFTING EMPTY TANKS ONLY.

DESIGN INT. PRESS.	DESIGN EXT. PRESS.	DESIGN INT. PRESS.	DESIGN EXT. PRESS.	UNIT	16.0 oz./sq.in.	0.4 oz./sq.in.	11.7
TEMP	TEMP	TEMP	TEMP		°C	°F	°C
SPECIFIC GRAVITY							
JOINT EFFICIENCY							
CORROSION ALLOWANCE							
ROOF LOADS							
WIND LOADS							
SEISMIC LOADS							
FOUNDATION							
UNKNOWN (BY OTHERS)							

MATERIAL NOTES

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

SHELL	A-36	
ROOF	A-36	
BOTTOM	A-36	
CONES	N/A	
HEAD(S)	N/A	
SUPPORT STRUCTURE	N/A	
NOZZLE NECK	SA-106-B	
MANWAY	A-36	
FLANGE	SA-105N / REM. INTERNAL: SA-182-F400	A-36
REINFORCING PAOS		A-36
INT. PIPING	A-106-B / A-312-TP301	

FABRICATION NOTES

7. ALL SHELL NOZZLES TO STRADDLE VERTICAL CENTERLINES.
8. ALL ROOF NOZZLES TO STRADDLE TANK RADIAL CENTERLINES UNLESS OTHERWISE SHOWN ON GENERAL ARRANGEMENT.
9. SHOP TRIAL FIT ALL APPURTENANCES PRIOR TO PAINTING OR COATING.

COUPLERS OR FORGINGS	A-193-B7 STUDS & A-194-2H NUTS	SA-182-7304
BOLTING	FLANGES: A-193-B7 STUDS & A-194-2H NUTS	
	STRUCTURAL: GRADE 2 OR 5 PLATED	
	FABRICATED MANWAY / THIEF: NEOPRENE	
GASKETS		
	NOTES: 304 S.S. FLEXITALUC	
STRUCTURAL	A-479-304 / G40.21-44W	
OTHER		N/A

PAINTING & COATING NOTES

- ALL INTERNAL INSPECTION 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.
FLANGE FACES MAY RECEIVE INTERNAL COATING BUT ARE EXCLUDED FROM SPECIFIC BLAST AND MILS DFT REQUIREMENTS.

P.A. NOTES

INSPECTOR: (CUSTOMER TO SPECIFY)
COMPANY: (CUSTOMER TO SPECIFY)
PHONE: BUS. (CUSTOMER TO SPECIFY)
CELL: (CUSTOMER TO SPECIFY)
MAIL: (CUSTOMER TO SPECIFY)
INSPECTION DETAILS: (CUSTOMER TO SPECIFY)

- TANK ROOF & SHELL SHALL RECEIVE AIR/SOAP LEAK TEST TO 15.125 IN. OF H₂O.
TANK FLOOR SHALL RECEIVE VACUUM BOX LEAK TEST TO 3.0 PSIG.
TANK SHELL—FLOOR WELD TO RECEIVE 100% MPI

SHIPPING NOTES

- OPEN CONNECTIONS SHALL BE BLANKED WITH TEMPORARY SHIPPING COVERS.**

[illegible]

SERIAL NO.	DESCRIPTION	REV. NO.	REVISION DATE	ISSUANCE DATE	RELEASE DATE
1	TANK DATA	3	09/30/11	01/31/11	
2	GENERAL AGREEMENT	3	09/30/11	01/31/11	
3	MISC. NOZZLE COUPLING DETAILS	1	02/18/11	01/31/11	
4	ENTRAVAILMENT DETAILS	1	02/18/11	01/31/11	
50	TANK ASSEMBLY DETAILS	0	-	01/31/11	

G.L.M. INDUSTRIES I.P.		MOD. <input checked="" type="checkbox"/>	
API 122	ED. 12	APP. <input type="checkbox"/>	
Serial No. 10-797-1		YEAR	2011
OWNER TAG NO. <input type="text"/>		-320	
SERVICE <input type="text"/>		WATER <input type="text"/>	
NOM DIA	12.0	FT BTM	THK 1/4
NOM HT	20.0	FT BTM	TYPE FLAT
NOM CAP	40.0	BSL	ROOF THK 3/16
DES. PRES	16.0	OZ	P.W.H.T. NO
DES. S.G.	1.0	DES. LIQ. LM 20.0	
DMPT	11	F MAX TEMP 1200	
SHELL THICKNESS		MATERIAL	
3/16"		A-36	

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



G.L.M. Industries LP

[illegible]

REV 3

NOZZLE SCHEDULE									
Wk#	QTY.	SIZE	CLASS	TYPE	Q.S.P.	I.S.P.	SERVICE/DESCRIPTION	ELEVATION (MOUNTING NO.)	ASSY
N1	1	10"	FAB'D	FAB'D	8"	FLOSH	VENT NOZZLE c/w FAB'D MUSHROOM TOP CONN. w/ BRASS/BRONZ MESH	CTR. OF ROOF	3-A
N2	1	3"	150	RFWN	SEE PLAN	1/4"	FLY CONN. WATER INLET	0'-11 13/16"	3-D
N3	1	3"	150	RFWN	SEE PLAN	6"	INLET CONN.	0'-11 13/16"	3-E
N4	1	3"	150	RFWN	8"	6"	DRYAN CONN. c/w REEL INT. S.S. SPRINKER DRAIN w/ COMPANION P.L.G. CLIP GATE VALVE (7-1960) & ALUM. CAMLOCK ASSY	2'-0"	4-A
N5	1	4"	150	RFWN	8"	1/4"	NOZZLE CONN. (LSH)	19'-0 3/16"	3-C
N6	1	4"	150	RFWN	8"	1/4"	SPARE c/w BLIND P.L.G. (L1)	ROOF	3-B
N7	1	4"	150	RFWN	8"	1/4"	SPARE c/w BLIND P.L.G.	0'-11 13/16"	3-C
N8	1	3"	150	RFWN	8"	1/4"	VENT NOZZLE c/w REEL	ROOF	3-B
N9	1	3"	150	RFWN	8"	1/4"	3"-0" U.G. PIPE EXTENSION	3'-0"	3-H
C1	1	1"	3000	NPT	FULL	1/4"	FUEL GAS	0'-7"	3-D
M1	1	30"	FAB'D	FAB'D	6"	1/4"	GLM STD SHELL MANWAY ASSY (MODEL 305MW-1-R124)	3'-0"	305MW
NP	1	N/A	N/A	N/A	N/A	N/A	GLM STD. ANGLE NAMEPLATE c/w C.S. BRACKET	5'-6"	NP-A
TH	1	8"	FAB'D	FAB'D	8"	1/4"	GLM STD THATCH NECK c/w EMARDO 330 PT THATCH HATCH (SET @ 12.0 oz. / 0.4 sq. yd.)	ROOF	THIEF
U	1	1 1/2"	3000	FNPT	FULL	1/4"	GLM STD CLOSED TYPE LEVEL INDICATOR c/w INCL. M. BOARD, GUIDE WRES & PVC FLOAT	ROOF	3-G CITL-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 MOUNT, THERMOSTAT AND 25' WATER-LEAD (SUITABLE FOR DRWS LADDER & NATURAL GAS)	STD	4-A
LAD	1	N/A	N/A	N/A	N/A	N/A	ON2S LADDER c/w FULL GAGE	STD	LADIONS
IL	2	N/A	N/A	N/A	N/A	N/A	GLM STD INSULATION STANDARDS	STD	LLUG
INS	4	N/A	N/A	N/A	N/A	N/A	GLM STD INSULATION STANDARDS	STD	STUMPT

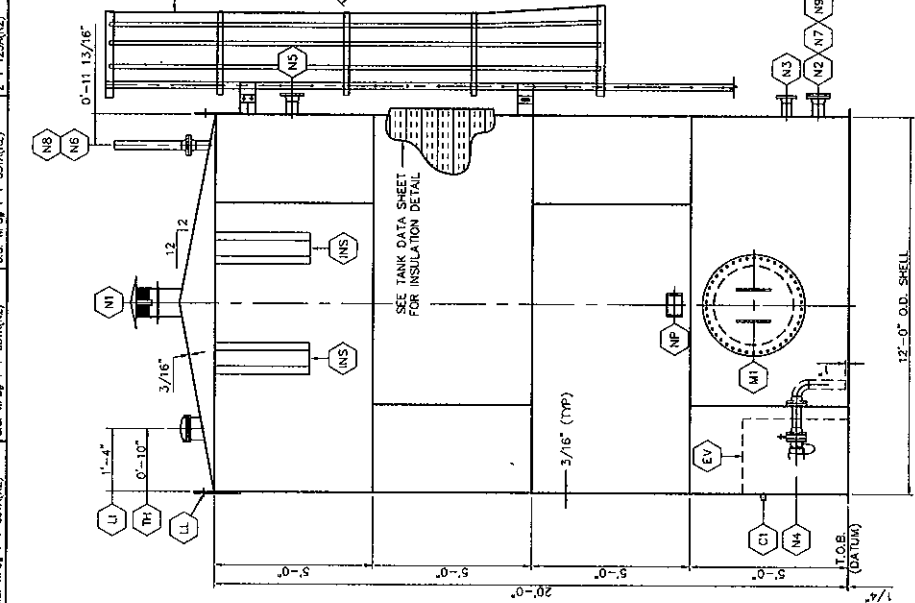
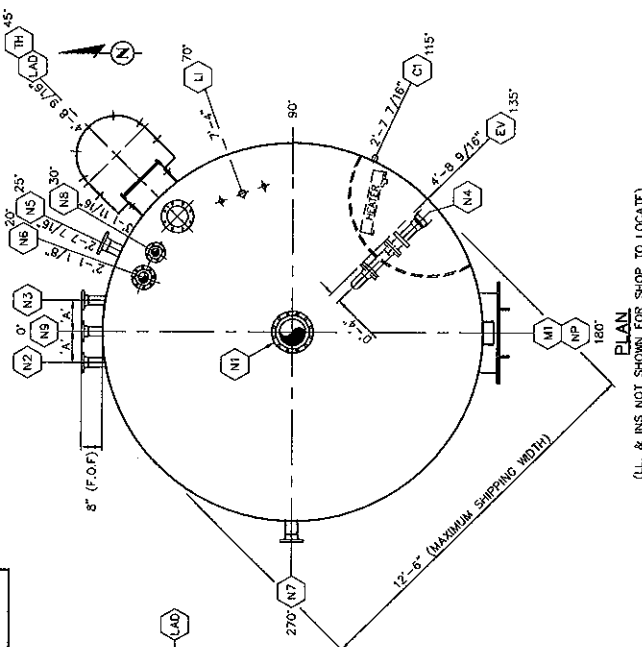
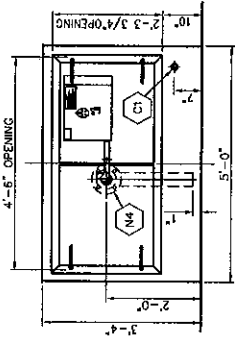
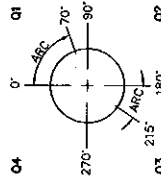
SMALL DIM'S TABLE	
TAG	DIMENSION
"A"	0'-11 13/16"

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.


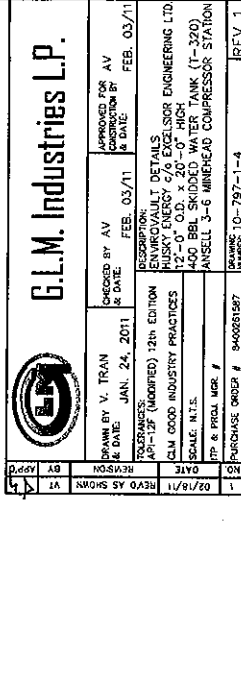
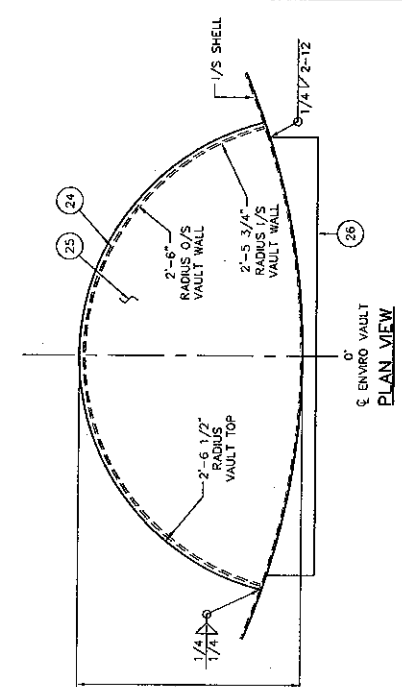
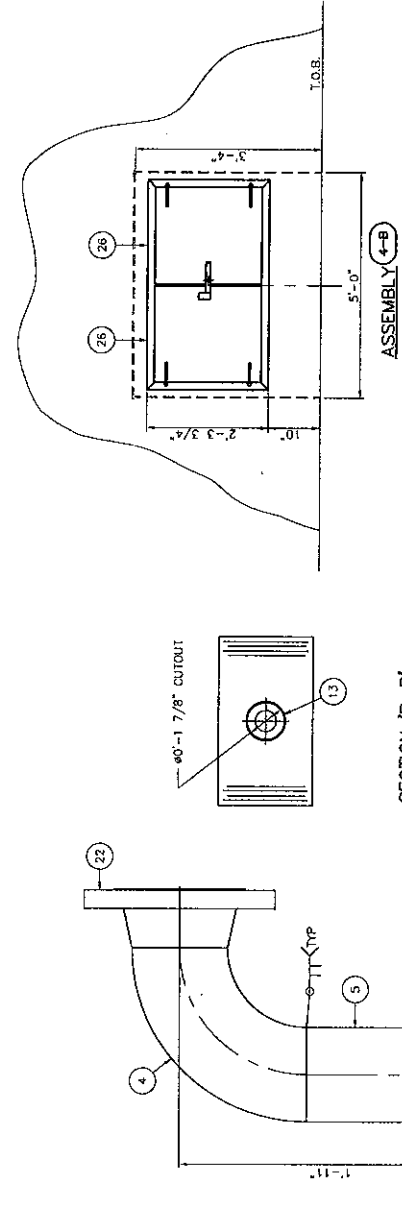
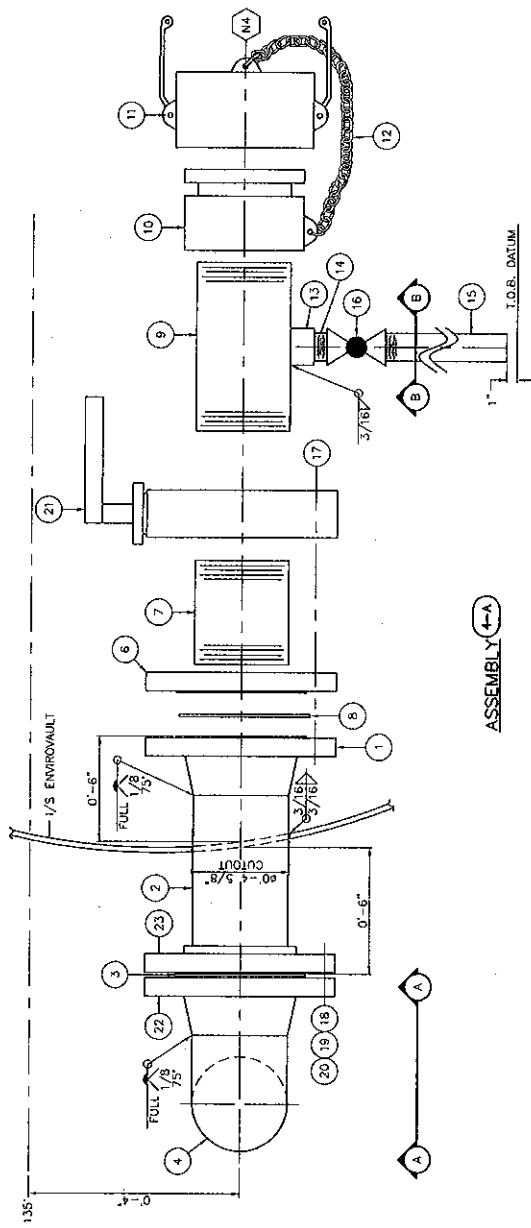
OUTSIDE DIAMETER = 12'-0"
 CIRCUMFERENCE = 37'-8 3/8"
 90° ARC LENGTH = 9'-5 1/8"



ELEVATION

[illegible]

BILL OF MATERIAL QUANTITIES SHOWN ARE FOR (03) TANK			
MATERIAL ITEM NO.	QTY PER UNIT	DESCRIPTION	WEIGHT (LBS)
4-A	1	ENVIRONMENTAL NOZZLE ASSEMBLY	
1	1	3" CL 150 R/W IN. C/W X 3/8" BORE	SA-105N
2	1	3" CL WT SMLS PIPE X 0-9 3/16" LG	SA-105N-B
3	1	3" CL 150 RING GASKET	NON-ASS
4	1	3" CL WT 90° L.H. WELDED ELBOW	A-402-WP-304
5	1	3" CL WT SMLS PIPE X 1-6 1/2" LG	A-402-TP304
6	1	3" CL 150 R/F COMPANION F.L.C.	SA-105N
7	1	3" CL WT ENVI PIPE T.B.E. X 0-4" LG	SA-53-B
8	1	CL 150 SPIRAL WOUND RING CASNET STYLE "CC"	NON ASS / SA-53-B
9	1	3" CL WT ENVI PIPE T.B.E. X 0-6" LG	SA-53-B
10	1	3" NPT MALE CAM LOCK	ALUMINUM
11	1	3" NPT FEMALE CAM LOCK CAP	ALUMINUM
12	1	1/8" PL. CHAIN X 1"-0" LG	NFG STD
(105)	1.3	1" CL 3000 NPT HALF COUPLING	SA-05N
	14	1" CL WT ENVI PIPE X 1"-8" LG	SA-53-B
	15	1 T.O.E. (SHOP TO TRIM TO SUIT)	SA-106-B
	16	1 C.S. BALL VALVE	NFG STD
	17	4 5/8" X 80 L.S. X 3/16" LG C/W (1) NUT EA.	Qr. 2 OK 5
18	4	5/8" STUDS X 3 1/2" LG C/W (1) NUT EA.	A-193-BB A-194-B
19	4	5/8" FLAT WASHERS	304 S.S.
20	4	5/8" FLAT WASHERS	NYLON
21	1	3" CLIP GATE VALVE	NFG STD
22	1	3" CL 150 R/W IN. C/W X 3/8" BORE	A-192-150A
23	1	3" CL 150 R/FSD F.L.C.	A-105
4-B	1	ENVIRONMENTAL ASSEMBLY	
EV (577)	24	1 1/4" PL. X 5'-0" W0 X 2-2 1/4" RAD. (ROLL TO 2'-5 3/4" 1/5 RAD.)	A-36
	25	1 1/4" PL. X SKETCH	A-36
	26	2 PRE-FABRICATED ENVIRONMENTAL DOORS	A-36



6'-0"

25'

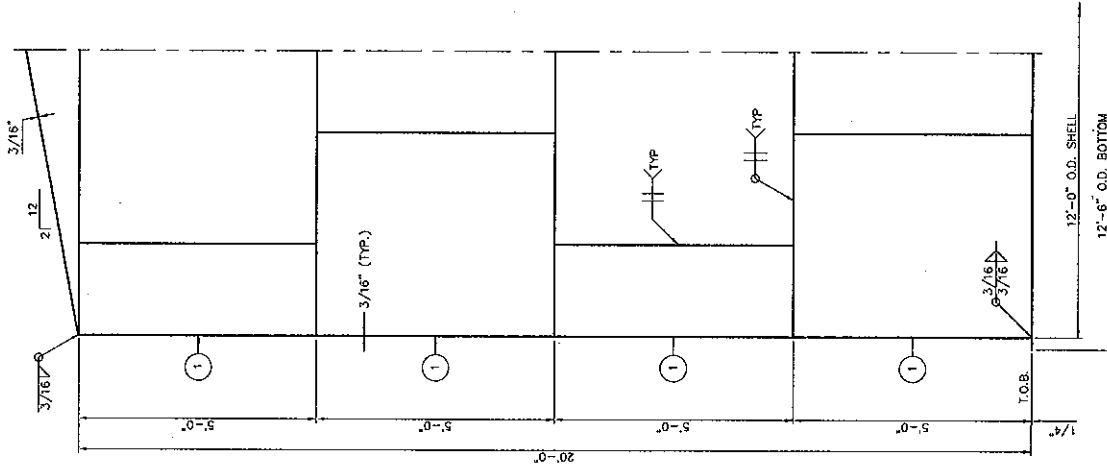
VAULT TOP LAYER

UNITED

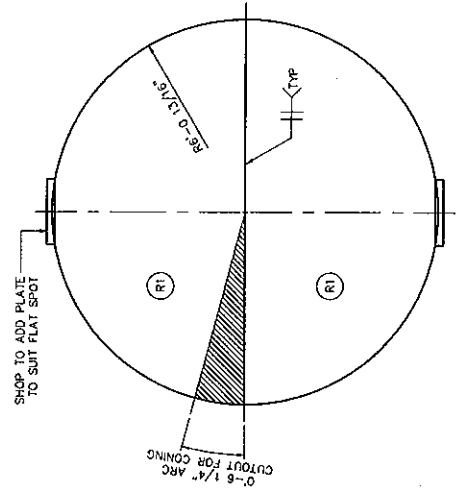
SECTION "B-B"
NOTE: COUPLING TO BE FLUSH

NOTES
1. SPECIF

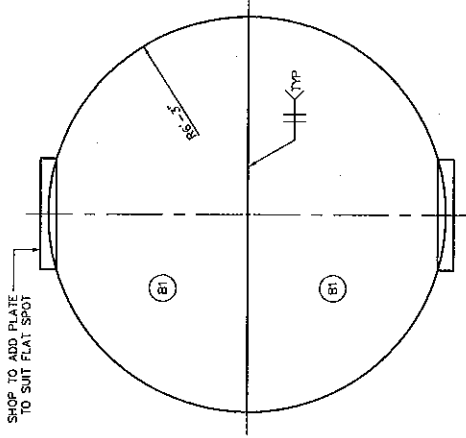
0'-1" I.O.S. DATUM



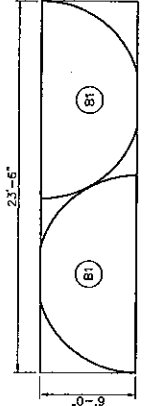
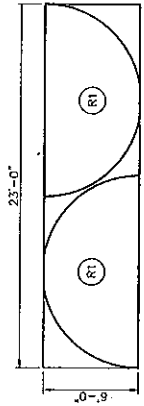
ASSEMBLY 50-A



ROOF LAYOUT



BOTTOM LAYOUT

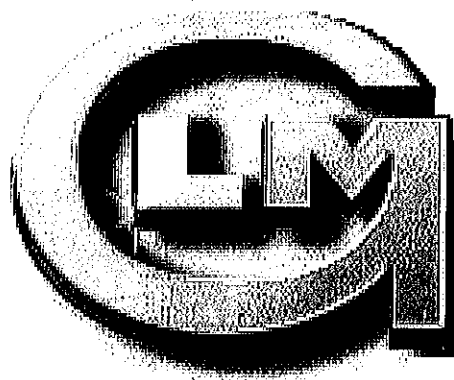


BILL OF MATERIAL QUANTITIES SHOWN ARE PER (Q1) TANK				
ITEM NO.	QTY	DESCRIPTION	SPECIFICATION	WEIGHT (LBS)
50-A	1	TANK ASSEMBLY		
1	4	3/16" PL. x 60" W.D. x 37'-7 1/2" L.G. (BOLL TO A 5'-11 13/16" /S RAD.)	A-36	5768 B
81	2	1/4" THK. PLATE x SKETCH	A-36	1253 B
82	2	3/16" THK. PLATE x SKETCH	A-36	882 B



G.L.M. Industries L.P.

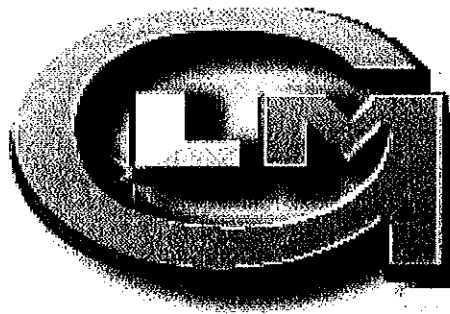
DESIGNED BY JAN. 10, 2011	CHECKED BY JAN. 10, 2011	APPROVED FOR CONSTRUCTION BY FEB. 07/11
PROJECT: TANK ASSEMBLY DETAILS HUSKY ENERGY C/O EXCELSIOR ENGINEERING LTD. 12'-0" O.D. x 20'-0" HIGH 400 BBL. SKIDDED WATER TANK (T-220) ANSELL 3-6 MINEHEAD COMPRESSOR STATION TYP. & PROD. MFR. #		
DATE	REVISION	NO.
PURCHASE ORDER # 940200487		REV. 0



G.L.M. INDUSTRIES L.P.

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

TABLE OF CONTENTS

Section	Page Number
Cover Page	1
Tank Design Summary	3
Settings	5
Shell	6
Self Supported Roof	10
Wind Overturning Analysis	15
Foundation	17
Anchor Chair	19
Repads	21
Lifting Lug	22
Appendix I	28
Center of Gravity	29
Appendix	30

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	<input checked="" type="checkbox"/>	See Notes:	Appendix J	<input type="checkbox"/>	Shop Built
Appendix A	<input type="checkbox"/>	Small Field Tanks	Appendix M	<input type="checkbox"/>	Elevated Temperature
Appendix E	<input type="checkbox"/>	Seismic	Appendix S	<input type="checkbox"/>	Stainless
Appendix F	<input checked="" type="checkbox"/>	Small Internal Pressure	Appendix V	<input type="checkbox"/>	External Pressure
Appendix I	<input checked="" type="checkbox"/>	Leak Detection	Appendix P	<input type="checkbox"/>	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 Apendices 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

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

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

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

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

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

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

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

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

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

$$1.334 > 0.19$$

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

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

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

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

$$H_{ts} = 20.0000 \text{ ft}$$

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

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

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

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

t_{\min} applies to all shell courses

$$t_{s\min} = 0.1875 \text{ in}$$

Max External Pressure for an unstiffened Shell

$$P_{\max} = 0.2 * E / ((H_{ts} / D) * (D / t_{s\min})^{2.5})$$

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

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

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

Intermediate Stiffening Rings



GLM INDUSTRIES, L.P.

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



GLM INDUSTRIES, L.P.

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



GLM INDUSTRIES, L.P.

Tank Data:

Nominal Diameter =	11.984 ft	Sd =	23200 psi
Height =	20 ft	Shell Joint Eff =	0.85
Pr =	48.13 psf	E =	28,800,000 psi
Roof Corrosion Allowance	0	Sts =	16000 psi
Consider CA for External Pressure?	No		

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



GLM INDUSTRIES, L.P.

NBC 2005 Snow Load

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

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

$$\text{Design Snow Load} = 1.78 \text{ kPa}$$

$$\text{Design Snow Load} = 37.18 \text{ psf}$$

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

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

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

$$\text{Roof Load} = 48.13 \text{ psf}$$

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

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

$$\text{Roof Load} = 27.99 \text{ psf}$$

Dead Load

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

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

$$DL = 9.52 \text{ psf}$$

Design Roof Load

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

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

$$T = 48.13 \text{ psf}$$

Roof Minimum Thickness

Appendix M 5.1 If Applicable

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

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

$$TF = 1.0000$$

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 in H₂O

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

$$t_{\text{roof2}} =$$

$$t_{\text{roof2}} =$$

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

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

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

$$\begin{aligned} X_{\text{roof}} &= 1.47 * (D * t_{\text{cone}} / \sin(\theta))^{\wedge}0.5 \\ X_{\text{roof}} &= 1.47 * (11.984 \text{ ft} * 0.1875 \text{ in} / \sin(10.62))^{\wedge}0.5 \\ X_{\text{roof}} &= 5.1330 \text{ in} \end{aligned}$$

$$\begin{aligned} \text{top } X_{\text{shell}} &= 1.47 * (D * t_{\text{top}})^{\wedge}0.5 \\ X_{\text{shell}} &= 1.47 * (11.984 \text{ ft} * 0.1875)^{\wedge}0.5 \\ X_{\text{shell}} &= 2.20 \text{ in} \\ A_{4\text{req}} &= Pr * D^2 / (8 * f * \tan(\theta)) \\ A_{4\text{req}} &= 48.13 \text{ psf} * 11.984^2 / (8 * 23200 * \tan(10.62)) \\ A_{4\text{req}} &= 0.0000 \text{ in}^2 \end{aligned}$$

Top Stiffener

$$\begin{aligned} A_{1\text{stiff}} &= (A_{\text{req}} - JE_s * t_{\text{top}} * X_{\text{shell}} - JE_r * t_r * X_{\text{cone}}) / JE_{\text{st}} \\ A_{1\text{stiff}} &= (0 \text{ in}^2 - 0.85 * 0.1875 \text{ in} * 2.2 \text{ in} - 0.7 * 0.1875 \text{ in} * 5.13 \text{ in}) / 0.7 \\ A_{1\text{stiff}} &= -1.464 \text{ in}^2 \\ A_{\text{stiff}} &= \text{Max}(0.5 * A_{4\text{req}}, A_{1\text{stiff}}) \\ A_{\text{stiff}} &= \text{Max}(0.5 * 0, -1.464) \\ A_{\text{stiff}} &= 0 \text{ in}^2 \end{aligned}$$

For Anchored Tanks Only

API 620 -5.12.4

$$\begin{aligned} w_h &= 0.6 * (R_2 * (t_h))^{\wedge}0.5 \\ w_h &= 0.6 * (389.662 * (0.1875))^{\wedge}0.5 \\ w_h &= 5.1286 \text{ in (Corroded Condition)} \\ w_c &= 0.6 * (R_c * (t_c))^{\wedge}0.5 \\ w_c &= 0.6 * (71.81 * (0.1875))^{\wedge}0.5 \\ w_c &= 2.2016 \text{ in (Corroded Condition)} \\ R_3 &= 71.81025 \text{ in} \\ F &= 0 \text{ psi} \quad \text{- additional downward force on Roof} \\ T_1 &= (R_3 / (2 * \sin(\theta))) * (DL + (W + F) / A) \\ T_1 &= (71.81 \text{ in} / (2 * \sin(10.62))) * (1 \text{ psi} + (-0.066 \text{ psi} + 0)) \\ T_1 &= 181.9532 \text{ lb/in} \\ T_2 &= DP * R_3 / \sin(\theta) \\ T_2 &= 1 \text{ psi} * 71.81 \text{ in} / \sin(10.62) \\ T_2 &= 389.6621 \text{ lb/in} \end{aligned}$$

Self Supported Roof



GLM INDUSTRIES, L.P.

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

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

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

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

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

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

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

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

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

API 620 5.10.3

$$t_{roof3} = \text{Max}(T_1, T_2) / (Sts * E) + RCA$$

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

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

Wind Overturning and Pmax



GLM INDUSTRIES L.P.

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.

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)	Mdl (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

$$M_w = (arm * area * P_H) + (area * arm * P_V)$$

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

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

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

Pressure Moment

$$M_{pi} = P_{int} * area * OD / 2$$

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

$$M_{pi} = 97,326 \text{ ft lbs}$$

Resisting Moment from tank weight

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

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

$$M_{dl} = 53,325 \text{ ft lbs}$$

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

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

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

$$W_L = w_a * pi * D$$

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

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

Liquid Resisting Moment

$$M_f = W_L * D / 2$$

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

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

If Internal pressure exceeds the following limits then Anchors are required

5.11.2.1

$$P_{max1} = (M_{dl} / 1.5 - 0.6 * M_w) / (pi / 8 * D^3)$$

(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

$$P_{max2} = [(M_{dl} + M_f) / 2 - M_w] / (0.4 * pi / 8 * D^3)$$

(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

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

(Check full tank)

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

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

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

Design Pressure = 16 oz

Anchors Required

Anchor Spacing (If Required)

Min Number of Anchors = circumference / 10

Min # Anchors = 11.984 ft * 3.14 / 10ft

Min # Anchors = 4

Estimated Tank Weight



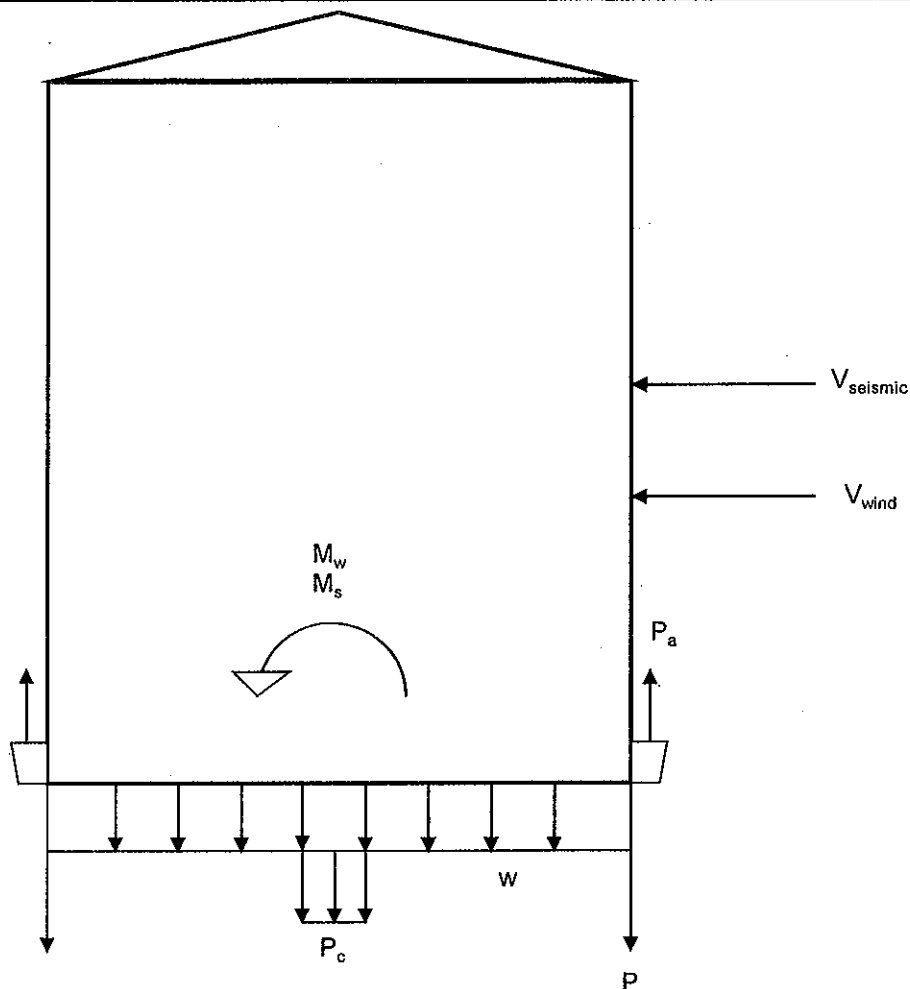
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Estimated Tank Weights

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



GLM INDUSTRIES, L.P.

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)

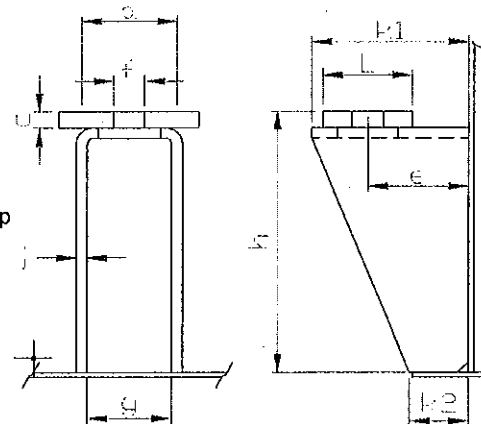
Uplift Load	Net Uplift Formula (lbf) and calculated result - U	Allowable Anchor Bolt Stress	Total Anchor Bolt Load	Allowable Shell Stress	Shell Stress (no Repad)
Design Pressure	$[(P-8*th)D^2 * 4.08] - W1$ 7,391 lbf	15,000 psi	7,391 lbf	20,000 psi	4,826 psi
Test Pressure	$[(Pt-8*th)D^2 * 4.08] - W1$ 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	4.918 kip
Anchor bolt diameter	d	1.25 in
Anchor chair height	h	12 in
Anchor bolt eccentricity	e	4.5 in
Top plate width along shell	a	5.5 in
Repad Height	H	0 in
Repad Width	A	0 in
Repad Thickness	tr	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



GLM INDUSTRIES, L.P.

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	0.4335	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

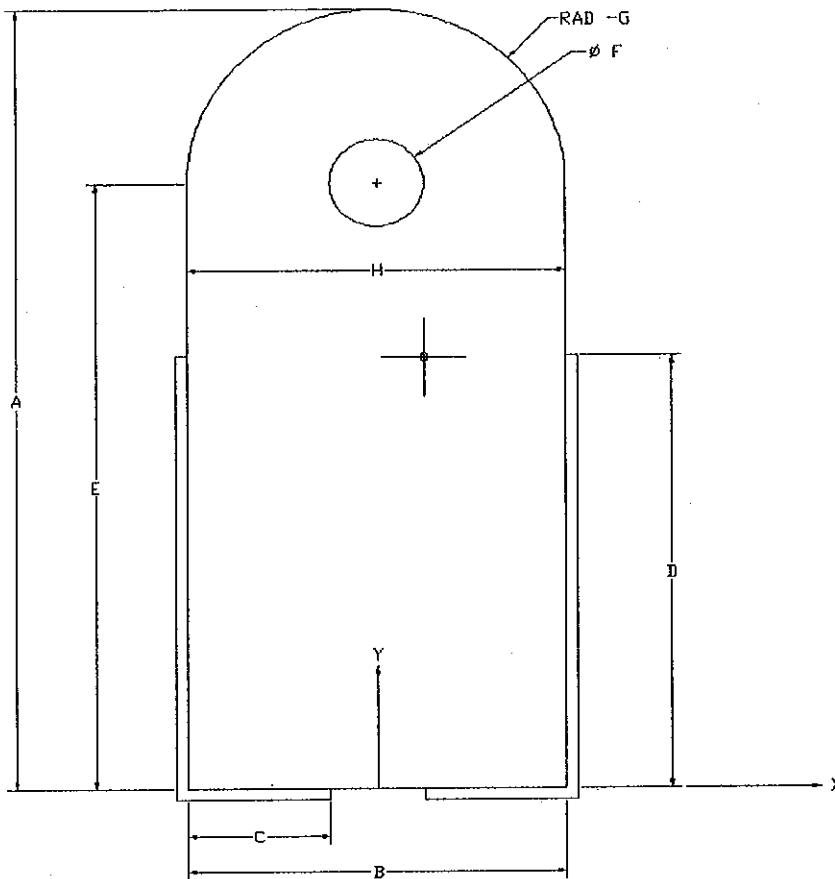
Nozzle Size NPS	Repads Required for Shell Course:							
	1	2	3	4	5	6	7	8
3	No	No	No	No				
4	No	No	No	No				
6	No	No	No	No				
8	No	No	No	No				
10	No	No	No	No				
12	No	No	No	No				
24*	No	No	No	No				
48	No	No	No	No				

* - API 650 Shell Manway

Lifting Lug Design/Lift Analysis



GLM INDUSTRIES, L.P.



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

$$\begin{aligned}\sigma_{All} &= 0.9 * \sigma_{Y.S.} \\ &= 0.9 * 38000 \text{ psi} \\ \sigma_{All} &= 34,200 \text{ psi}\end{aligned}$$

Allowable stress is from AISC (J8-1)

Shear Failure

$$\begin{aligned}\sigma_{All} &= 0.4 * \sigma_{Y.S.} \\ &= 0.40 * 38000 \text{ psi} \\ \sigma_{All} &= 15,200 \text{ psi}\end{aligned}$$

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

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

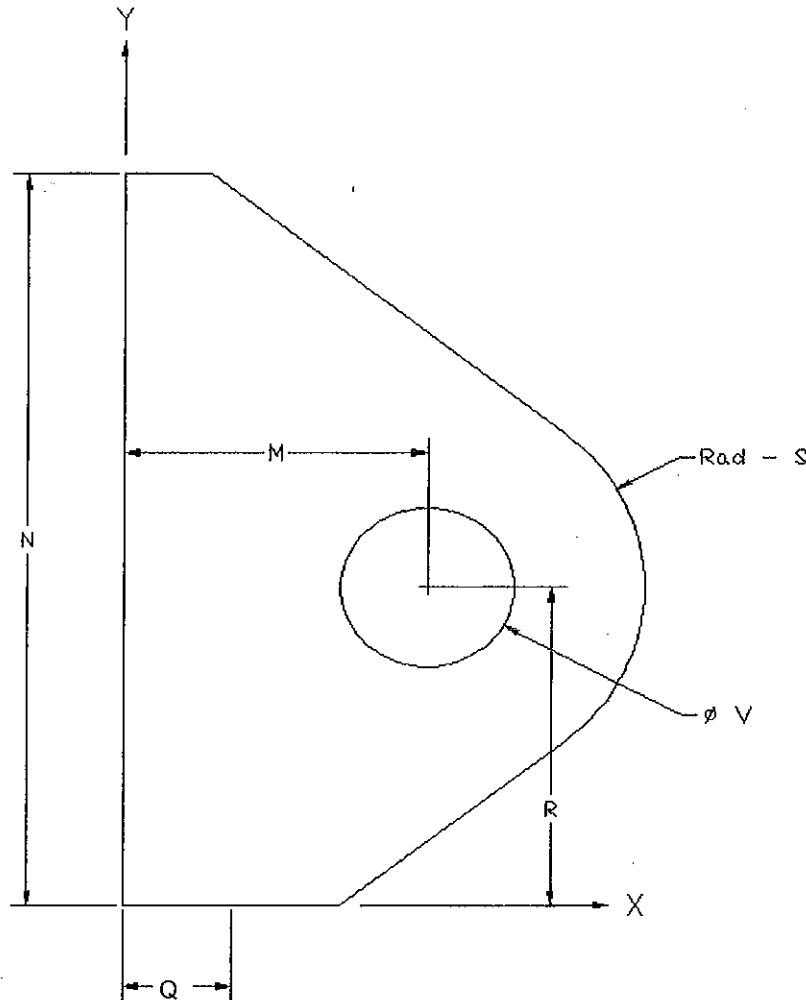
$$\tau_y = P * \sin \theta * (E - y\text{-bar}) * (B / 2) / J + P * \cos \theta / ((D + C)^2 * t)$$

$$\tau_{\text{Total}} = (\tau_y^2 + \tau_x^2)^{1/2}$$

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

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

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

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

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

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

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

$$J_1 = t * N^3 / 12 + N * t * (X^2 + (N/2 - Y)^2)$$

$$J_1 = 0.177 * 9^3 / 12 + 9 * 0.177 * (0.182^2 + (9/2 - 3.682)^2)$$

$$J_1 = 11.871 \text{ in}^4$$

$$J_2 = t * Q^3 / 12 + Q * t * (Y^2 + (Q/2 - X)^2)$$

$$J_2 = 0.177 * 2^3 / 12 + 0.177 * 2 * (3.682^2 + (2/2 - 0.182)^2)$$

$$J_2 = 5.154 \text{ in}^4$$

$$J = 2 * (J_1 + J_2) \quad \text{- Welded on both sides}$$

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

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

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



GLM INDUSTRIES, L.P.

$$T_{total} = (\tau_y^2 + \tau_x^2)^{1/2}$$

Table 2. Tailing Lug Stress (Twice tank Weight)

Angle	TL Load (lbs)	Weld Torque (lb in)	τ_x (psi)	τ_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

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

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

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

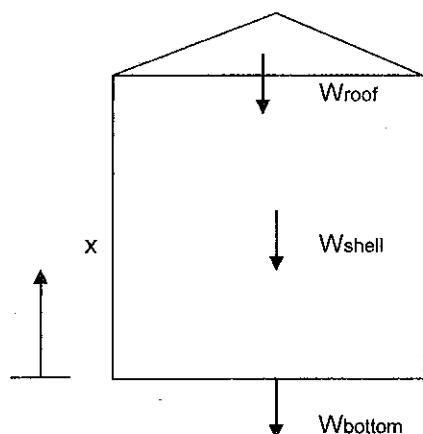
$$d_{\text{limit}} = (t_g) / 2$$

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

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
<i>for C3 x 4.1 3/8" from top of shell</i>		
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.



Title

Base Skid Analysis

3

APPENDIX 1:
BASE SKID ANALYSIS



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BASE SKID ANALYSIS:

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

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

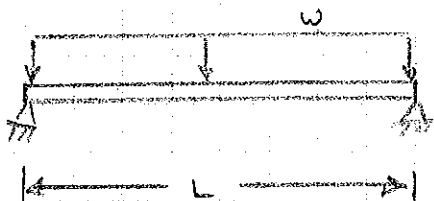
$$\text{WEIGHT} = PA = (9.67)(\pi)(72)^2 = 157486 \text{ lb.}$$

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

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

ASSUME (6) MAIN BEAMS TAKE THE ENTIRE WEIGHT

$$\text{RESULTANT LOADING, } w = \frac{\text{WEIGHT}}{\Sigma L} = \frac{172486}{(2)(135) + (2)(128) + (2)(89)} = 245 \text{ lb/in}$$



ALLOWABLE STRESSES ($640.21 \cdot 4/w$ MATEL)

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

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

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

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

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

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

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

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

USE 8" x 4" x 1/4" HSS

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

CHECK INNER BEAMS:

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

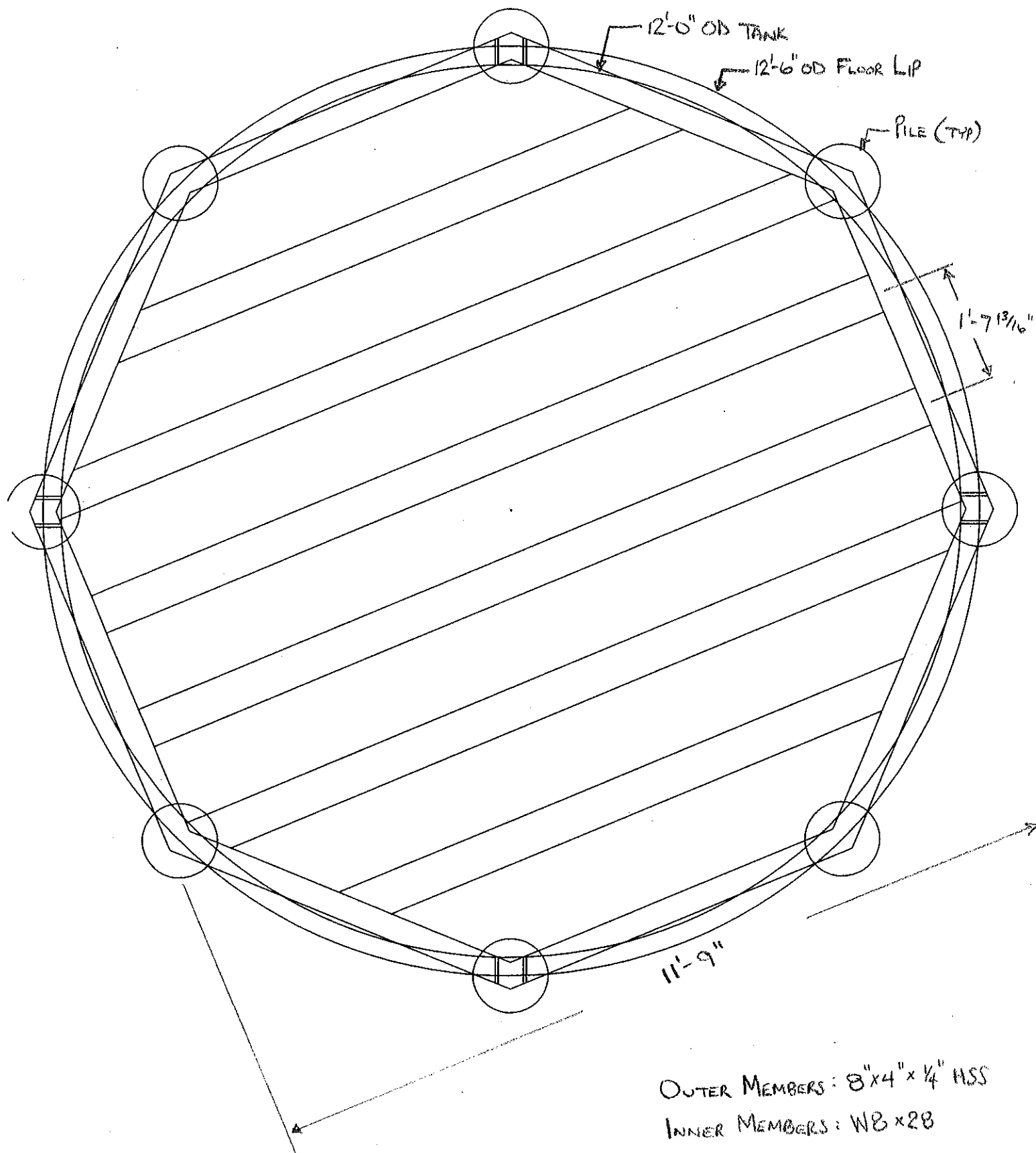
$$S_{REQ'D} = \frac{M}{\sigma_{BALL}} = \frac{WL^2}{8\sigma_{BALL}} = \frac{(245)(135)^2}{8(26100)} = 21.4 \text{ in}^3$$

USE WB x 28

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

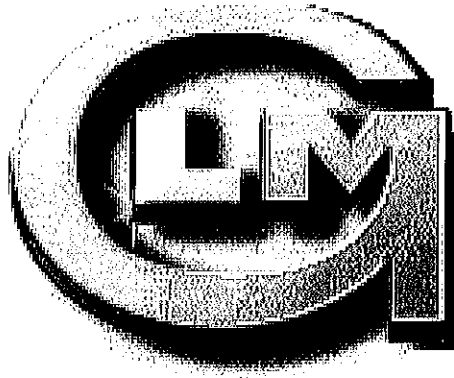
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BASE SKID LAYOUT:



JB
JAN 4/11

10-797-1/2
SHT. 3 OF 3



G.L.M. INDUSTRIES L.P.

SECTION 3

MATERIAL TEST REPORTS



MATERIAL IDENTIFICATION SHEET

GLM JOB #:		DESCRIPTION:		CUSTOMER:		FAB. FACILITY: Nisku
10-797-1		12'-0" O.D. X 20'-0" HIGH 400 BBL Skidded Water Tank (T-320)		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	N2	70225
3	25	1	3" XS SMLS PIPE	SA-106-B	N2	965485
3	26	1	3/16" THK REPAD X SKETCH	A36	N2	1457V
3	27	1	3" XS RFWN 150#	SA-105N	N9	70225
3	28	1	3" XS SMLS PIPE	SA-106-B	N9	965485
3	29	1	3" XS RFWN 150#	SA-105N	N3	70225
3	30	1	3" XS SMLS PIPE	SA-106-B	N3	965485
3	35	1	1 1/2" NPT FULL COUPLING 3000#	SA-182-F304		Q268
3	36	2	1 1/4" NPT COUPLING 3000#	SA-182-F304		87B1
3	37	1	1" NPT COUPLING 3000#	SA-182-F304		N936
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		NT8184
50	R1	2	3/16" THK REPAD X SKETCH	A36		NT7748

NUCOR STEEL TUBCALOOSA, INC.

A080896

[illegible]

SAWYER, SON & CO., LTD.
CERTIFIED COPY OF
TEST REPORT
YOUR NO. 905669
OUR ORDER 38750
DATE 08/10/10.
FILED BY:

100% indicates Hots melted and Manufactured in the USA

MTR VERIFICATION STAMP
 DATE: **AUG 18 2010**
 CONFORMS TO ASME § II A EDITION / ADDENDA: **2009b**



INSPECTION CERTIFICATE

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

58142

717

SOCALSA S.A.
 Dr. Jorge A. Smith 250
 1200 METRY CAMPESIA
 Buenos Aires, Argentina
 (54) 3485 43100 INT.
 (54) 3485 43102 EXT.

Client / Customer VAN LEEUWEN CANADA		Expediente / Manufacturing Order 571387.03		Numero / Number 452585		Fecha / Date 12/08/2006		Pag / Page 1 / 5	
Product / Product SMALLS LINE PIPE		Orden de Compra / Purchase Order 45001146		Referencia del Cliente / Customer Reference Item 3					
Norma / Standard API 5L EDA4150 3183-07 + ASMA 53-196 + CSANZAS R1+P4.17.01 20+VACENR0775MR0103		Grado / Grade B/X42-80SS		Extremos / Ends BEVEL AT 30 DEG APPEL ISO					
Dimensions / Dimensions 273.10 x 9.30 mm		Peso Nominal / Nominal Weight 60.30 KG/MET		Superficie / Surface INT BARE EXT VARNISHED		Cantidades / Quantities 234 Pcs		230389 Kg	
Schedule 40		Longitud / Length DR (SP)				234 Pcs		12522.57 Ft 507943 Lb	

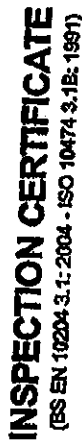
ENSAYOS DE TRACCION / TENSILE TEST

ENSAYOS DE TRACCION / TENSILE TEST																								
Código Ensayo	Condiciones de la probeta				Dimensiones		Sección	Fluencia / Yield Strength				Rotura U.T.S				Alargamiento Elongation				Reducción de área		Dureza / Hardness Tipo / Type BH-N		
	Heat	Test Nr	Specimen condition		Test Temp	Size		Area	EUT Method				EUT Method				Lo	Z	Y	V	R ₄₀	R ₅₀	R ₆₀	R ₇₀
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NOTA / NOTE

Pro = Proceso de fabricación / Manufacturing process
 N = Normalizado / Normalized
 DNST = Desnormalizado / Unnormalized
 Q & T = Normalizado y Tratamiento Térmico / Normalized and Heat Treatment
 TART = Tratamiento Térmico / Heat Treatment
 RE = Resistencia / Resistance
 CI = Capacidad / Capacity
 ST = Tensión / Tension
 L = Longitud / Length
 T = Travesaño / Transverse
 PIT = Tubo / Pipe
 EXT = Extremo / End
 M = Medio / Middle
 V. Chl = Valor Cantidad / Quantity value
 Consenso de medición / Measuring consensus
 Extremo opuesto al 50 por ciento estimado en E
 Extremo opuesto al 50 por ciento estimado en E

10.365 AS3B/5A 106B/5L-x42 smL BE SR



SIDERCA S.A.I.C.
Dr. Jorge A. Smits 250
(12200-MIA) Campana
Buenos Aires, Argentina
CSA 3489 43100 tel.
CSA 3489 43305 fax

Clients / Customer VAN LEEUWEN CANADA						Especialty Manufacturing Order 971357.03						Número / Number 455585		Fecha / Date 12/08/2008		Pág./Page 2 / 6	
Producto / Product SMALLS LINE PIPE												Orden de Compra Purchase Order 45001146		Item 3		Referencia del Cliente / Customer Reference	
Normal / Standard API 5L EDAISO 3188-07 + NISA 33-105 + CSAZ245 R5+P4.17.01 RCNACEMIROTTSMR0103						Grado / Grade BXXC245250SS						Extremos / Ends BEVEL AT 30 DEG API SL ISO					
Dimensions / Dimensions 273.10 x 9.53 mm 10.750 x 0.385 inches			Schedule 40			Peso Nominal / Nominal Weight 60.30 KG/MET 40.52 LB/FT			Longitud / Length DR (SP)			Superficie / Surface INT BARE / EXT VARNISHED			Cantidades / Quantities 294Pcs 3816.88 m 294Pcs 12522.57 Ft		
												ENSAYOS QUIMICOS / CHEMICAL ANALYSES					

ENSAYOS QUIMICOS / CHEMICAL ANALYSES

ENSAYOS QUIMICOS / CHEMICAL ANALYSES																																				254Pcs	12522.57 R	5073431LB																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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Sum 1 = 2000000000

118.5) + 57.6N + 14.0M + 2.0V + 2.0CR + 14.0W + 18.7S + (5.7B)

SECRET

100

1

CONFIDENTIAL

第一卷



INSPECTION CERTIFICATE

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

SORICA S.A.C.
Dr. Jorge A. Soria 220
02000AAV0 Campoz
Buenos Aires, Argentina
E54 3481 433100 Tel.
(54) 3481 433105 Fax

Cliente / Customer VAN LEEUWEN CANADA	Expediente / Manufacturing Order 51387.03	Número / Number 455385	Fecha / Date 12/02/2006	Pág. / Page 3 / 5
Producto / Product SMALL LINE PIPE	Orden de Compra / Purchase Order 45001146	Item 3	Referencia del Cliente / Customer Reference	
Norma / Standard API 5L EDAISO 3183-07 + ASA 53-105 + CSN 2245 E1+P4.17.91 R3+NAEIR01756R0183	Grado / Grade BX42+290SS	Extremos / Ends BEVEL AT 30 DEG APRESURSO		
Dimensiones / Dimensions 273.10 x 9.30 mm	Superficie / Surface INT BARE / EXT VARNISHED	Cantidades / Quantities 294 Pcs 3016.35 m 230339 Kg		
10.750 x 0.353 inches	Peso Nominal / Nominal Weight 60.30 KG/MET	294 Pcs 12522.57 R 5879431b		
	Longitud / Length DR (SP)			

ENSAYOS QUIMICOS / CHEMICAL ANALYSES

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Producto / Product SMLS LINE PIPE		Orden de Compra / Purchase Order 45391148		Item 3		Referencia del Cliente / Customer Reference			
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272.10 x 9.30 mm		40		60.30 KG/MT		INT BARE EXT VARNISHED		294 Pz		230399 Kg	
16.750 x 0.365 inches				40.52 LB/FT				294 Pcs		597943 Lb	

<p>¿Es la presente descripción del material así descrito ya sea listado o de otro modo, en forma de especificaciones, suficiente para permitir a un fabricante de productos de este tipo, fabricar un producto que sea sustancialmente igual al que se describe en la presente especificación?</p>	<p>¿El presente material ha sido descrito en forma de especificaciones suficientes para permitir a un fabricante de productos de este tipo, fabricar un producto que sea sustancialmente igual al que se describe en la presente especificación?</p>	<p>¿El presente material ha sido descrito en forma de especificaciones suficientes para permitir a un fabricante de productos de este tipo, fabricar un producto que sea sustancialmente igual al que se describe en la presente especificación?</p>	<p>¿El presente material ha sido descrito en forma de especificaciones suficientes para permitir a un fabricante de productos de este tipo, fabricar un producto que sea sustancialmente igual al que se describe en la presente especificación?</p>	<p>¿El presente material ha sido descrito en forma de especificaciones suficientes para permitir a un fabricante de productos de este tipo, fabricar un producto que sea sustancialmente igual al que se describe en la presente especificación?</p>	<p>¿El presente material ha sido descrito en forma de especificaciones suficientes para permitir a un fabricante de productos de este tipo, fabricar un producto que sea sustancialmente igual al que se describe en la presente especificación?</p>	<p>¿El presente material ha sido descrito en forma de especificaciones suficientes para permitir a un fabricante de productos de este tipo, fabricar un producto que sea sustancialmente igual al que se describe en la presente especificación?</p>
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[illegible][illegible]

QUALITY CERTIFICATION DEPT.
DITO CERTIFICACION DE CALIDAD
ESUARDO A. VERRE



METALFAR

PRODOTTI INDUSTRIALI S.P.A.

CAMPARIO A CALDO IN ACCIAIO CORRU-LEGGERE E RISPONDEBILI
QUALITÀ E PREZZO

Tel. +39 071 655441
Fax +39 071 655449

28051 CESSANA BRANCA (LC) - Italy
Via G. Patti, 28

SOCIETÀ AMMINISTRATIVA E SOCIETÀ ADDETTE

COMMITMENT WITH QUALITY MANAGEMENT

CERTIFICATO DI COLLAUDO SECONDO EN 10204 - 3.1 INSPECTION CERTIFICATE

GLOBAL GATE SERVICE LTD

Unit 1E, Block 71, The Plaza Nangor Road
DUBLIN 12

Card#	N.	2570	28.06.2010
Fatura / Invoice	N.	1921	28.06.2010
DOT / Del Norte	N.	3553	28.06.2010
No.Ord. / Our ref.	N.		28.06.2010

P29.3 • 9

[illegible][illegible][illegible]

NOTE MATERIAL IN ACCORDANCE WITH NACE MR-0175/2003 ISO 15156
NOTES MATERIAL IN ACCORDANCE WITH NACE MR-0175/2003

REPERCUSSIONS

DATE: ~~SEP 07 2010~~

CONFORMS TO ASME :: A

EDITION / ADDENDA: 2009/6

**UFFICIO CONTROLLO QUALITA'
QUALITY CONTROL DEPARTMENT**

ENTE UFFICIALE DI COLLABORAZIONE
INSPECTION AUTHORITY

**MARCHIO PRODUZIONE
MANUFACTURER'S SYMBOL**



965485

V&M FRANCE TUBERIE SAINT SAULVE SAINT SAULVE ZONE INDUSTRIELLE 69880 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. LA1989 (A03.2) Suborder 666/6988 0
(A06.1) Customer CCTF 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 (± 0.6) 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.1:2006 / EN ISO 15156-2:2003, Annexe A.2.1.2 Nace MR 0103-2006, Paragraph 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
(B05) 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	(B09) Dimensions	(B10) Single length
14		SKU No 2620419	NPS 3 SCH 80 OD-Tolerance + 0.75 % - 0.75 % WT-Tolerance + 15 % - 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. : 110705v10 Page: 2 / 5 Date: 19.11.2010
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(A13) V&M Item	(A06) Cust. Item	(B07.1) Heat	(B04) Quantity	(B11) Total length m	(B13) Weight lb
14		985485	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 1.06 % would be permitted to a maximum of 1,35% manganese.

(B07.1) Heat	(B16) Process	C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Cu %	Ti %
min	-	-	0,10	0,29	-	-	-	-	-	-	-
max	-	0,26	0,50	1,06	0,030	0,030	0,40	0,15	0,40	0,40	0,11
985485	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 %	1099 %				
min	-	-	-	-	3,00	-	-	-				
max	0,11	0,08	0,001	0,15	-	1,00	0,40	0,40				
985485	0,00	0,00	0,000	0,00	4,84	0,52	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)/16
1099	C+F(MN/8+SI/24+CU/15+NI/20+((CR+MO+V+NB)/5)+5*B)

Heats fully killed

(C72)

PRODUCT CHEMICAL ANALYSIS

For each reduction of 0,01% carbon below 0.30 %, an increase of 0,05% manganese above 1.06 % would be permitted to a maximum of 1,35% manganese.

V&M FRANCE TUBERIE SAINT SAULVE SAINT SAULVE ZONE INDUSTRIELLE 89880 SAINT SAULVE	 VALLOUREC & MANNESMANN TUBES Vallourec Group	MATERIAL TEST REPORT - INSPECTION CERTIFICATE 3.1 EN 10204 : 2004 No. : 110709sv10 Page: 3 / 5 Date: 19.11.2010
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(072)
PRODUCT CHEMICAL ANALYSIS

(807.1) Heat	(C00.1) Test Place	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	0,15	0,40	0,40	0,11
985485	01DL276	0,16	0,19	0,75	0,018	0,002	0,23	0,06	0,08	0,16	0,00
985485	02DL276	0,16	0,19	0,75	0,017	0,002	0,23	0,06	0,08	0,16	0,00

(807.1) Heat	(C00.1) Test Place	Nb/Cb %	V %	B %	0002 %	2628 %	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	0,35		
985485	02DL276	0,00	0,00	0,000	0,00	4,61	0,53	0,36	0,35		

0002	V+NB+Ti
2628	MN/C
0014	CR+CU+MO+NI+V
1003	CE = C+MN/8+(CR+MO+V)/5+(NI+CU)/16
1099	C+P(MN/8+SI/24+CU/16+NI/20+((CR+MO+V+NB)/5)+5*B)

(834)
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 69660 SAINT SAULVE	 VALLOUREC & MANNESMANN TUBES Vallourec Group	MATERIAL TEST REPORT - INSPECTION CERTIFICATE 3.1 EN 10204 : 2004 No. : 110708v10 Page: 4 / 5 Date: 18.11.2010
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TENSILE TEST RESULTS

(807.1) Heat	(C00.1) Test Piece	(C10.2) Dimension	(C11) YS	(C12) TS	(C13.2) Elong.						
		ln / sq in	R _{p0.2} psi	R _m psi	2" %						
min		-	42000	60000	24,0						
max		-	-	-	-						
985485	01DL276	0,74x0,30 0,22	47296	72975	33,8						

(C10.2) Dimension	Test piece dimensions Test piece area
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HARDNESS TEST RESULTS

99 HRB EQUIVALENT TO 22 HRC

Method of test (C30)	Rockwell B
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(807.1) Heat	(C00.1) Test Piece	(C31.1) HRB	(C31.1) HRB	(C31.1) HRB	(C32.1) Mean						
min		-	-	-	-						
max		99,0	99,0	99,0	-						
985485	01DL276	81,0	81,0	81,0	81,0						

(C30)

TECHNOLOGICAL AND OTHER TESTS ON SPECIMENS

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

(C34)

OTHER TESTS ON PIPE

Test	Conditions	Test rate	Result
Hydrostatic test	2873 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

(A04, B04)

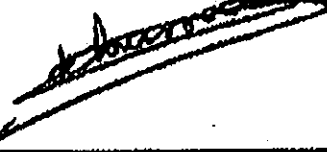
MARKING, IDENTIFICATION

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 88.90 X 7.62 B + X42 + 280 CAT 1 PSL1 8 SMLS 2870 PSI HT HEAT NUMBER 98 SCH 80 VM2454 4888381-00 LENGTH LENGTH
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V&M FRANCE TUBERIE SAINT SAULVE SAINT SAULVE ZONE INDUSTRIELLE 59880 SAINT SAULVE	<div data-bbox="699 161 810 275" data-label="Image"> </div> <p>VALLOUREC & MANNESMANN TUBES Vallourec Group</p>	MATERIAL TEST REPORT - INSPECTION CERTIFICATE 3.1 EN 10204 : 2004
		No. : 11070Sv10 Page: 5 / 5 Date: 19.11.2010

(201)
The supplied products are in compliance with the requirements of the order

(A05, 202, 203)

Date	19.11.2010
Validated by	Inspection Representative
	Valérie DELACROIX 
☎	+ (33) 3 27 23 14 56
☎	+ (33) 3 27 23 15 25
✉	valerie.delacroix@vmtubea.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, Jen Hsin Road, Jen Wu Hsiang
Kaohsiung Hsien, Taiwan, R.O.C.
TEL: 07-3724249; FAX: 07-3712923
URL: www.saneng.com.tw
e-mail: saneng@kts.seed.net.tw

MILL TEST CERTIFICATE

EN10204-3.1.B(DIN50049/3.1.B)

Customer: WEE FITTINGS & FLANGES (CANADA)

LTD.


Order No.: D000209575908553

Certificate No.: SE100555

Date: 01/17/2011

Page: 1 OF 1

80407

PRODUCT		MATERIAL SPECIFICATIONS		DIMENSIONAL SPECIFICATIONS													
FORGED CARBON STEEL FLANGES		ASTM A105-09/ASME SA105-09		ASME B16.5-09 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	0.250	1.060	0.009	0.009	0.009	0.041	0.044	0.005	0.031	0.005	0.004	0.398	
2		150 WNRFD STD 4" A105N	1,935 PCE	0.200	0.210	1.100	0.013	0.010	0.130	0.090	0.050	0.013	0.008	0.001	0.008	0.418	
3		150 WNRFD XS 4" A105N	15 PCE	0.200	0.210	1.100	0.013	0.010	0.130	0.090	0.050	0.013	0.009	0.001	0.008	0.418	
4		600 WNRFD XS 6" A105N	5 PCE	0.207	0.250	1.070	0.012	0.015	0.012	0.029	0.046	0.005	0.011	0.005	0.004	0.398	
Item No.	Heat No.	T.S.(*) (MPa)	Y.S.(*) (MPa)	EL.(*) (%)	Hardness (HRC)	RA.(*) (%)	Impact Test Temp: Minimum: Joule	Material Supplier	HEAT TREATMENT(*) EX N								REMARKS
1	21383	517.8	379.5	35.8	153	59.5	2	NTMK	880°C X 3HRS								CONFORMS WITH NACE MR0103-07 AND NACE
2	80407	533.5	395.2	34.4	154	59.5	3	WEI CHIH STEEL									MR017/ISO15155.2
3	80407	533.5	395.2	34.4	154	59.5		WEI CHIH STEEL									CONFORMS WITH Z245.12 CAT I GR.248 SOUR
4	40747	503.1	335.4	35.4	149	58.6		NTMK									SERVICE-05
TEST SPECIMEN ORIENTATION: TRANSVERSE																	
<div style="text-align: center;"></div>																	
*1: T.S. = Tensile Strength, Y.S. = Yield Strength, EL. = Elongation, RA. = 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: 1/17/2011 REVIEW BY: [Signature]

CONFORMS TO ASME S II 14 EDITION / ADDENDA: 2009b



MILL TEST CERTIFICATE CERTIFICADO DE PRUEBAS EN FABRICA

24137

PO# 7423

Alpura Tubes Inc.
547 Millbrook Terrace
Caledon, Ont. L9R 4Y1
POC 113
(905) 940-8130 ext
(705) 940-8131 fax

Customer / Cliente: MCJUNKIN RED MAN TUBULAR		Customer's Order Item / Orden Cliente - Item: PO # 0012 726237 4D0		Date / Dia: December 28, 2010	
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED		Product Type / Tipo de Producto: LINE PIPE SEAMLESS		Number / Número: 00030169	
Standard or Specification / Norma o Especificación: 22AS.1 APRIL 2007, ASME/ASTM SAJ106 B/2006		CONDUCCION SIN COSTURA		Page / Página: 1/7	
Dimensions / Dimensiones: 4.5 X 0.337 INCH 114.3 X 8.56 MM		Schedule / Catálogo: 080		Date / Dia: December 28, 2010	
Length / Longitud: 18.01 / 21.98 FT 5.49 / 6.70 MTS		Steel Grade / Grado de acero: B290 SS		Customer's Reference / Ref. del Cliente: 0012 726237 4D0	
Quantity / Cantidad: 262 Pcs/Pz		Nominal Weight / Peso Nominal: 15.00 LB/FT 22.32 KG/M		Manufacturer's Works Order N° / Confirmación de Venta: 007103703	
Surface / Superficie: VARNISHED		Ends / Extremos: NORMAL BEVEL		Surface / Superficie: BARNIZADO	
BISelado NORMAL		Nominal Weight / Peso Nominal: 15.00 LB/FT 22.32 KG/M		Ends / Extremos: NORMAL BEVEL	

TENSILE TEST / ENSAYO DE TENSION

Heat N° Caldas 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. Yield strength	U.T.S. Tensile strength	Elongation / Alargamiento	
			Ls	Sc	Type	On	Temp.			Req.	Obt.
24137	21708	00001	B	AM	SS	L	RT	51 829	72 224	0.71	25.4
24137	21709	00002	B	AM	SS	L	RT	51 046	72 823	0.70	25.4
24139	21710	00001	B	AM	SS	L	RT	53 535	75 240	0.71	25.3
24139	21711	00002	B	AM	SS	L	RT	56 408	79 946	0.73	25.0
24151	21698	00001	B	AM	SS	L	RT	52 127	72 992	0.71	25.3
24151	21699	00002	B	AM	SS	L	RT	53 393	73 704	0.72	25.3

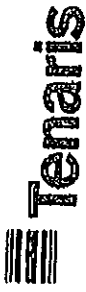
As manufactured / Según proceso de fabricación	Location of sample / Ubicación de la muestra	Orientation / Orientación	Specimen condition / Condición de la probeta
Body / Cuerpo	Max. Maximum / Máximo	Req. Max Required maximum / Máximo requerido	Sc: Strip specimen / Muestra rectangular
Longitudinal / Longitudinal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

MTR VERIFICATION STAMP

DATE: Dec 28 '11 REVIEW BY: [Signature]
CONFORMS TO ASME § II # EDITION / ADENDA: 2006

This certificate is issued by a computerized system and it is valid with electronic signature. On the original certificate, the electronic signature must be present. If the original certificate is not available, a copy of it must be obtained from the original one. Any alteration or modification will be subject to the law.

FOR03171



MILL TEST CERTIFICATE
CERTIFICADO DE PRUEBAS EN FABRICA

Algonia Tubes Inc.
547 Wallace Terrace
Sault Ste. Marie, ON CANADA
POB 119
(705) 946-6130/41
(705) 946-6131 fax

Customer / Cliente: MCJUNKIN RED MAN TUBULAR	Customer's Order Item / Orden Cliente - Item: C012 726237 4D0	Number / Número: 00030169	Page / Página: 2 / 7
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED	Product Type / Tipo de Producto: LINE PIPE SEAMLESS	Date / Día: December 28, 2010	
Standard or Specification / Normas o Especificaciones: Z345.1 APRIL2007, ASME/ASTM SAA106 B2006	CONDUCCION SIN COSTURA	Customer's Reference / Ref. del Cliente: C012 726237 4D0	Manufacturer's Works Order N° / Confirmación de Venta: 0007103703
Dimensions / Dimensiones: 4.5 X 0.337 INCH 114.3 X 8.56 MM	Schedule / Códulo: 060	Surface / Superficie: VARNISHED	Ends / Extremos: BARNIZADO
		Steel Grade / Grado de acero: B230 SS	
	Length / Longitud: 18.01 / 21.96 FT 5.49 / 6.70 MTS	Quantity / Cantidad: 262 Pcs/Pz 5535.914 FT 1687.316 MTS	Normal BEVEL BISELADO NORMAL Nominal Weight / Peso Nominal: 15.00 LB/FT 22.32 KG/M

CHEMICAL COMPOSITION / COMPOSICION QUIMICA

		Composition % / Composición %																		P: Product / Producto	
		x 100						x 1000						x 1000							
Heat N° Colado N°	Sample N° Muestra N°	C	Mn	Si	Cr	Mo	S	P	Ni	V	Co	Al	Sn	As	Nb	Ti	Co	B	N	Ca. 2	
		Max	Min	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max
24137	00001	H	15	111	24	4	1	11	20	15	48	25	4	3	1	2	15	1	78	35.2	
24137	21355	P	14	108	24	4	2	3	11	18	16	47	24	4.2	2	1	12	2	49	33.9	
24137	21356	P	14	108	23	4	2	3	11	19	15	48	24	4.1	2	0.8	15	2	46	33.9	
24139	00001	H	16	109	25	4	1	12	11	25	21	41	28	5	2	1	11	1	79	36	
24139	21656	P	15	105	24	5	1	3	10	22	19	42	23	5	2	0	6	1	72	34.5	
24139	21657	P	15	104	24	5	1	3	10	22	19	41	23	5	2	1	8	1	72	34.3	
24151	00001	H	15	109	24	2	1	11	20	18	28	24	5	2	1	2	12	1	80	34.4	
24151	21688	P	14	107	24	3	2	10	17	19	29	23	5	2	0	7	2	58	33.5		

Ca. 2: Carbon equivalent/Carbono equivalente

Max: Maximum / Máximo

Min: Minimum / Mínimo

Ca. 2: Carbon equivalent/Carbono equivalente
H: Heat / Colado

This certificate is issued by a computer system and is a valid electronic signature. On the original certificate two bubble marks given others Tenaris' is stamped. In case the owner of the original certificate would release a copy of it, he must attach the company's seal and the original one taking upon himself the responsibility for any misuse or not allowed too. Any alteration and/or falsification will be subjected to the law.
Este certificado es emitido mediante sistema computacional y es válido con firma electrónica. El certificado original posee impresos el logo Tenaris color verde. En caso de que el poseedor del certificado, entregue una copia, deberá garantizar la conformidad con el original/huella verde responsable por cualquier uso ilegal o indebido. Cualquier alteración y/o falsificación estará sujeta a la ley.

FOR03171



MILL TEST CERTIFICATE CERTIFICADO DE PRUEBAS EN FABRICA

Alcan Tubos Inc.
547 Wallace Terrace
Sault Ste. Marie, ON CANADA
POC 1L9
(705) 940-8100 Int
(705) 946-3131 Fax

Customer / Cliente: MCJUNKIN RED MAR TUBULAR		Customer's Order Item / Orden Cliente - Item: PO # C012 726237 4D9		Date / Dia: December 28, 2010		Number / Número: 00030169		Page / Página: 3 / 7	
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED		Product Type / Tipo de Producto: LINE PIPE SEAMLESS		Customer's Reference / Ref. del Cliente: C012 726237 4D9		Manufacturer's Work Order N° / Ordenación de Venta: 9007103403		Surface / Superficie: VARNISHED	
Standard or Specification / Norma o Especificación: Z245.1 APRIL 2007, ASME/ASTM SA106 B/2006		CONDUCCION SIN COSTURA				Ends / Extremos: BARNIZADO		Normal Bevel	
Dimensions / Dimensiones: 4.5 X 0.337 INCH		Schedule / Cálculo: 080		Length / Longitud: 18.01 / 21.98 FT		Quantity / Cantidad: 262 Pcs/Pz		BISelado NORMAL	
114.3 X 8.56 MM				5.49 / 6.70 MTS		5535.814 FT		Nominal Weight / Peso Nominal: 15.00 LB/FT	
						1687.316 MTS		72.32 KG/M	

SUPERFICIAL HARDNESS / DUREZA SUPERFICIAL

Heat N°	Sample N°	External / Extrema	Scale / Escala HBW	Req. Min. - Req. Max. 237	Heat N°	Sample N°	External / Extrema	Scale / Escala HBW	Req. Min. - Req. Max. 237
24137	21708	B	143		24151	21698	B	143	
24137	21709	B	143		24151	21699	B	143	

B: Body / Cuerpo

LS: Location of sample / Ubicación de la muestra

THROUGH WALL HARDNESS / DUREZA EN EL ESPESOR

Required values										Individuals / Individuos										Average / Promedio										Hardness type HRC										Type of clamps																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Values requested					Specimen condition					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. -					Max. 22.0					Ver. -					Min. 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AM: As manufactured / Según proceso de fabricación

Avg: Average / Promedio

B: Body / Cuerpo

LS: Location of sample / Ubicación de la muestra

MD: Internal diameter / Diámetro interno

Max Minimum / Mínimo

MMW: Media wall / Centro

OD: Outside diameter / Diámetro externo

Quat: Quadraal / Cuadrado

Sc: Specimen condition / Condición de la probeta

This certificate is issued by a computerized system and is valid with electronic signature. On the original certificate the name and position of the person who issued it is stamped. In case the owner of the original certificate would refuse a copy of it, he must attach his signature to the original one using upon through the responsibility for any alteration or not allowed use. Any alteration under restriction will be subjected to the law.

Este certificado es emitido por un sistema automatizado y es válido con firma electrónica. El certificado original posee el sello y la firma de la persona que lo emite. En caso de que el propietario del certificado rechace una copia, deberá garantizar la conformidad con el original haciéndolo responsable por cualquier uso no autorizado o no permitido. Cualquier alteración en el documento quedará sujeta a la ley.

FOR03171



Number / Número:	Page / Página:
00030169	417

Number / Número:	00030169	Page:	41
Date / Día: December 28, 2010			

Customer / Cliente: MCJUNKIN RED MAN TUBULAR		Date / Dia: December 28, 2010	
Customer's Order Item / Orden Cliente - Item:		Customer's Reference / Ref. del Cliente:	
PO # C012 726237 4D0		C012 726237 4D0	
Manufacturing Process / Proceso de Manufactura:		Surface / Superficie:	
SEAMLESS HOT ROLLED		VARNISHED	
LAMINADO EN CALIENTE SIN COSTURA		BARNIZADO	
Standard or Specification / Normas o Especificaciones:		Ends / Extremos:	
Z24S.1 APRIL 2007, ASME/ASTM SAUA106 B/2006		NORMAL BEVEL	
Dimensions / Dimensiones:		BISELADO NORMAL	
4.5 X 0.337 INCH	Schedule / Calibre:	Nominal Weight / Peso Nominal:	
114.3 X 8.56 MM	080	15.00 LB/FT	
	Length / Longitud:	22.32 KSM	
	18.01 / 21.98 FT		
	5.49 / 6.70 MTS		
	Quantity / Cantidad:		
	5535.814 FT		
	1687.316 MTS		
	83278.981 LB		
	37752.000 KG		

FLATTENING TEST / ENSAYO DE APLASTAMIENTO

Standard / Normas		Sample N° Muestra N°	Pipe N° Tubo N°	Result Resultado
Heizi N°	Colegia N°	24137	00001	Good / Bueno
		24137	00002	Good / Bueno

Standard / Norma			
Host N° Código N°	Sample N° Muestra N°	Pipe N° Tubo N°	Result Resultado
24139	21716	00061	Good / Bueno
24150	21711	00005	

Standard / Normal:			
Heart N°	Sample N°	Pipe N°	Result
Colado N°	Muestra N°	Tubo N°	Resultado
24151	21492	00001	Good Banzo

HYDROSTATIC TESTING/PRUEBA HIDRÁULICA

Pressure / Presión		Time / Tiempo	Results / Resultados
Unit / Unidad	Value / Valor	Seconds / Segundos	
psi	3,750	6	Satisfactory / Satisfactorio

HEAT TREATMENT TREATMENT THERMO

Heat treatment / Tratamiento térmico: Pipo / Tubes

Quench media of post treatment process / Medio de enfriamiento termico n°6

Temperature Scale / Escala de Temperatura Celsius

Time

100

[illegible]

The certificate is issued by a computerized system and is void with electronic signature. In the original certificate the trademark given ceased to exist" is stamped. In case the owner of the original certificate would release a copy of it, he must submit it conforming 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 se emite mediante sistema computarizado y es válido con fines electorales. El certificado expira dentro de los 30 días de cada voto. En caso de que el poseedor del certificado entregue una copia, deberá garantizar la conformidad con el original almacenado responsable por cualquier uso ilegal o indebido. Cualquier violación estará sujeta a la ley.

FOR03171



MILL TEST CERTIFICATE CERTIFICADO DE PRUEBAS EN FABRICA

Algonia Tubes Inc.
547 Ambrose Terrace
Sault Ste. Marie, ON CANADA
P6C 1L9
(705) 948-4150 Ext.
(705) 948-2131 Ext.

Customer / Cliente: MC/JUNION RED MAN TUBULAR		Customer's Order Item / Orden Cliente - Item: C012 725237 4D0		Number / Número: 00030169		Page / Página: 5 / 7	
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED		Product Type / Tipo de Producto: LINE PIPE SEAMLESS		Customer's Rollstock / Rod. del Cliente: C012 725237 4D0		Manufacturer's Works Order N° / Confirmación de Venta: 0007103003	
Laminado en caliente sin costura		CONDUCCION SIN COSTURA		Surface / Superficie: VARNISHED		BARNIZADO	
Standard or Specification / Normas o Especificaciones: Z245.1 APRIL/2007, ASME/ASTM SA/A106 B/2006		Steel Grade / Grado de acero: B230 SS		Ends / Extremos: NORMAL BEVEL		BISELADO NORMAL	
Dimensions / Dimensiones: 4.5 X 0.337 INCH		Schedule / Calibre: 080		Quantity / Cantidad: 252 Pcs/Pz		Nominal Weight / Peso Nominal: 15.00 LB/FT	
114.3 X 8.56 MM		Length / Longitud: 18.01 / 21.98 FT		5.49 / 6.70 MTS		22.32 KG/M	

SUPPLEMENTARY INFORMATION / INFORMACION SUPLEMENTARIA

Supplementary Information / Información Suplementaria

Manufactured by ALGOMIA TUBES
Steel making process:
Electric Arc Furnace-Ladle Refractory-Continuous Casting Machine.

Fully Killed Steel
Not repaired by welding
Non destructive test. Satisfactory
Inspection method
NDE - UT - WALL - FLW - 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 B/2006 ASME SA106 B/2006.

RAILCAR IC295952
ALGOMIA Ref: 039554

Fabricated by ALGOMIA TUBES
Fabricación del acero:
Horno de Arco Eléctrico-Horno de Molienda-Máquina de Colada Continua.

Acero laminado con aluminio
Material libre de contaminación de Mercurio
No reparado por soldadura
Control no destructivo. Satisfactorio
Método de inspección

NDE - UT - WALL - FLW - 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 B/2006 ASME SA106 B/2006.

RAILCAR IC295952
ALGOMIA Ref: 039554

MARKING / MARCACION

Marking
Marcación

PIPE STENCIL:

MASCARILLA DE TUBO ESTARCIDO:

This certificate is issued by a computerized system and it is valid with electronic signature. On the original certificate the tenaris mark given colored "Tenaris" is stamped. In case the owner of the original certificate would make a copy of it, he must send the certificate to the original one taking upon himself the responsibility for any unlawful or not allowed use. Any alteration another falsification will be subjected to the law.

Este certificado se emite mediante sistema computarizado y es válido con firma electrónica. En el certificado original aparece impreso el logo "Tenaris" color violeta. 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 indebido. Cualquier alteración u falsificación estará sujeta a la ley.

FOR03171



MILL TEST CERTIFICATE CERTIFICADO DE PRUEBAS EN FABRICA

Aljona Tubos Inc.
547 Wallace Terrell
Sault Ste. Marie, ON CANADA
PSC 119
(705) 941-8130 (tel)
(705) 941-0331 fax

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		Manufacturer's Works Order N° / Confirmación de Venta: 007163703	
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED		Product Type / Tipo de Producto: LINE PIPE SEAMLESS		Surface / Superficie: VARNISHED		Ends / Extremos: BARNIZADO	
Standard or Specification / Normas o Especificaciones: Z245.1 APRIL 2007, ASME/ASTM SAJ106 B12006		CONDUCCION SIN COSTURA		Speed Grade / Grado de acero: B1290 SS		NORMAL BEVEL	
Dimensions / Dimensiones: 4.5 X 0.337 INCH		Schedule / Calibre: 080		Length / Longitud: 18.01 / 21.98 FT		BESELADO NORMAL	
114.3 X 8.56 MM				Weight / Peso: 5.49 / 6.70 MTS		Nominal Weight / Peso Nominal: 15.09 LB/FT	
						22.32 KG/M	

MARKING / MARCACION

TENARIS AT 01E3 ASTM A106 ASME SA106 Z245.1-07 GR B1290CAT 1 SS 114.3 8.56 S 26.1 INDE HEAT		TENARIS AT 01E3 ASTM A106 ASME SA106 Z245.1-07 GR B1290CAT 1 SS 114.3 8.56 S 26.1 INDE HEAT	
WHERE: #C*** #N*** #K*** 22.32 KG/M MADE IN CANADA		#C*** #N*** #K*** 22.32 KG/M MADE IN CANADA	
Heat number #C***		Numero de calado #C***	
Net weight of pipe in Kgs #K***		Peso real de tubo en Kgs #K***	
Length Mts #N***		Longitud del tubo en Mts #N***	
Pipe number #N***		Numero de secuencia #N***	

SUMMARY REPORT / REPORTE RESUMEN

Heat N° Calada N°	Quantity Cantidad (Pieces)	Length Longitud (m)	Weight Peso (Tons)
24137	144	3,040.81	529.277
24138	34	711.88	217.01
Average length per pipe Longitud promedio por tubo (m)		Nominal weight per pipe Peso nominal por tubo (kg/m)	
21.129		15.035	

Heat N° Calada N°	Quantity Cantidad (Pieces)	Length Longitud (m)	Weight Peso (Tons)
24151	84	1,775.03	541.029
Average length per pipe Longitud promedio por tubo (m)		Nominal weight per pipe Peso nominal por tubo (kg/m)	
21.129		15.035	

This certificate is issued by a computerized system and it is valid with electronic signature. On the original certificate the trade-mark, green, colored "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 unlawful or not allowed use. Any alteration and/or falsification will be subjected to the law.

This certificate is only valid when accompanied by the original certificate. In case of loss, the holder must request a new one from the original holder. Tenaris color mark. In case of loss, the holder must request a new one from the original holder. Responsible for customer use: legal & technical. Cualquier falsificación o alteración estará sujeta a la ley.

FOR03171



Tenaris


MILL TEST CERTIFICATE
CERTIFICADO DE PRUEBAS EN FABRICA

Alpina Tubos Inc.
547 Wallace Terrace
Sault Ste. Marie, ON Canada
P6C 1L9
(705) 945-5130 (tel)
(705) 945-5131 fax

Customer / Cliente: MCJUNKIN RED MAN TUBULAR		Customer's Order Item / Orden Cliente - Item: PO # C012 726237 4D0		Number / Número: 00030169		Page / Página: 7 / 7	
Manufacturing Process / Proceso de Manufactura: SEAMLESS HOT ROLLED LAMINADO EN CALIENTE SIN COSTURA		Product Type / Tipo de Producto: LINE PIPE SEAMLESS CONDUCCION SIN COSTURA		Customer's Reference / Ref. del Cliente: C012 726237 4D0		Date / Día: December 28, 2010	
Standard or Specification / Normas o Especificaciones: Z245.1 APRIL2007, ASME/ASTM SAJ4106 B22006		Sheet Grade / Grado de acero: B1290 SS		Manufacturer's Works Order N° / Confirmación de Venta: 007103703		Surface / Superficie: VARNISHED BARNEZADO	
Dimensions / Dimensiones: 4.5 X 0.337 INCH 114.3 X 8.58 MM		Length / Longitud: 18.04 / 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	

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.

 Quality System Certified N° 110950007 The certification owner is Tenaris Quality Management System exclusively		CUSTOMER - THIRD PARTY INSPECTION COMPANY COMPAÑIA DE INSPECCION NOT APPLY Employee Name: N/A		TENARIS QUALITY DEPARTMENT SIGNATURE Van Boerdonk QUALITY CERTIFICATION DEPT. DEPTO. DE CERTIFICACION DE CALIDAD VAN BOERDONK Dave		FELI DINGBO CHIEF OF QUALITY CERTIFICATION DEPT. RESPONSABLE DEL DEPTO. DE CERTIFICACION DE CALIDAD	
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This certificate is issued by a computerized system and it is valid with electronic signature. On the original certificate the mark-man, green colored "Tenaris" is stamped. In case the owner of the original certificate would submit a copy of it, he must attach the green mark to the original one taking upon himself the responsibility for any alteration not allowed here. Any alteration, neither fabrication will be subjected to this law.

Este certificado es emitido por un sistema automatizado y es válido con firma electrónica. El certificado original posee el sello verde "Tenaris" en color. En caso de que el poseedor del certificado entregue una copia, deberá garantizar la conformidad con el original haciendo responsable por cualquier uso no autorizado. Cualquier alteración y/o falsificación estará sujeta a ley.

FOR03171

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

CUSTOMER PURCHASE ORDER NUMBER P71102DI006 ENTRY DATE 2007/11/08 SHIP DATE 2007/12/02 FULLY NUMBER SHIPPERS NUMBER CP MILL ORDER 28748

CHARGE TO CUSTOMER NAME & ADDRESS

WILKINSON A DIVISION OF PREMETALCO INC
888 SOUTH EAST MARINE DRIVE
VANCOUVER BRITISH COLUMBIA
V5X 2V3

SHIP TO CUSTOMER NAME & ADDRESS

WILKINSON A DIVISION OF PREMETALCO 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 METALLURGISTTHIS 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: PLATE TEST COUPON:

NSP T/R TEST REPORTS REQUIRED

CUST
USE RESALE

2000041171 WS WS

2007/12/03 06:21

MEETS EN 10204 3.1

***** PRODUCT SHIPPED *****
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	SAMPLE	SRCE	GAUGE	COND	METH	DIR	YIELD	TENSILE	% ELONG
1457V	106"	.1880	.2	AR	.2	T	51.0	73.0	29(2")
7571G	106"	.1880	.2	AR	.2	T	43.5	69.0	32(2")

HEAT	C	MN	P	S	SI	CR	NI	CU	MO	AL	CB	V	B
1457V	.21	.86	.011	.007	.01	.04	.01	.02	.01	.048	.002	.002	
7571G	.21	.85	.015	.010	.02	.02	.01	.02	.01	.036	.000	.000	

WARNING

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.

PAGE 1 OF 1

MTR VERIFICATION STAMP
DATE: Jan 28 '11 REVIEW BY: [Signature]
CONFORMS TO ASME § II 14 EDITION/ADDENDA: 2007
LAB
OTL
OTL

PO #64226



柏維鐵工股份有限公司

An ISO-9001 Registered Manufacturer

高雄縣仁武鄉竹林村仁心路 303 號

BOTHWELL STEEL FITTINGS CO., LTD.

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

KAOHSIUNG HSIEN, TAIWAN R.O.C.(81406)

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



MILL TEST & INSPECTION CERTIFICATE

ACCORDING TO EN10204/DIN50049/3.1.B

CUSTOMER: UNIFIED ALLOYS

INVOICE NO: BW069509097

ORIGIN: TAIWAN

CERT NO: 62877

ORDER NO: EP-57197

L/C NO:

DATE: 12/30/01

PAGE: 3

ITEM	RAW MATERIAL HEAT NO.	BOTH WELL HT. CD.	DESCRIPTION	QUANTITY	SPECIFICATION: A182/SA182 -04a F304 / 304L DIMENSION: ASME B16.11 - 2001 SURFACE: BY VISUAL...GOOD
115	9U078	N876	FULL CPLG 3/4" 3000# NPT	75 PC	
116	9U105	N879	FULL CPLG 1" 3000# NPT	80 PC	
117	9U067	N860	FULL CPLG 1-1/4" 3000# NPT	20 PC	
118	YT060855	Q268	FULL CPLG 1-1/2" 3000# NPT	25 PC	
119	YT060864	Q267	FULL CPLG 2" 3000# NPT	50 PC	
120	FS-0174	N851	FULL CPLG 2-1/2" 3000# NPT	5 PC	
121	U0807	N827	45D ELBOW 3/4" 3000# NPT	20 PC	

ITEM	CHEMICAL COMPOSITION (%)											
	C	Si	Mn	P	S	Cu	Cr	Ni	Mo	V	Cb(Nb)	N
Min	-	-	-	-	-	-	18.000	8.000	-	-	-	-
Max	0.030	1.000	2.000	0.045	0.030	-	20.000	13.000	-	-	-	0.100
115	0.020	0.250	1.700	0.027	0.024	-	18.210	8.510	-	-	-	0.100
116	0.020	0.290	1.730	0.026	0.027	-	18.250	8.550	-	-	-	0.100
117	0.020	0.250	1.700	0.024	0.028	-	18.160	8.520	-	-	-	0.100
118	0.021	0.430	1.150	0.039	0.002	-	18.180	8.350	-	-	-	0.036
119	0.027	0.440	1.370	0.035	0.002	-	18.260	8.150	-	-	-	0.030
120	0.022	0.270	1.940	0.039	0.020	-	18.200	8.150	-	-	-	0.081
121	0.020	0.310	1.530	0.029	0.026	-	18.270	8.610	-	-	-	0.100

ITEM	MECHANICAL TEST					Remark: SOLUTION TREATED : 1040°C W.Q. CONFORMS TO NACE MR0175-2003 STEEL MAKING PROCESS : ELECTRIC FURNACE MERCURY FREE
	Tensile Strength (KSI)	Yield Strength (KSI)	Elongation (%)	R of A (%)	Hardness (HB)	
Min	75.0	30.0	30.0	50.0	-	
Max	-	-	-	-	235	
115	82.2	36.1	66.0	74.6	156	WE CERTIFY THE ABOVE MENTIONED FITTINGS HAVE BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH THE SPECIFICATIONS SHOWN <i>S. C. Lee</i> <i>C. C. Huang</i> Q.C. MANAGER INSPECTOR SHENG CHENG LEE CHUN CHIEH HUANG
116	86.5	40.8	60.8	75.4	163	
117	81.3	37.0	66.0	75.3	152	
118	79.2	38.7	73.1	81.7	156	
119	79.7	36.3	69.7	81.7	156	
120	83.6	41.8	66.8	71.4	161	
121	83.8	40.0	63.4	73.7	167	

BW-D0839 REV:0

Q268(YT060855)(1 1/2 FCPLG) 304

1107304F

March 1 End to S.W.

MTR VERIFICATION STAMP

DATE: July 4, 11

REVIEW BY: *[Signature]*

CONFORMS TO ASME § II

EDITION / ADDENDA: 2009b

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

KS Manufacturing Enterprises Ltd.

8781
5203-76 Avenue
Edmonton Alberta T6B 0A7

MATERIAL TEST REPORT 12117
Purchaser: UNIFIED ALLOYS, EDM
Purchaser Order No. EP60792

Date: 2007-03-13
Distributor:
Distributor Order No.:

FO# 63066

Products

Item No.	Qty.	Product	Specification	Heat No	Description
1	8	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		

87B1

87B1 (1 1/4 x 3 1/2 3000# CPLG) 304

MTR VERIFICATION STAMP	
DATE: <u>July 4 '11</u>	REVIEW BY: <u>[Signature]</u>
CONFORMS TO ASME § II A EDITION / ADDENDA: <u>2009b</u>	

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

[Signature]
Kwang Y. Lee

N936



柏緯鐵工股份有限公司

高雄縣仁武鄉烏林村仁心路 303 號

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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



MILL TEST & INSPECTION CERTIFICATE

ACCORDING TO EN10204/DIN50049/3.1.B

ORIGIN: TAIWAN

CUSTOMER: UNIFIED ALLOYS

INVOICE NO: BW079608013

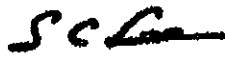

DATE: 11/14/07

CBRT NO: 72746

ORDER NO: EP-63527

L/C NO:


PAGE: 6

ITEM	RAW MATERIAL HEAT NO.	BOTH WELL HT.CO.	DESCRIPTION								QUANTITY	SPECIFICATION: ASTM A182 -05a ASME SA182 -A06 F304 / 304L
095	3W356	N942	FULL CPLG 3/4" 3000# NPT								100PC	DIMENSION: ASME B16.11 - 2005 SURFACE: BY VISUAL...GOOD
096	9W177	N941	FULL CPLG 1" 3000# NPT								100PC	
097	3W278	N936	FULL CPLG 1"x3-1/2"L 3000# NPT								50PC	
098	9W151	N926	FULL CPLG 1-1/4" 3000# NPT								25PC	
099	9W148	N923	FULL CPLG 1-1/2" 3000# NPT								100PC	
100	9W175	N939	45D ELBOW 1/2" 3000# NPT								10PC	
101	PS-1488	N904	45D ELBOW 3/4" 3000# NPT								10PC	
CHEMICAL COMPOSITION (%)												
ITEM	C	Si	Mn	P	S	Cu	Cr	Ni	Mo	V	Cb(Nb)	N
Min	-	-	-	-	-	-	18.000	8.000	-	-	-	-
Max	0.030	1.000	2.000	0.045	0.030	-	20.000	13.000	-	-	-	0.100
095	0.020	0.290	1.770	0.028	0.028	-	18.120	8.180	-	-	-	0.100
096	0.030	0.230	1.850	0.029	0.028	-	18.150	8.180	-	-	-	0.100
097	0.020	0.310	1.830	0.029	0.030	-	18.160	8.190	-	-	-	0.100
098	0.020	0.280	1.870	0.028	0.029	-	18.240	8.200	-	-	-	0.100
099	0.030	0.270	1.870	0.028	0.028	-	18.240	8.200	-	-	-	0.100
100	0.030	0.260	1.840	0.025	0.028	-	18.140	8.120	-	-	-	0.100
101	0.022	0.330	1.850	0.040	0.024	-	18.080	8.080	-	-	-	0.094
MECHANICAL TEST												
ITEM	Tensile Strength (KSI)	Yield Strength (KSI)	Blow- Gation (%)	R of A (%)	Hardness (HB)	Remark: SOLUTION TREATED : 1040°C, W.Q. CONFORMS TO NACB MR0175-2003 STEEL MAKING PROCESS : ELECTRIC FURNACE MERCURY FREE						
Min	75.0	30.0	30.0	50.0	-	WE CERTIFY THE ABOVE MENTIONED FITTINGS HAVE BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH THE SPECIFICATIONS SHOWN <div> O.C. MANAGER SHENG CHENG LEE</div> <div> INSPECTOR CHUN CHIEH HUANG</div>						
Max	-	-	-	-	235							
095	89.0	44.0	59.4	75.7	170							
096	84.2	35.5	64.6	75.8	156							
097	88.2	43.6	58.8	74.9	171							
098	82.1	37.8	67.0	72.7	155							
099	83.2	39.7	66.2	76.2	152							
100	83.3	36.1	65.4	76.3	161							
101	87.4	42.2	57.8	75.4	170							

BW-D0839 REV:0

MTR VERIFICATION STAMP

DATE: 4.6.15.11

REVIEW BY: 

CONFORMS TO ASME § II

EDITION / ADDENDA: 2009b

113C5104F

267151

90#73588

RVC-232

TEST CERTIFICATE

Test Report/Inspection Certificate No.: RELICFF/A0-11/1290-011 DATE 16.10.2010 As Per DIN EN 10204 - 3.1

Invoice No./Date	1280	01/13/Oct/2010
Marking	As P.O.	Manufacturers Mark

Designation of Article		Grade	Specification	Delivery Condition	Melting Proc.	Steel Mill
CARBON STEEL FORGED FLANGES		ASA 105N	ASTM 2009/ ASME 2006	FINISH 125-250 AARH	EMF	RNL
Item sr. no.	Quantity	Dimension	Heat Code	P.O.No.		
1	500	3" 150# SO RF -105N -FINISH	RVC-232	4608380		

CHEMICAL ANALYSIS AND CHEMICAL PROPERTIES

	C %	Si %	Mn %	P %	S %	Cr %	Ni %	Mo %	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	0.40 Max	0.12 Max		0.40 Max	0.08 Max	0.47 Max
RVC-232	0.197	0.251	0.660	0.020	0.015	0.011	0.007	0.003	0.034	0.004	0.006	0.32

Heat Treatment: Normalized at 910° C & air cooled.

Mechanical Tests:

Test No.	Direction	Yield Strength		Tensile Strength Rm	Elongation A	Reduct of area Z	Energy of Impact (TEMPERATURE <20°C)	Hardness
		Re	Rp 0.2%					
SPECIFIED			250MPa	480MPa	22Min	30Min		
RVC-232	T		307.77	489.17	34.50%	61.66%		

Additional Test - Conform to NACE MR-0175 & NACE MR-0103

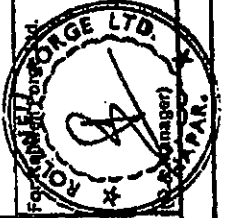
Surface and Dimensional Inspection

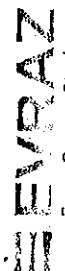
Testing of material

Remarks: We certify that the material has been tested and complies with the given purchase order

MTR VERIFICATION STAMP	
DATE: 2009.11.11	REVIEW BY: [Signature]
CONFORMS TO ASME § II A EDITION / ADDENDA: 2009b	

For ROLLWELL FORGE LTD. (L.B. 10/11/09) F.O. 10/11/09





EVRAZ INC. NA
EvrAZ Oregon Steel 14400 N. Riverside Blvd., Portland, Oregon 97203

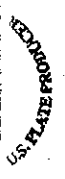
REPORT OF CHEMICAL/PHYSICAL TESTS

NT8184

CERTIFICATE NO.	DATE	PAGE
1115395	SEP 24, 2010	1
MILL ORDER NO.	DATE	
236102		
CUSTOMER ORDER NO.		
PO0824DI008V		
JOB/REQ. NO.		
SHIPPING NO.	DATE	
1115395	09/24/2010	
CARRIER		
TS EXPRESS		
CART/CRK NO.		
035A		

WILKINSON STEEL & METAL/OTV PERMIT
ATTN: ACCOUNTS PAYABLE
888 SE MARINE DR
VANCOUVER, BC V5X 2V3
CANADA

WILKINSON COMPANY LTD.
888 SE MARINE DR
VANCOUVER, BC V5X 2V3
CANADA



THIS MATERIAL HAS BEEN MANUFACTURED, TESTED AND FOUND TO MEET THE SPECIFICATIONS AND PURCHASE ORDER REQUIREMENTS
STRUCTURAL QUALITY COIL FOR CONVERSION TO ASTM A36-08/ASME SA36 2007/08 ADD CSA
G40.21-04 GRADE 44W PLATE CSA GRADE 38W.

PHYSICAL PROPERTIES

ITEM NO.	DESCRIPTION	HEAT NO.	SLAB	YIELD PSI X 100	TENSILE PSI X 100	% ELONG & 2"	% RA	HARDNESS BHN	IMPACTS
1	0.2500 X 96.000ME X COIL SCHEDULE B: 7208.37.00.30								
	1 PC 44350 LBS A69836 ^ NT8184			540	720	20			
	1 PCS 44350 LBS TOTALS								

MTR VERIFICATION STAMP
DATE: SEP 24, 2010 REVIEW BY: RA
CONFORMS TO ASME § II A EDITION / ADDENDA: 2009b

CHEMICAL ANALYSIS

HEAT NO.	C	Mn	P	S	SI	CU	NI	V	CO	AL	CR	MO	TI	B	N	CA	OE
NT8184	.14	.85	.013	.007	.26	.01	.04	.008	.000	.038	.02	.00					
	HEATS INDICATED WITH (+) WERE MELTED & MANUFACTURED IN THE USA. HEATS INDICATED WITH (^) WERE ROLLED IN THE USA.																
.....	END OF REPORT																

Clifford
Technical Support Coordinator

I certify the above to be correct as contained in the records of EVRAZ INC. NA By _____

NT 7748

907236B



EVRAZ INC. NA
Evraz Oregon Steel 14400 N. Rivergate Blvd., Portland, Oregon 97203

REPORT OF CHEMICAL/PHYSICAL TESTS

CERTIFICATE NO. 1112251
DATE Sep 09, 2010
PAGE 1



WILKINSON STEEL & METALS/DIV PREMET
ATTN: ACCOUNTS PAYABLE
888 SE MARINE DR
VANCOUVER, BC V5X 2V3
CA

WILKINSON COMPANY LTD.
888 SE MARINE DR
VANCOUVER, BC V5X 2V3
CANADA

SHIP ORDER NO. 234921
CUSTOMER ORDER NO. P00706ME001V
JOB/REQ. NO.
SHIPPING NO. 1112251
DATE 09/09/2010
CARRIER
HELSEBROS TRANSFER CO
CART/BUCK NO. 79

THIS MATERIAL HAS BEEN MANUFACTURED, TESTED AND FOUND TO MEET THE SPECIFICATIONS AND PURCHASE ORDER REQUIREMENTS
STRUCTURAL QUALITY COIL FOR CONVERSION TO ASTM A36-08/ASME SA36 2007/08 ADD CSA
G40.21-04 GRADES 44W PLATE CSA 38W.

PHYSICAL PROPERTIES

ITEM NO.	DESCRIPTION	HEAT NO.	SLAB	YIELD PSI X 100	TENSILE PSI X 100	% ELONG 8" 2"	% RA	HARDNESS BHN	BEND TEST	IMPACTS
2	0.1880 X 96.000ME X COIL SCHEDULE B:7208.37.00.00									
1 PC	15180 LBS A68666	NT7748		510	740 21					
1 PC	21860 LBS A68667	NT7778		510	740 20					
2 PCS	37040 LBS TOTALS			520	690 21					

CHEMICAL ANALYSES

HEAT NO.	C	Mn	P	S	Si	Cu	Ni	V	Co	Al	Cr	Mo	Ti	B	N	Ca	CE
NT7748	.14	.89	.011	.004	.27	.02	.04	.005	.005	.045	.02	.00					
NT7778	.13	.85	.013	.005	.27	.02	.04	.003	.005	.035	.02	.00					
HEATS INDICATED WITH (+) WERE MELTED & MANUFACTURED IN THE USA.																	
1000/																	

MTR VERIFICATION STAMP

DATE: 09/09/2010

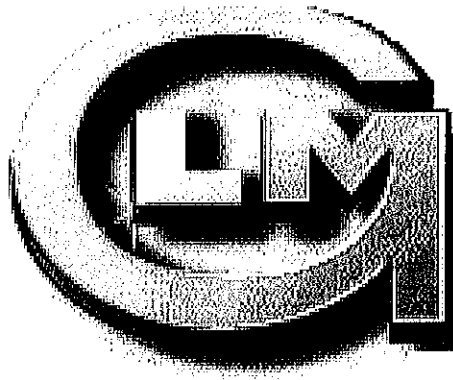
CONFORMS TO ASME SA 36

2009b

I certify the above to be correct as contained in the records of EVRAZ INC. NA

Signature

Technical Support Department



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.LF2, SA 420 WPL6, SA 516 Gr.70, etc.)
Process(es): SMAW Weld Types: GROOVE & FILLET
Position: ALL POSITIONS Diameter: ALL DIAMETERS
Filler Metal: E8010, 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	182 - 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	187 - 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	382 - 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

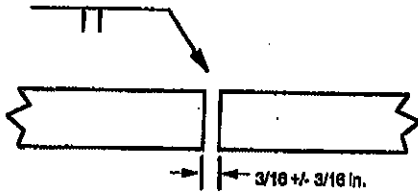


Figure 1
Single Square Butt

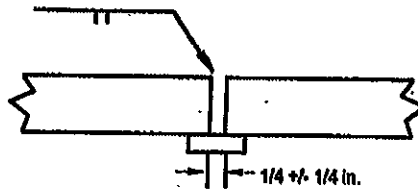


Figure 2
Single Square Butt with Backing Strip

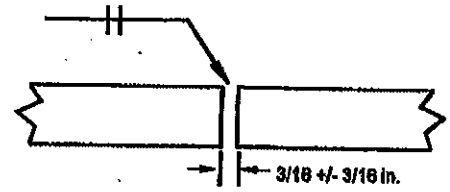


Figure 3
Double Square Butt

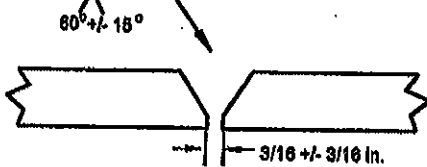


Figure 4
Single Vee Butt
Radius 1/8 in.
+/- 1/16 in.

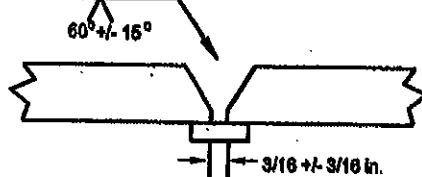


Figure 5
Single Vee Butt with Backing Strip
Radius 1/8 in.
+/- 1/16 in.

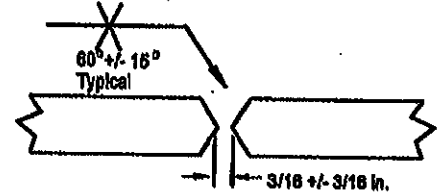


Figure 6
Double Vee Butt
Radius 1/8 in.
+/- 1/16 in.

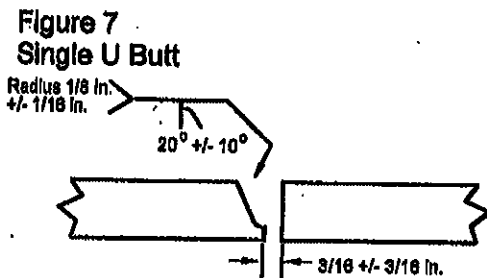


Figure 7
Single U Butt
Radius 1/8 in.
+/- 1/16 in.

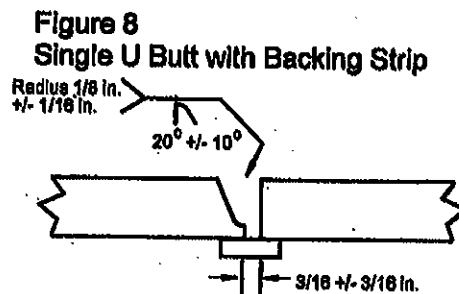


Figure 8
Single U Butt with Backing Strip
Radius 1/8 in.
+/- 1/16 in.

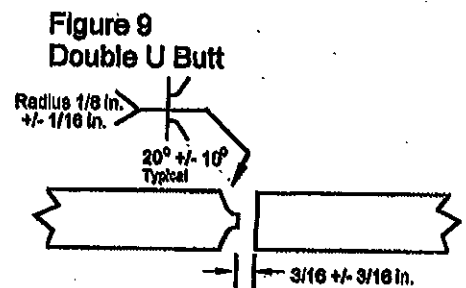


Figure 9
Double U Butt
Radius 1/8 in.
+/- 1/16 in.

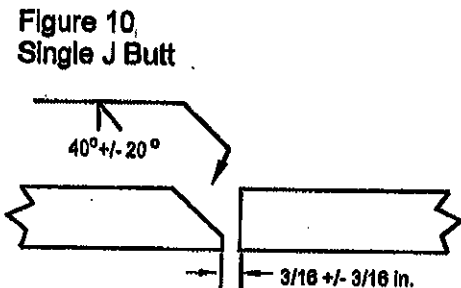


Figure 10
Single J Butt

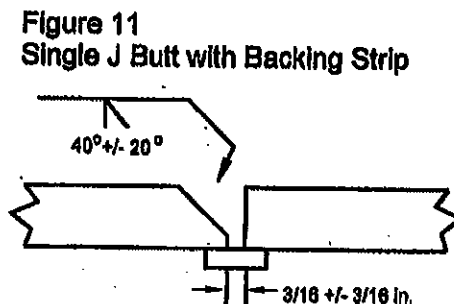


Figure 11
Single J Butt with Backing Strip

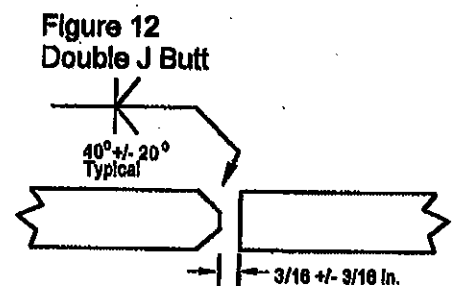


Figure 12
Double J Butt

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 Gr.1 To P-No. P1 Gr.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

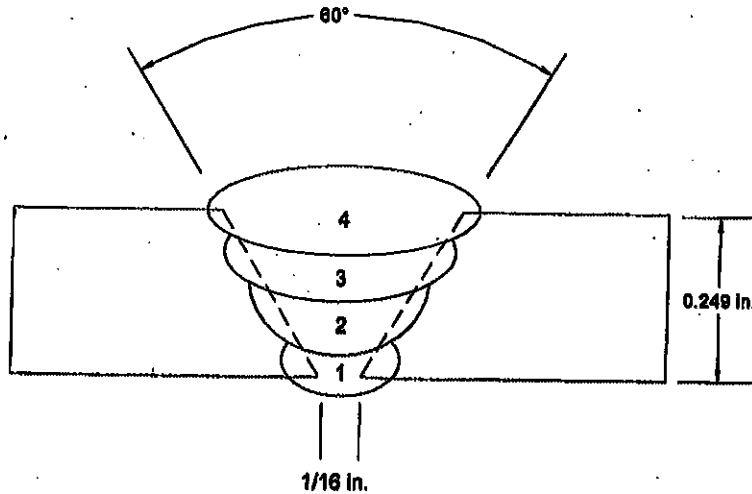
ELECTRICAL CHARACTERISTICS (QW-409)

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
T2	19.2 (0.756)	5.51 (0.217)	106 (0.164)	53 178 (12,000)	503 (72,900)	Parent Metal (SA 516 Gr. 60) 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	26.8 (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 14/07 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	(0.758)
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 Davis

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

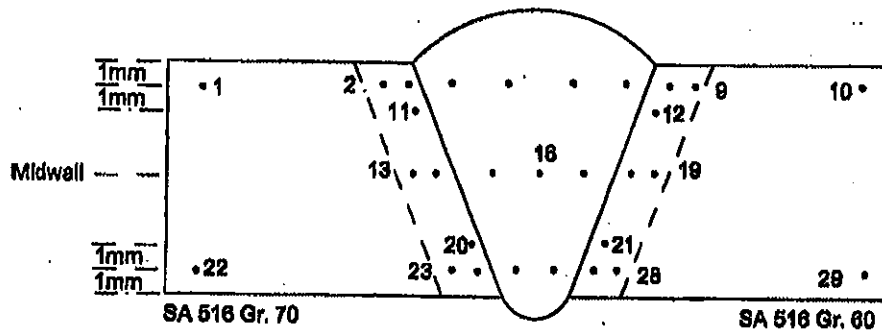
Laboratory Test No.: E06-1029.2
Date: January 9, 2007

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

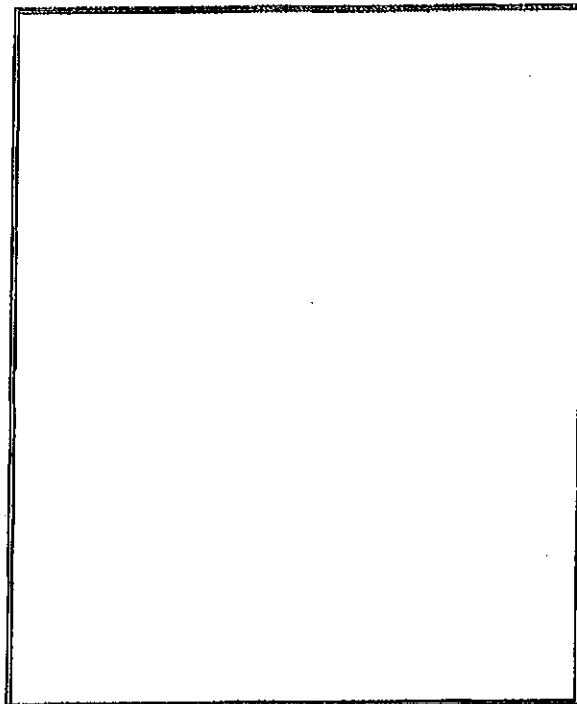
Restricted Applications: API 12D, 12F, 620 & 650 Welded Storage Tank Fabrication
Base Metal (Typical): P1 Groups 1 & 2 to P1 Groups 1 & 2
(SA 333 Gr.6, SA 350 Gr.LF2, SA 420 WPL6, SA 516 Gr.70 etc.)
Process(es): SAW Weld Types: GROOVE & FILLET
Position: FLAT & HORIZONTAL Diameter: ALL DIAMETERS
Filler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

ABIA	
SAFETY CODES ACT - PROVINCE OF ALBERTA WELDING PROCEDURE	
Reg. No. WP	863.2
Spec. No.	2-1-129A (REV.2)
Weld Process	SAW
Matl. Gr. P No.	1 Gr. 12 to P No. 1 Gr. 12
Elec. Gr. F No.	6 A No. 1
Th. Qual. For	4.8 to 38.1 mm P.W.T. NO
	CVA - 29°C
WELDED STORAGE TANK FABRICATION	
Yr. OK	No. P.R. Day 24 Signed
H. ROSEBERG, P.E. 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 - 500	26 - 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

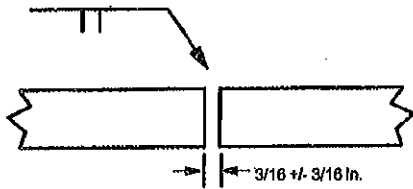


Figure 1
Single Square Butt

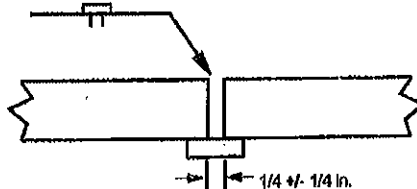


Figure 2
Single Square Butt with Backing Strip

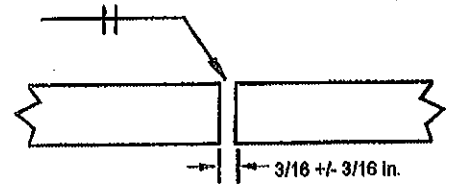


Figure 3
Double Square Butt

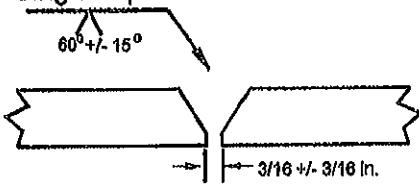


Figure 4
Single Vee Butt

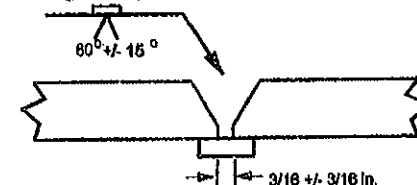


Figure 5
Single Vee Butt with Backing Strip

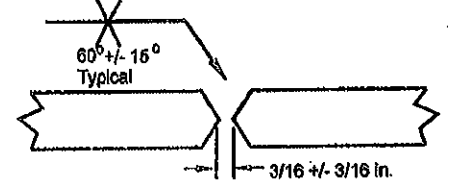


Figure 6
Double Vee Butt

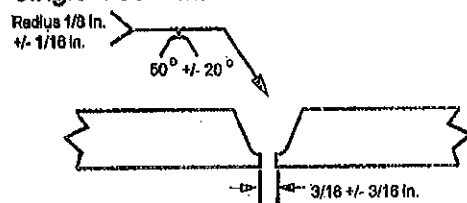


Figure 7
Single U Butt

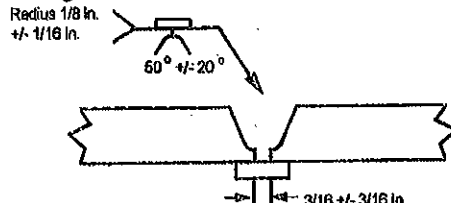


Figure 8
Single U Butt with Backing Strip

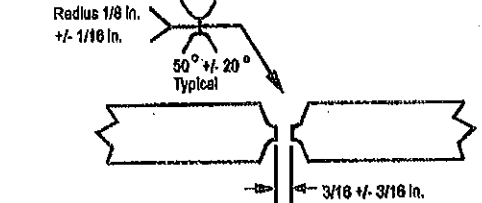


Figure 9
Double U Butt

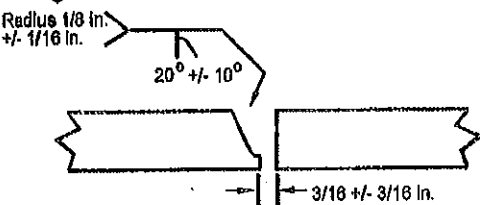


Figure 10
Single J Butt

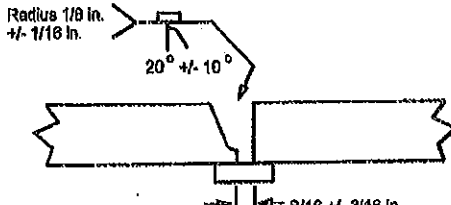


Figure 11
Single J Butt with Backing Strip

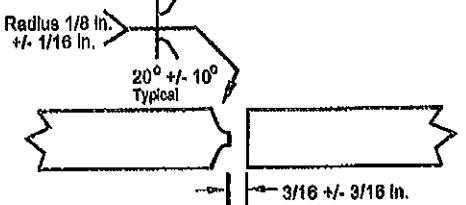


Figure 12
Double J Butt

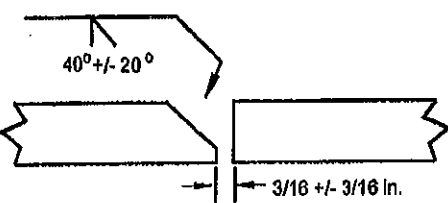


Figure 13
Single Bevel Butt

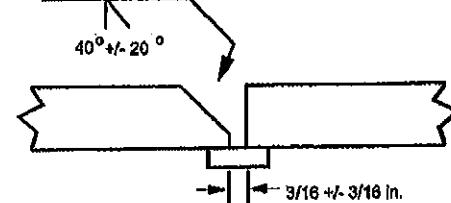


Figure 14
Single Bevel Butt with Backing Strip

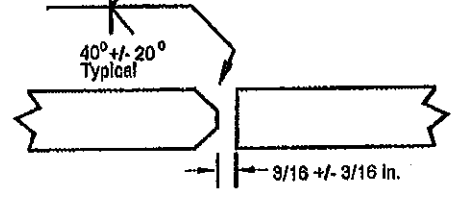


Figure 15
Double Bevel Butt

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) 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 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

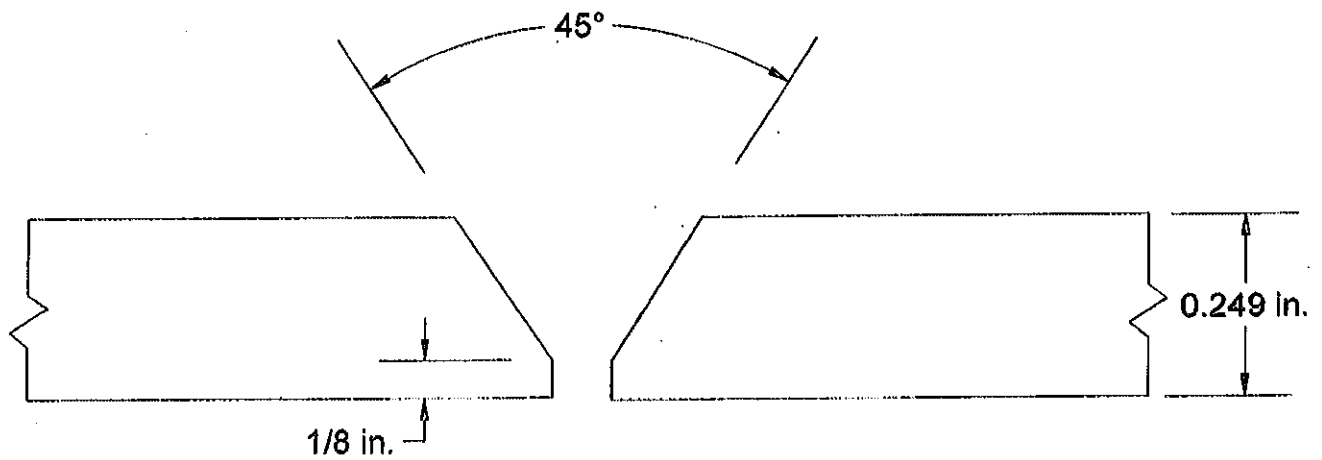
ELECTRICAL CHARACTERISTICS (QW-409)

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 (l.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 TESTSRockwell Hardness - see attached laboratory test reportWelders 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.	<u>SA 516 to SA 516</u>	Type or Grade	<u>Gr.60 to Gr.70</u>
P-No. <u>P1</u> Grp.1	To P-No. <u>P1</u> Grp.2	Thickness	<u>9.52 mm (0.375 in.)</u>
Heat Number	<u>297420 - 65196</u>	Carbon Equivalent	<u>0.36 %</u>
Diameter	<u>N/A</u>	Other	<u>Plate Product Form</u>

FILLER METALS (QW-404)

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

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

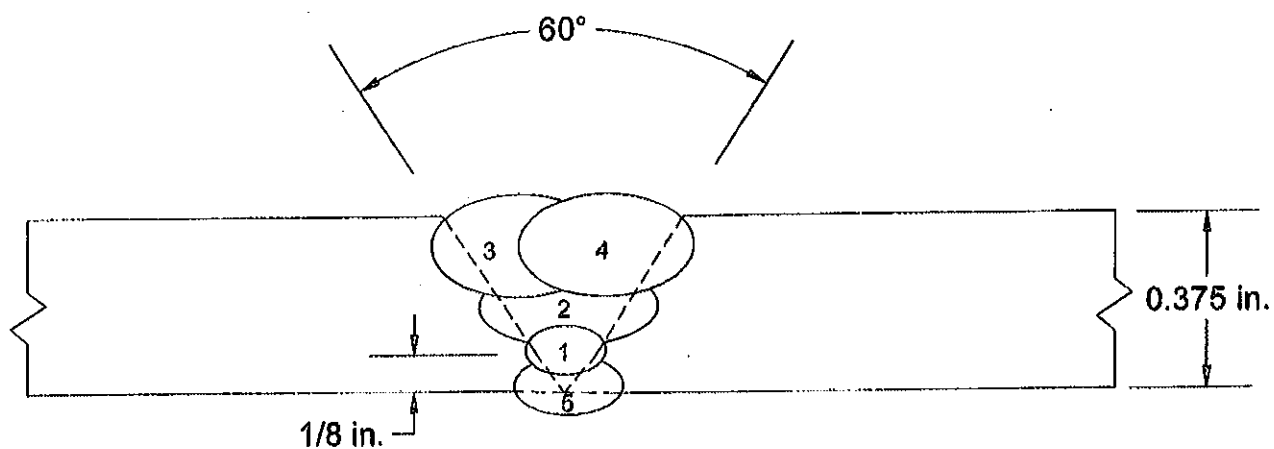
ELECTRICAL CHARACTERISTICS (QW-409)

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

TECHNIQUE (QW-410)

String or Weave	<u>String</u>	Travel Speed	<u>See next page</u>
Multiple or Single Pass Per Side	<u>Both</u>		
Multiple or Single Electrodes	<u>Single</u>		

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 Grabla 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)

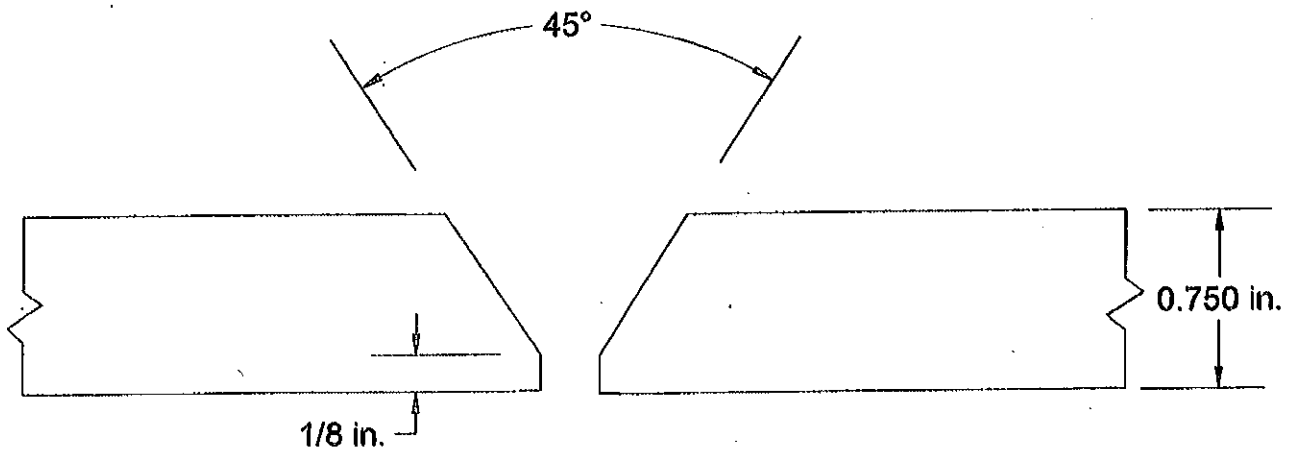
Temperature N/A Time N/A

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



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	16.0	304	160 200	527	Partial Cup & Cone
	(0.748)	(0.630)	(0.471)	(36,020)	(76,400)	Parent Metal (SA 516 Gr. 70)
T2	19.0	16.0	304	15 600	525	Partial Cup & Cone
	(0.748)	(0.630)	(0.471)	(35,900)	(76,100)	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. 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: _____

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

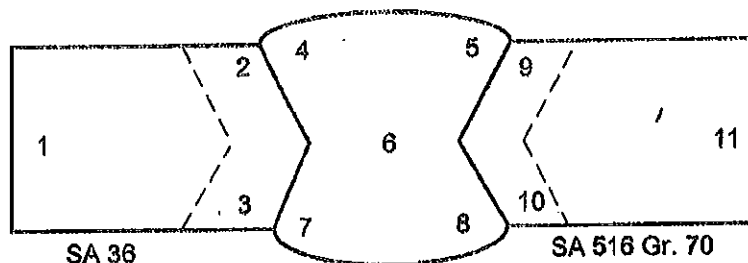
Attention: Wilber Davie

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 Sultanlan/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, 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

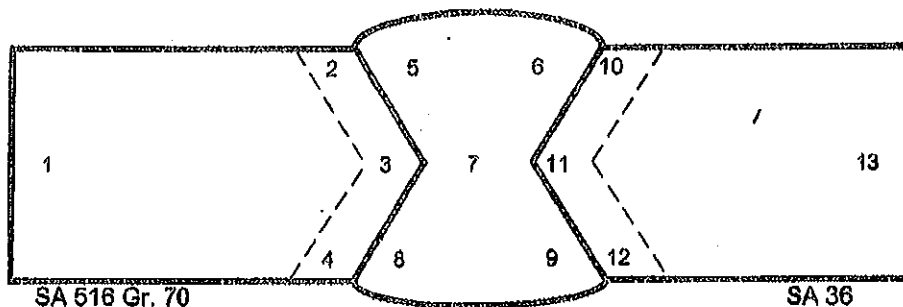
Attention: Wilber Davie

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 Sultanian/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) 460-3030 FAX: (780) 460-3032



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

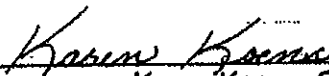
SAMPLE NUMBER	T1	QW-462.1(a)	T2	QW-462.1(a)
WIDTH mm (in)	19.0	(0.748)	19.0	(0.748)
THICKNESS mm (in)	16.0	(0.630)	16.0	(0.630)
AREA sq mm (sq in)	304	(0.471)	304	(0.471)
ULTIMATE LOAD N (lbs)	160 200	(36,020)	15 500	(35,900)
UTS MPa (psi)	527	(76,400)	525	(76,100)
FRACTURE TYPE	Partial Cup & Cone		Partial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

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

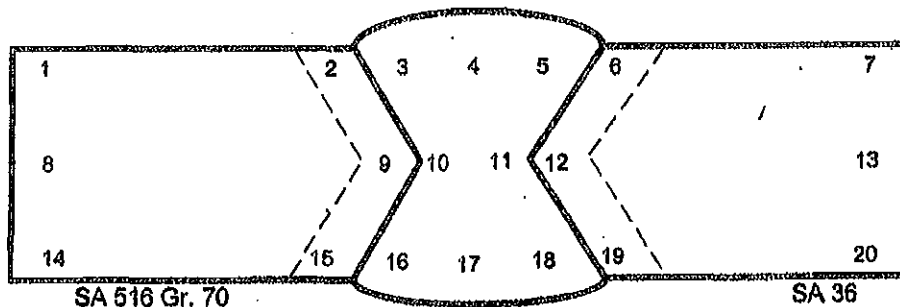
Attention: Wilber Davie

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
INSTRUMENT TYPE: Wilson

SCALE: B



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: _____

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



WELDING PROCEDURE SPECIFICATION NO.: 3-8-168A (Rev.2)

WELDING PROCEDURE QUALIFICATION RECORD NO. (S): 3-8-168

QUALIFIED FOR

Base Metal (Typical): P8 to P8 (SA 240, SA 312 Types 304, 304L, 316, 316L, etc.)
Process(es): GMAW (Surface-Tension-Transfer) / GMAW Weld Types: GROOVE & FILLET
Position: ALL POSITIONS Diameter: ALL DIAMETERS
Filler Metal: GMAW - STT: ER308LSI, ER316LSI
GMAW: ER3XX(L)(SI)

BASE METAL CONDITIONS & GROOVE THICKNESS RANGE QUALIFIED:

STANDARD APPLICATIONS AS WELDED
BASE METAL THICKNESS RANGE 1.6 to 9.42 mm (0.062 to 0.371 in.) inclusive

COMBINED DEPOSITED WELD METAL THICKNESS
ASME B31.1 9.42 mm (0.371 in.) maximum
ASME B31.3 9.42 mm (0.371 in.) maximum
ASME SECT. VIII, DIV.1 9.42 mm (0.371 in.) maximum

ALBERTA BOILERS SAFETY ASSOCIATION	
PROVINCE OF ALBERTA	
SAFETY CODES ACT	
WELDING PROCEDURE	
Reg. No. WP	<u>863.7</u>
Spec No.	<u>3-8-168A (REV 2)</u>
Weld Process	<u>GMAW (STT) / GMAW</u>
Matl. Gr. P No.	<u>8</u> to P No. <u>8</u>
Elec. Gr. F No.	<u>6+6</u> A No. <u>8</u>
Th. Qual. For	<u>9.4 mm</u> PWHT <u>NO</u>
Yr. <u>09</u> Mo. <u>10</u> Day <u>22</u> Signed <u>R. ROSEBERG, P.ENG.</u>	
WELDING SPECIALIST	

PROVINCIAL REGISTRATION

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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.** 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

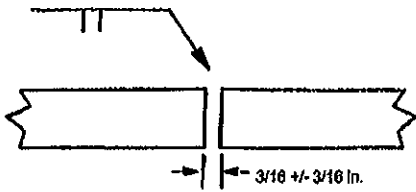


Figure 1
Single Square Butt

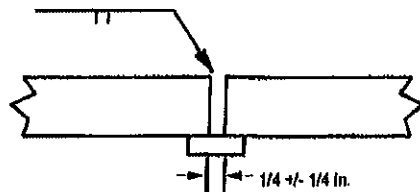
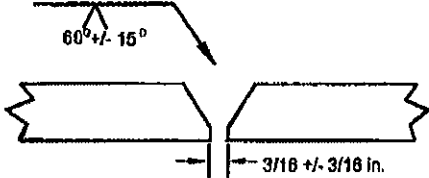


Figure 2
Single Square Butt with Backing Strip

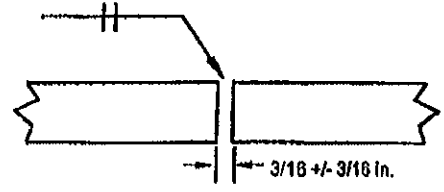
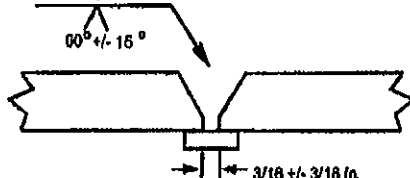


Figure 3
Double Square Butt

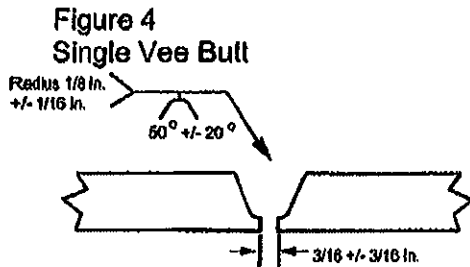
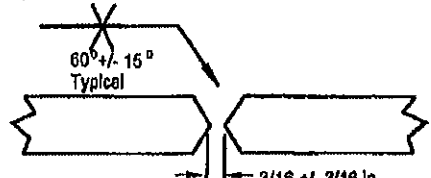


Figure 4
Single Vee Butt

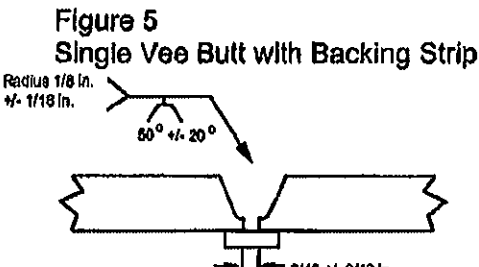
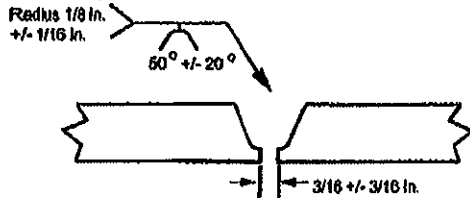


Figure 5
Single Vee Butt with Backing Strip

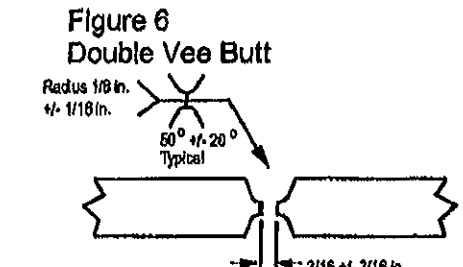
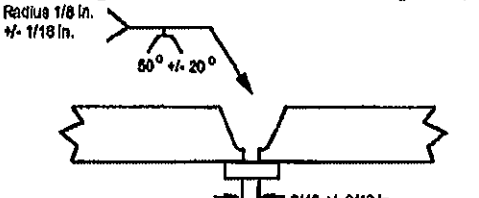


Figure 6
Double Vee Butt

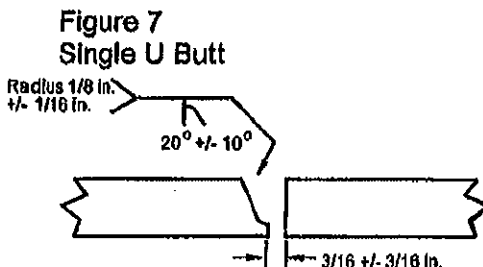
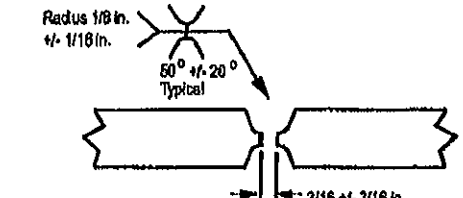


Figure 7
Single U Butt

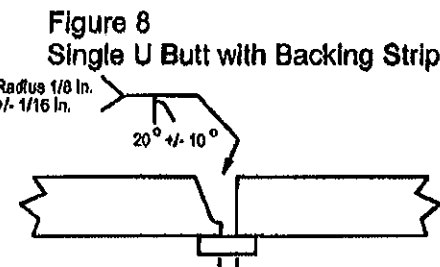
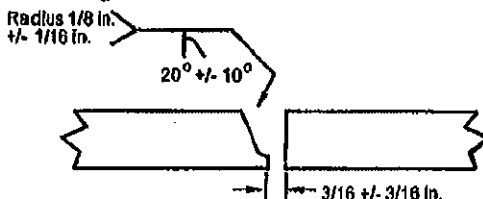


Figure 8
Single U Butt with Backing Strip

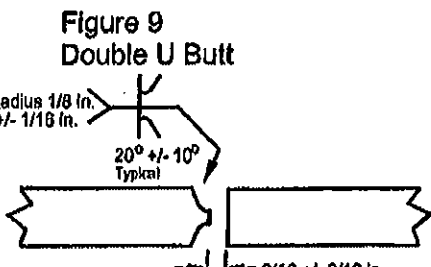
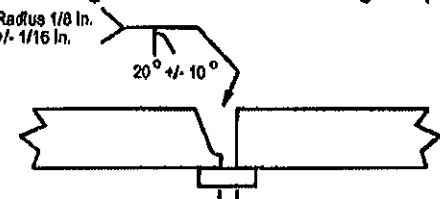


Figure 9
Double U Butt

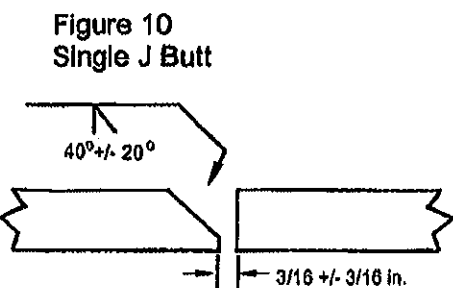
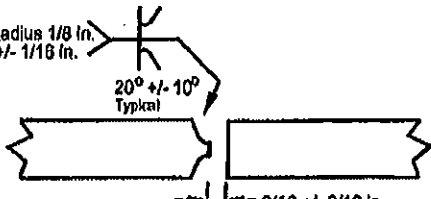


Figure 10
Single J Butt

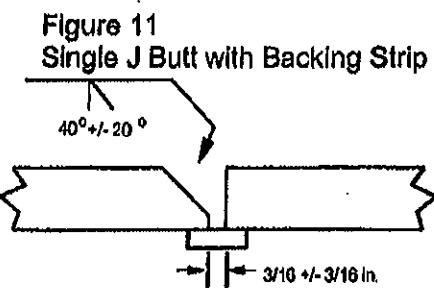
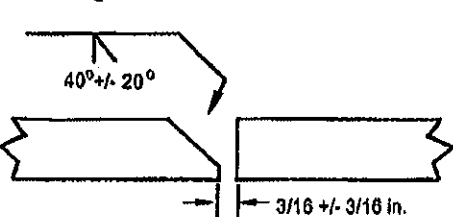


Figure 11
Single J Butt with Backing Strip

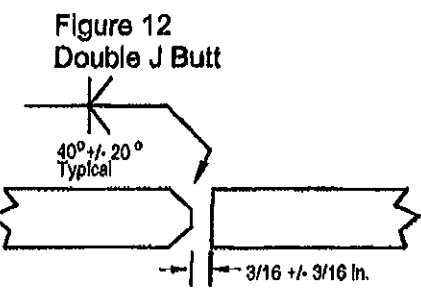
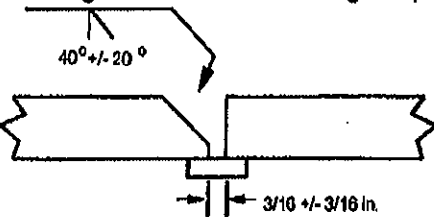


Figure 12
Double J Butt

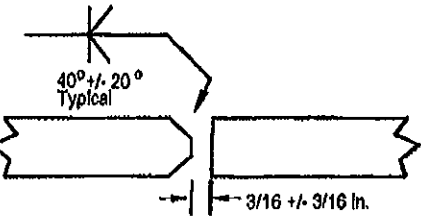


Figure 13
Single Bevel Butt

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. 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)

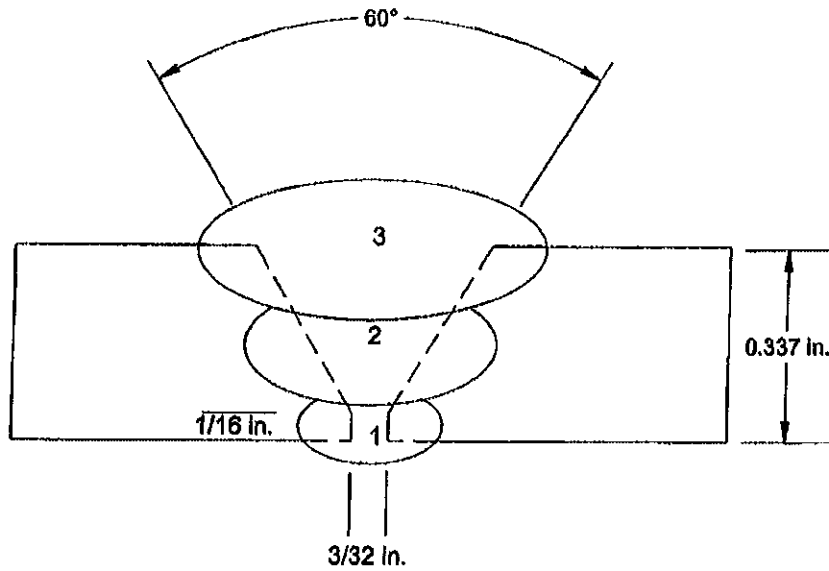
Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-HeAC-7.5/2.5
Shielding 90% Helium, 7.5% Argon, 2.5% Carbon Dioxide, 17.5 liters per minute (35 cfph)
Backing N/A

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



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 TESTS

Vickers 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 Davle

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

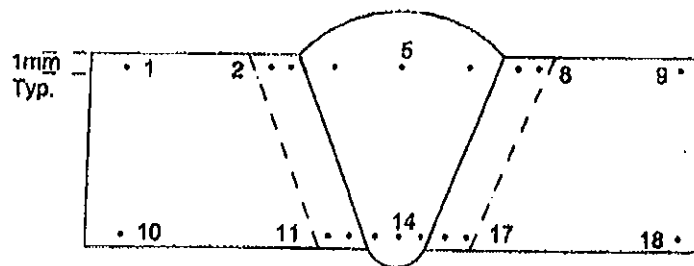
Attention: Wilber Davie

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
INSTRUMENT TYPE: Leco V-100-C1

LOAD: 500g



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

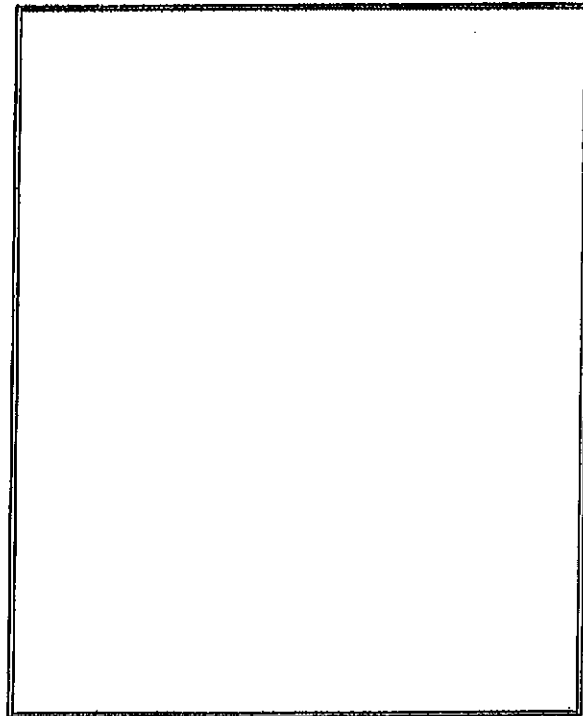
BASE METAL THICKNESS RANGE 3.2 to 25.4 mm (0.125 to 1.0 in.) inclusive

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>

ADSA	
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>
Matl. 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> A No. <u>* + 1</u>
Th. Qual. For	<u>3.2 to 25.4 mm W.P.T.</u> <u>NO</u>
<u>CVA-46°C</u>	
<u>* ER 70S-6</u>	
Yr. <u>08</u> Mo. <u>07</u> Day <u>28</u>	Signed <u>R. ROSEBERG, P.ENG</u>
WELDING SPECIALIST	

PROVINCIAL REGISTRATION



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

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

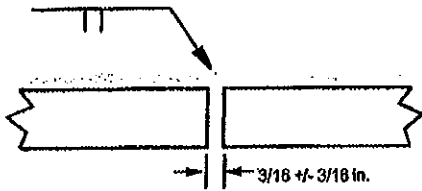


Figure 1
Single Square Butt

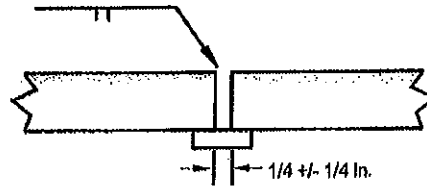


Figure 2
Single Square Butt with Backing Strip

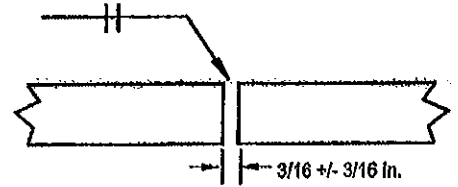


Figure 3
Double Square Butt

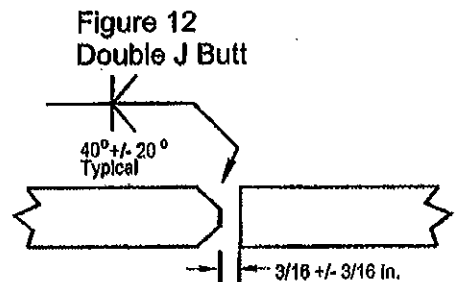
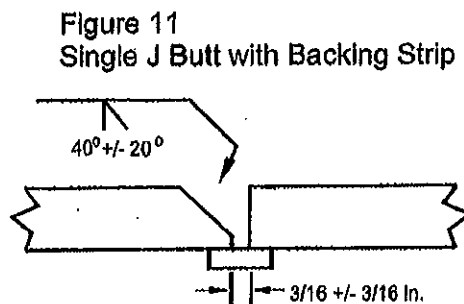
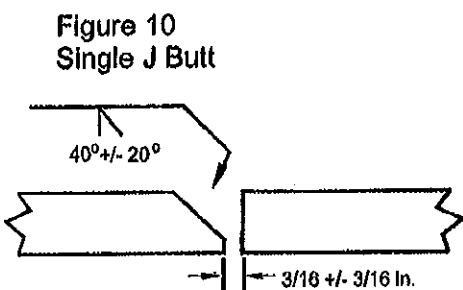
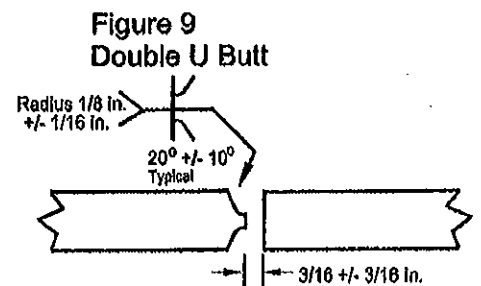
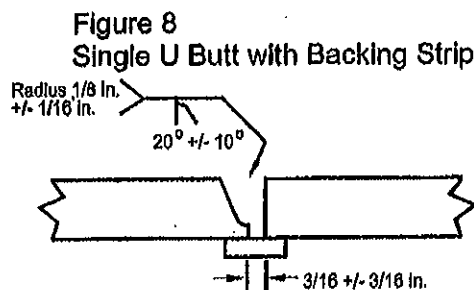
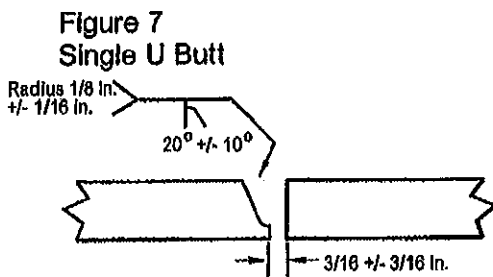
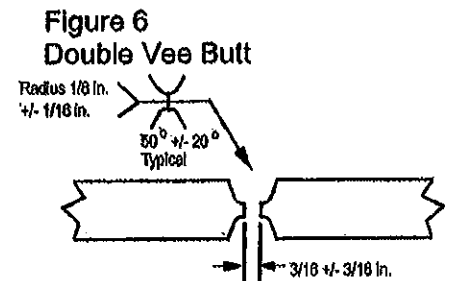
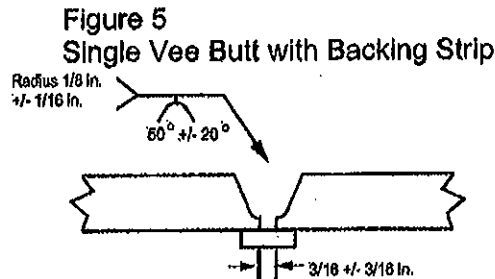
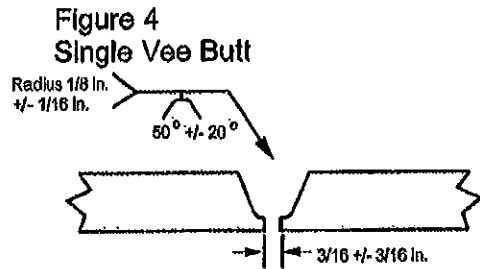
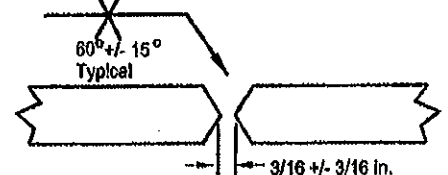
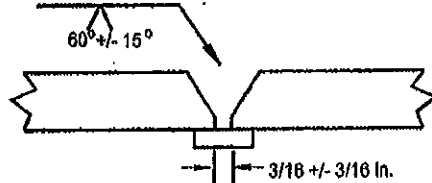
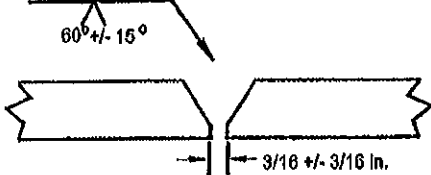


Figure 13
Single Bevel Butt

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.L.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)

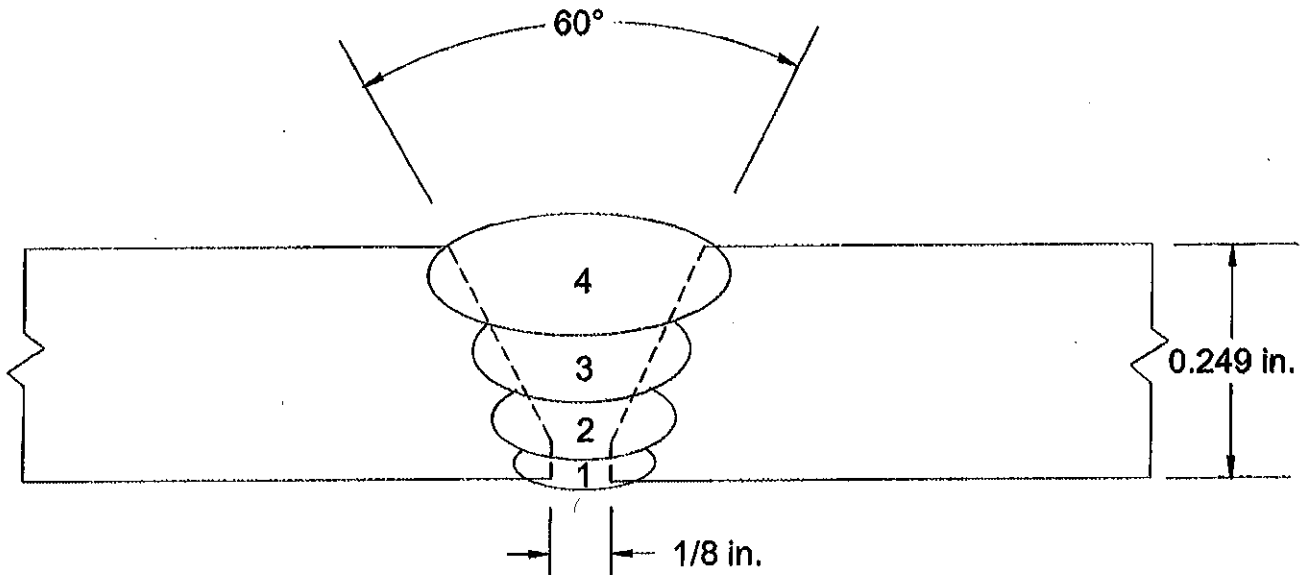
Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-AC-25
Shielding 75% Argon, 25% CO₂, 10 liters per minute (20 ft³/hr)
Backing Without Trailing Without

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



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.1, 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 TAILLEUX, 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)

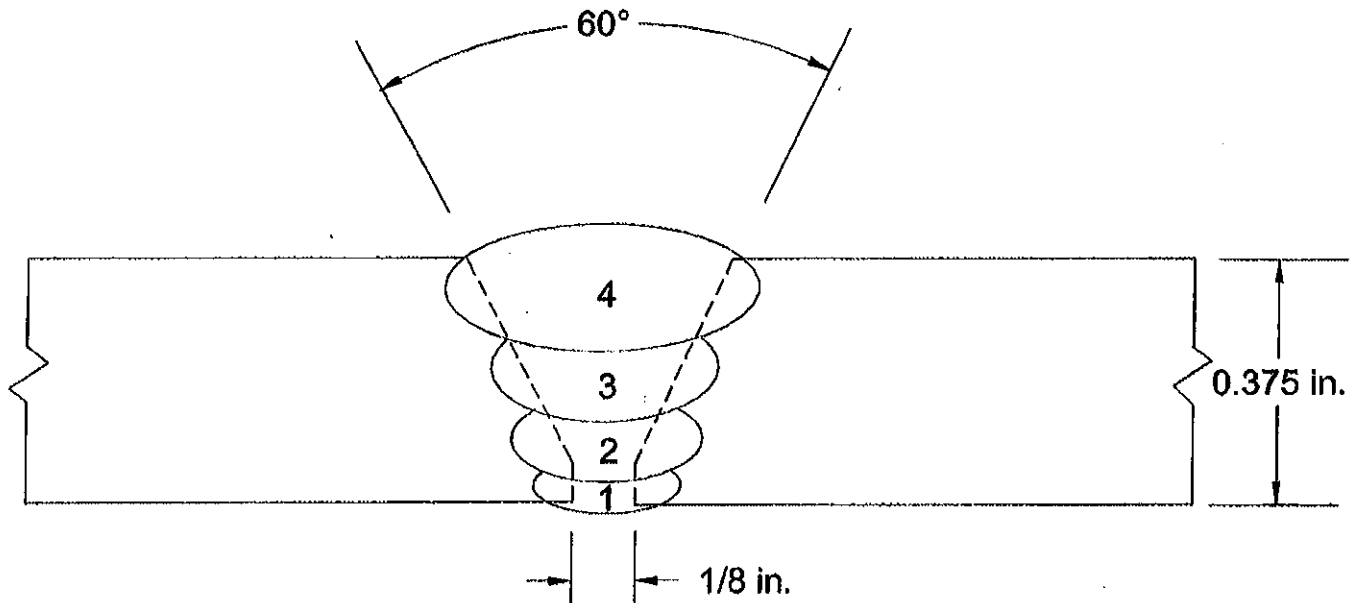
Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-AC-25
Shielding 75% Argon, 25% CO₂, 10 liters per minute (20 ft³/hr)
Backing Without Trailing Without

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. (I.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

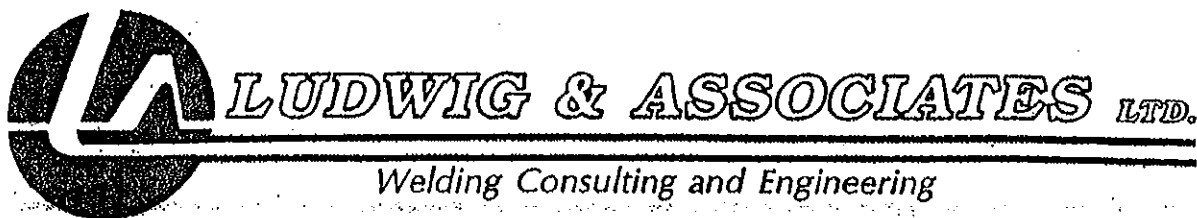
Vickers Hardness - see attached laboratory test report

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 14/2008 Signed [Signature]



Welding Consulting and Engineering

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)

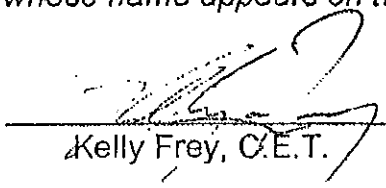
SAMPLE NUMBER	T1	T2
WIDTH mm (In)	18.9 (0.744)	19.0 (0.748)
THICKNESS mm (In)	8.43 (0.332)	8.37 (0.330)
AREA sq mm (sq In)	159 (0.247)	159 (0.247)
ULT. LOAD N (lbs)	76 900 (17,300)	76 600 (17,240)
UTS MPa (psi)	483 (69,990)	482 (69,840)
FRACTURE TYPE	Partial Cup & Cone	Partial Cup & Cone
FRACTURE LOCATION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

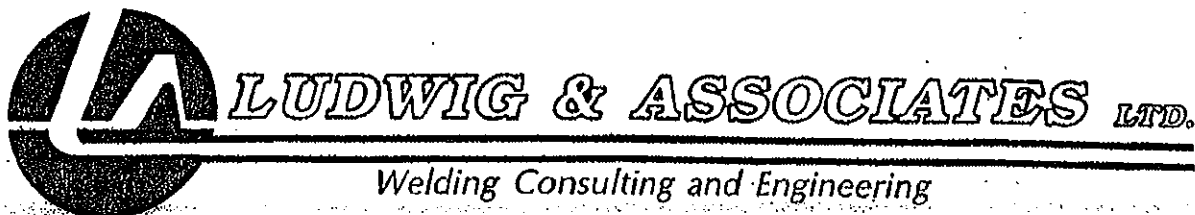
GUIDED-BEND TEST (QW-160)

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

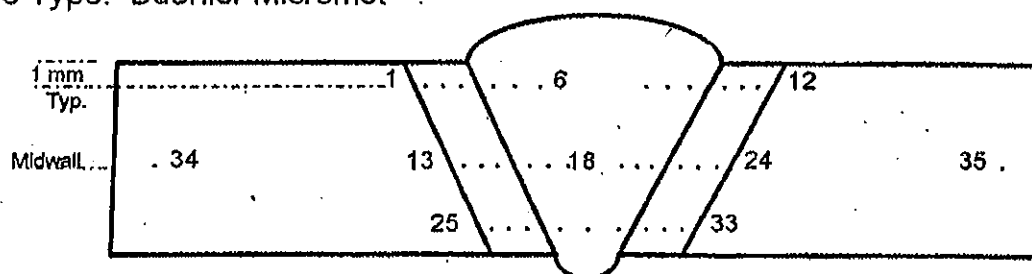
Attention: Wilber Davie

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, 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)

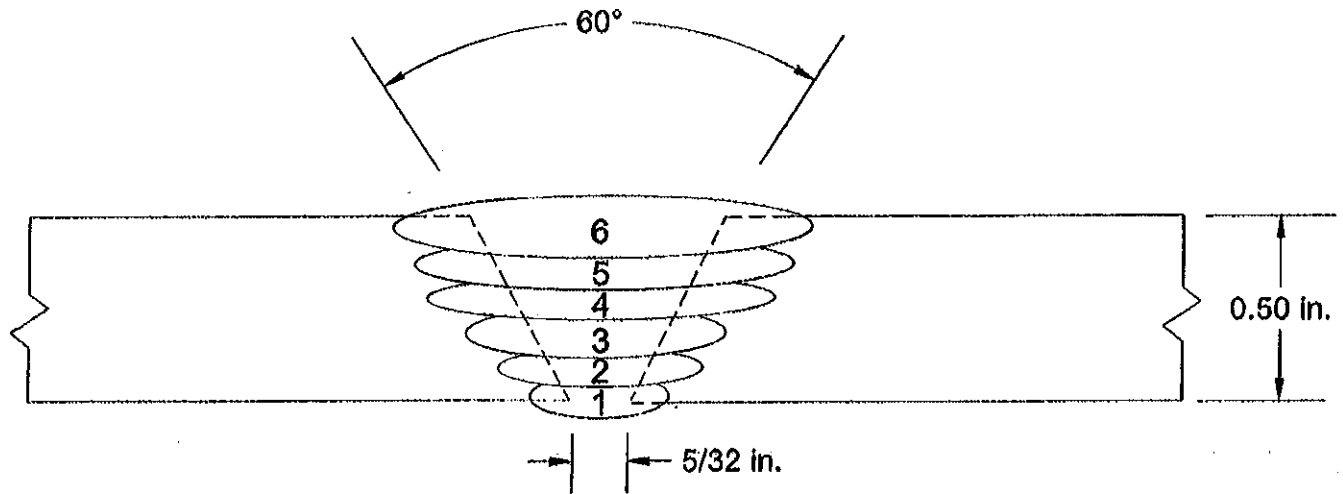
Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-AC-25
Shielding 75% Argon, 25% CO₂, 13 liters per minute (28 ft³/hr)
Backing Without Trailing Without

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	11.3	215	112 020	522	Partial Cup & Cone
	(0.748)	(0.445)	(0.333)	(25,200)	(75,700)	Parent Metal (SA 516 Gr. 60)
T2	19.1	11.5	220	113 618	529	Partial Cup & Cone
	(0.752)	(0.453)	(0.340)	(25,500)	(76,800)	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
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

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	Slide 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 Davie

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

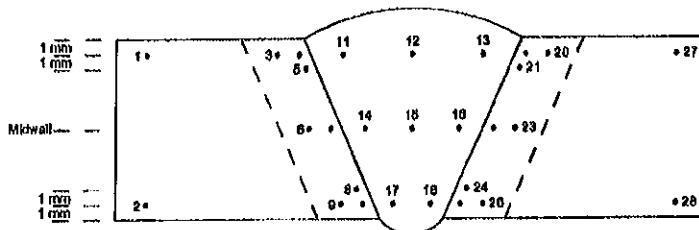
PQR No.: 31-1-066-3
Material: SA 516 Gr. 60 to SA 516 Gr. 70
Thickness: 12.7 mm (0.500 in.)
Thermal Condition: As Welded

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:

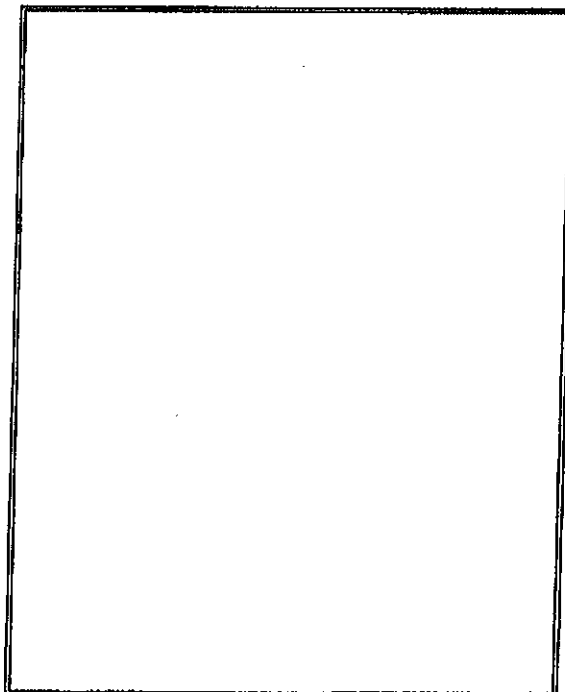
NOTCH TOUGHNESS APPLICATIONS TO -46°C AS WELDED
BASE METAL THICKNESS RANGE 3.2 to 25.4 mm (0.125 to 1.00 in.) inclusive

COMBINED DEPOSITED WELD METAL THICKNESS

ASME B31.1	<u>19.1 mm (0.750 in.) maximum</u>
ASME B31.3	<u>19.1 mm (0.750 in.) maximum</u>
ASME SECT. VIII, DIV.1	<u>25.4 mm (1.00 in.) maximum</u>

ALBERTA BOILERS SAFETY ASSOCIATION	
PROVINCE OF ALBERTA	
SAFETY CODES ACT	
WELDING PROCEDURE	
Reg. No. WP	<u>863.2</u>
Spec No.	<u>41-1-144A (REV 2)</u>
Weld Process	<u>GTAW / SMAW</u>
Matl. 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> A No. <u>1</u>
Th. Qual. For	<u>3.2 to 25.4 mm PWHT</u> <u>NO</u>
<u>CVN-46°C</u>	
Yr. <u>06</u> Mo. <u>09</u> Day <u>19</u>	Signed <u>[Signature]</u>
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)	<u>SFA 5.18</u>	<u>SFA 5.1</u>
AWS No. (Class)	<u>ER70S-2</u>	<u>E7018-1</u>
F-No.	<u>F6</u>	<u>F4</u>
A-No.	<u>A1</u>	<u>A1</u>
Size	<u>1/16 to 5/32 in. inclusive</u>	<u>3/32 to 1/4 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>20.6 mm (0.812 in.) max.*</u>
Fillet	<u>All fillet sizes</u>	<u>All fillet sizes</u>
Other	<u>*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</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) 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.

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

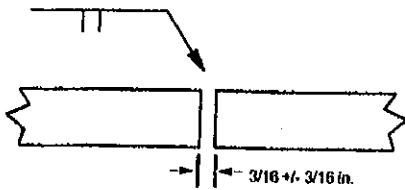


Figure 1
Single Square Butt

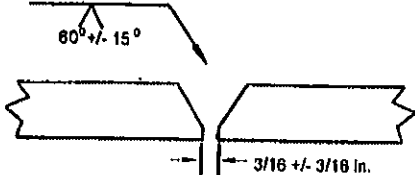


Figure 2
Single Square Butt with Backing Strip

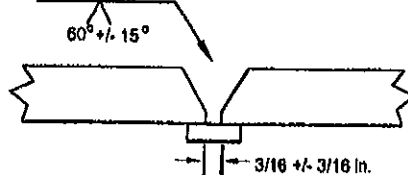


Figure 3
Double Square Butt

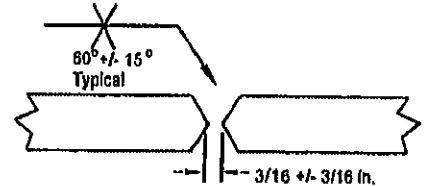


Figure 4
Single Vee Butt

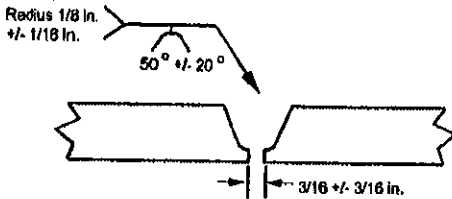


Figure 5
Single Vee Butt with Backing Strip

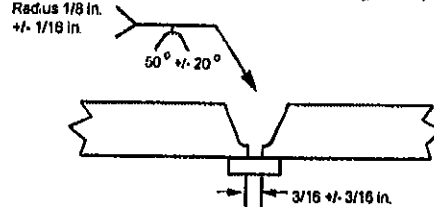


Figure 6
Double Vee Butt

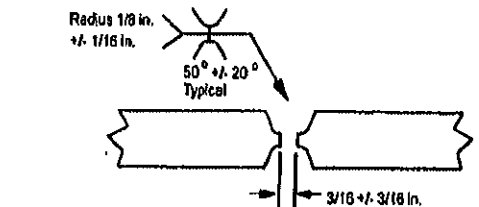


Figure 7
Single U Butt

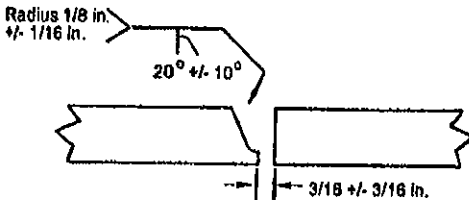


Figure 8
Single U Butt with Backing Strip

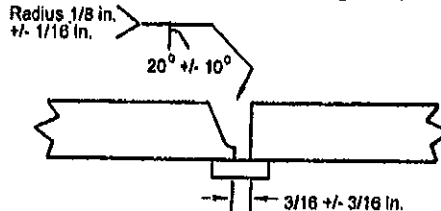


Figure 9
Double U Butt

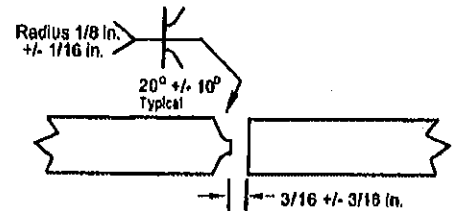


Figure 10
Single J Butt

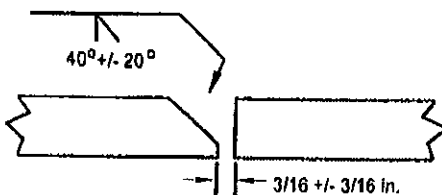


Figure 11
Single J Butt with Backing Strip

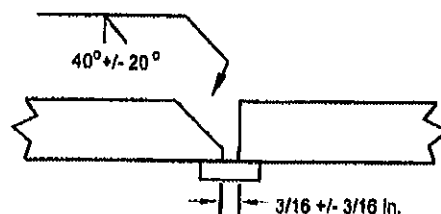


Figure 12
Double J Butt

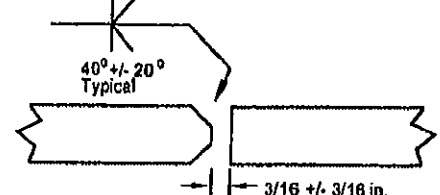


Figure 13
Single Bevel Butt

Figure 14
Single Bevel Butt with Backing Strip

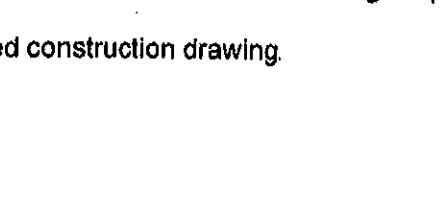


Figure 15
Double Bevel Butt

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

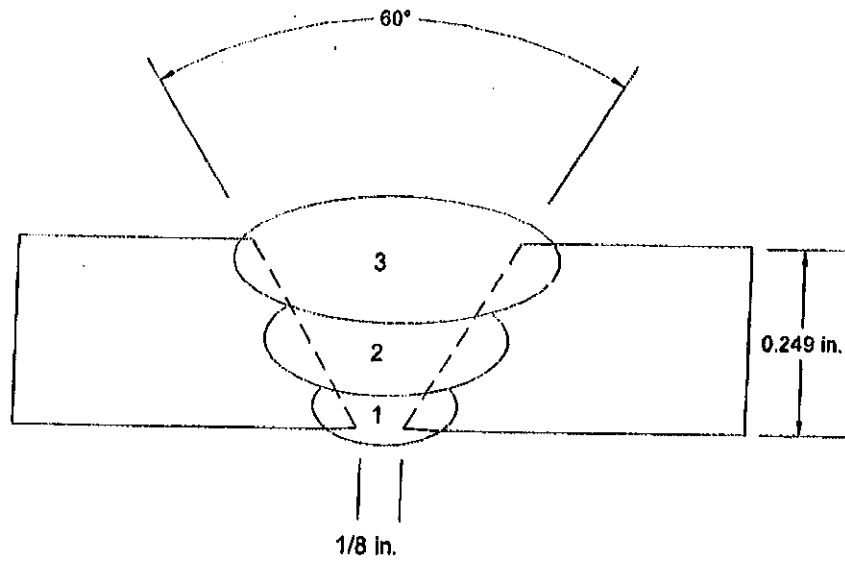
ELECTRICAL CHARACTERISTICS (QW-409)

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 [Signature]

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, 2008
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

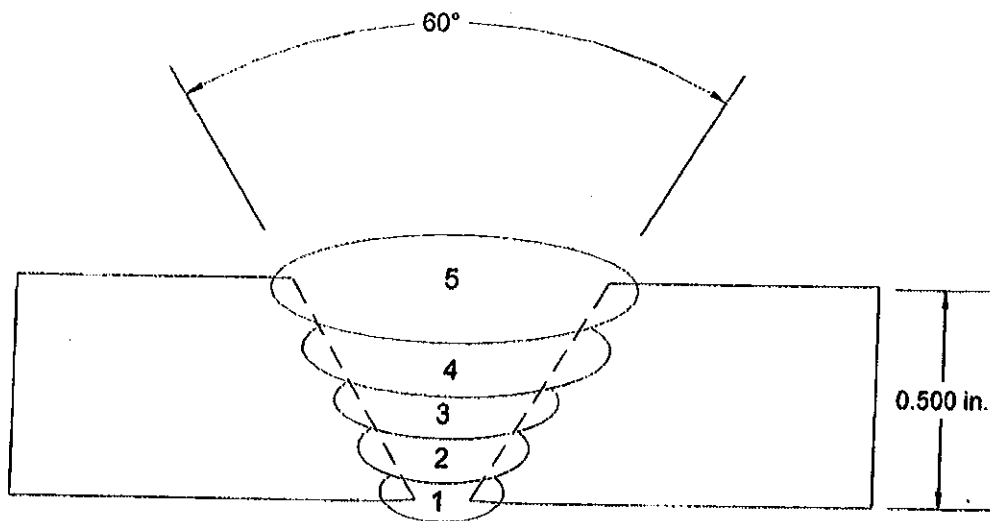
ELECTRICAL CHARACTERISTICS (QW-409)

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 (0.744)	11.6 (0.457)	219 (0.340)	94 400 (21,200)	431 (62,400)	Partial Cup & Cone Parent Metal (SA 333 Gr. 6)
T2	19.0 (0.748)	9.82 (0.387)	187 (0.289)	81 200 (18,300)	435 (63,100)	Partial Cup & Cone 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. 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: _____

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

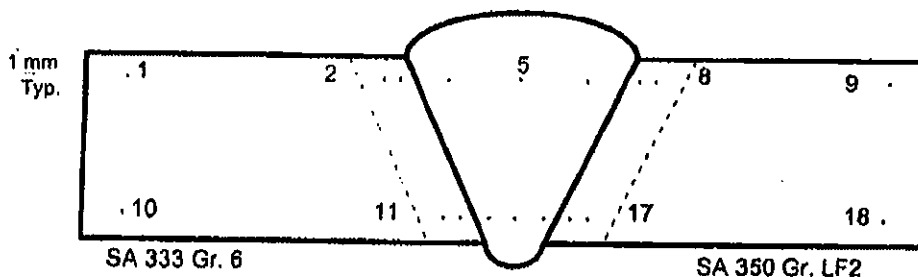
Attention: Wilber Davie

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 Koens

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

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

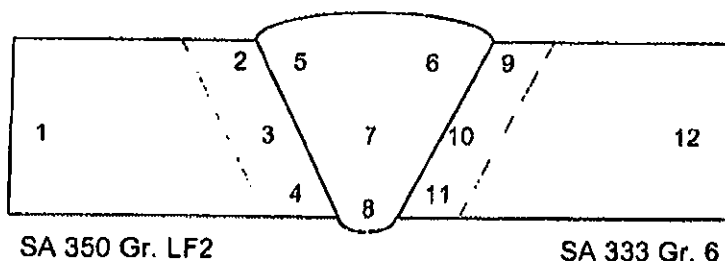
Attention: Wilber Davie

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



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:

Karen Koens
Chris Lachuk / Karen Koens, C.E.T.

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

2425 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 Ltd.
1508 - 8 Street
Nisku, AB
T9E 7S6

Laboratory Test No.: E02-150.15
Date: March 1, 2002

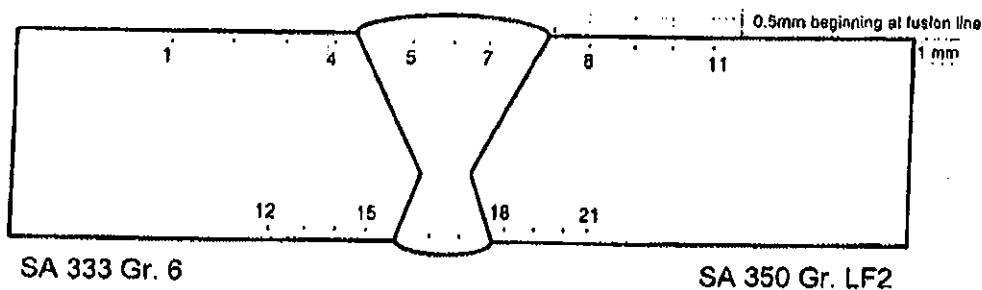
Attention: Wilber Davie

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
INSTRUMENT TYPE: Mitutoyo AVK-C1

LOAD: 10kg



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: _____


Chris Lachuk / 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



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 863.2
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 WHT 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	58 - 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.

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

TYPICAL JOINT DESIGNS

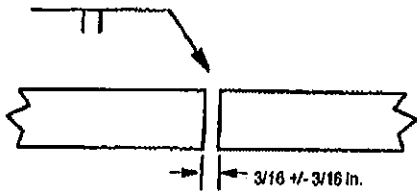


Figure 1
Single Square Butt

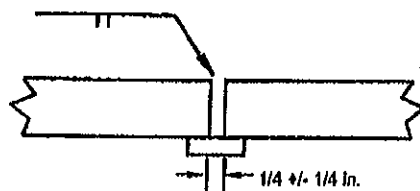


Figure 2
Single Square Butt with Backing Strip

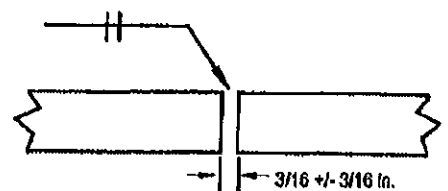


Figure 3
Double Square Butt

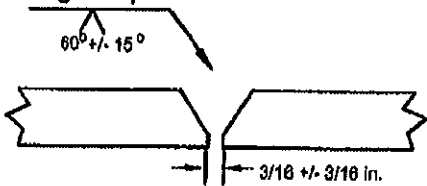


Figure 4
Single Vee Butt

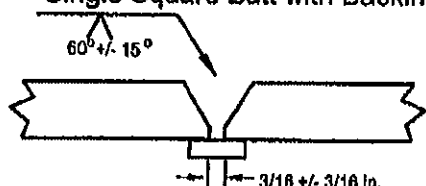


Figure 5
Single Vee Butt with Backing Strip

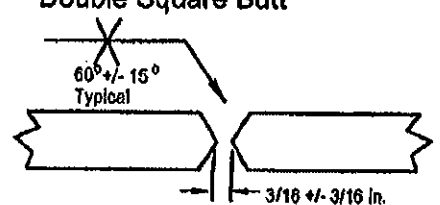


Figure 6
Double Vee Butt

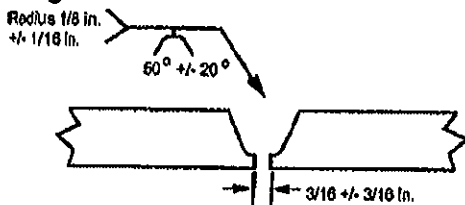


Figure 7
Single U Butt

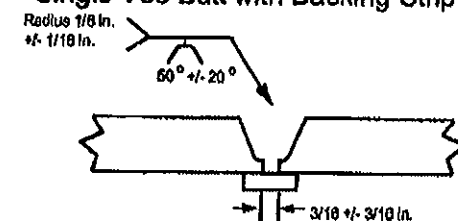


Figure 8
Single U Butt with Backing Strip

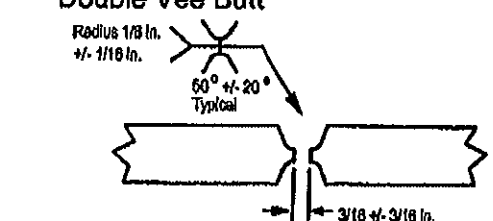


Figure 9
Double U Butt

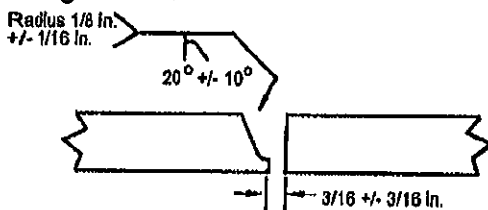


Figure 10
Single J Butt

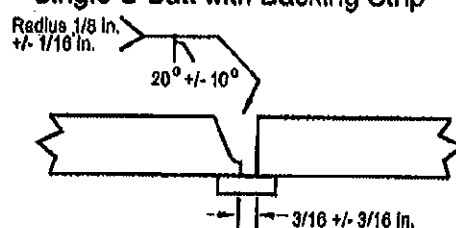


Figure 11
Single J Butt with Backing Strip

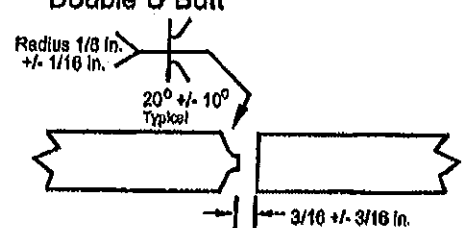


Figure 12
Double J Butt

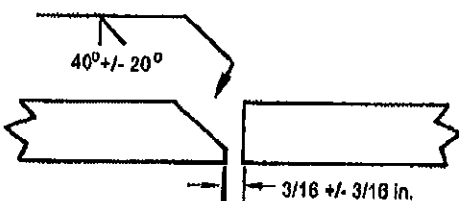


Figure 13
Single Bevel Butt

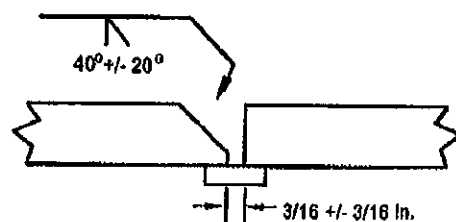


Figure 14
Single Bevel Butt with Backing Strip

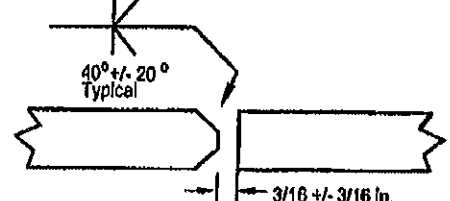


Figure 15
Double Bevel Butt

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

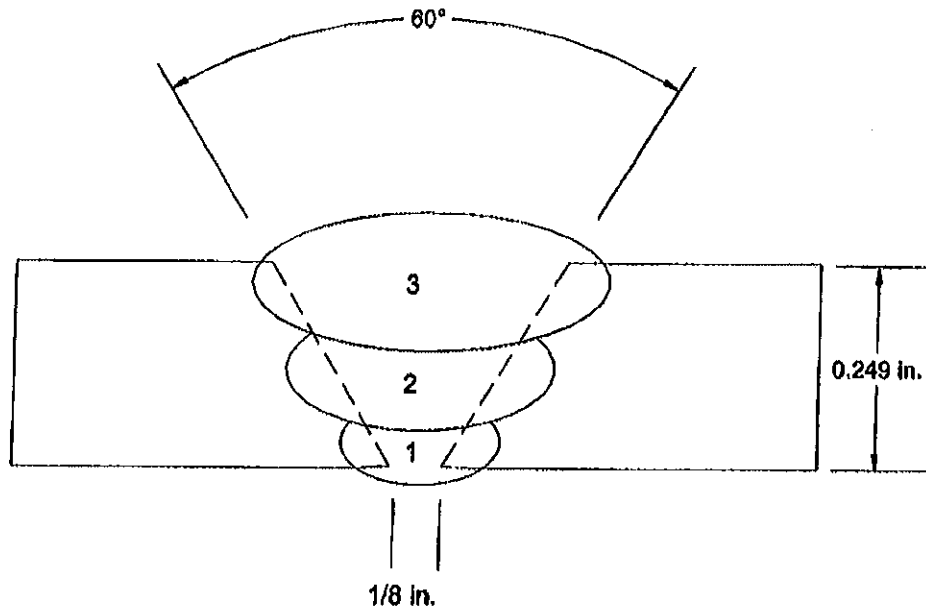
ELECTRICAL CHARACTERISTICS (QW-409)

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

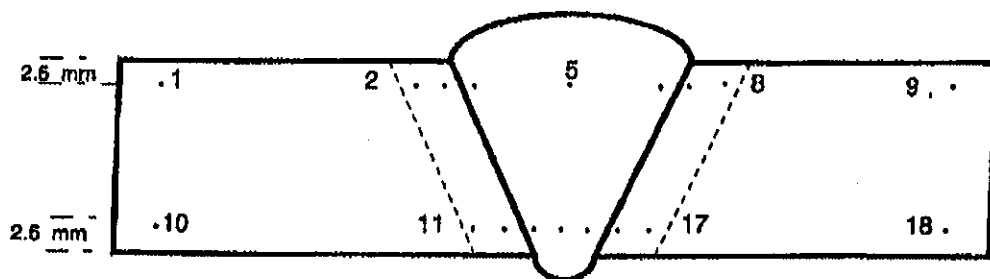
Attention: Wilber Davie

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

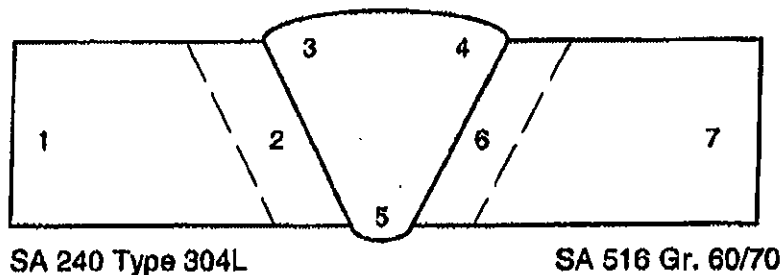
Attention: Wilber Davis

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
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

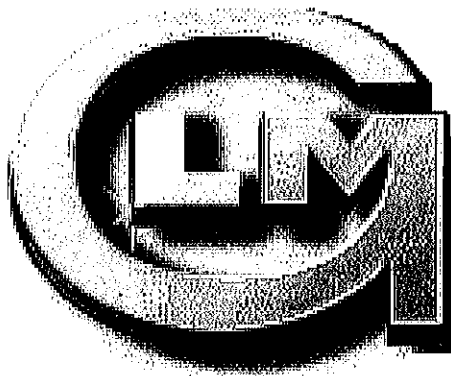
Location	Brinell Hardness (BHN)
Surface of Weld Cap	166
Surface of Weld Cap	170
Surface of Weld Cap	159

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:

10-797-1

Description:

12'-0" OD x 20'-0" HG SKIDDED TANK
HUSKY c/o EXCELSIOR ENGINEERING

Customer:

Action By:

Job Classification - 3: G.L.M. Standard Design / MTR Trace / 3" Party Involvement / No Amendments to Traveler.

Action By:	Serial Number:	Description:	Customer:	MTR TRACE?	YES	Ref. Documents or Standards (Where applicable)	Hold/Witness/Review			Initial & Date of Completion/Acceptance
							HP	WP	RP	
PREP		Material / Nozzle / Flange mapping		MTR TRACE?	YES	Q-826 / Q-827	GLM	CQR	GLM	CQR
MFG		Material: Yard Selection / Rolling / Burning / Tacking / Marking				Drawings/BOM				
		Roof Fittings: Orientation				As per Drawings				SM-3/30/11
		Roof Fittings: Alignment / Projection (ISP & OSP)				As per Drawings				SM-3/31/11
		Shell Fittings: Orientation				As per Drawings				SM-3/30/11
		Shell Fittings: Elevation				As per Drawings				SM-3/30/11
		Shell Fittings: Alignment / Projection (ISP & OSP)				As per Drawings				SM-3/31/11
MFG		Internal weld spatter / stray arcs and grinding suitable for internal coating					HP			SM-4/6/11
		External weld spatter / stray arcs and grinding suitable for external paint or primer					HP			SM-4/5/11
		Internals trial fit and verified.				As per Drawings				SM-4/3/11
		All welds and fittings visually inspected & Welders ID Verified (Metal Marker)				As per Drawings				SM-4/7/11
		Double wall construction?	NO							
		Complete floor vacuum / air tested								MG Mar 24/11
MFG	Testing:	Repads air tested (15 psig)								DN-4/5/11
		Air/Soap Test				E-315 (API 650)				TO-4/7/11
		Hydro. Pressure Test				N/A				
		Heat Coil(s) (air/hydro test) (Non-Registered Coils ONLY)				N/A				
QC	IF Double Wall	RT:				E-329 to E-340				WAIKUP
		MT:				As per Drawings				
		PT:				PER API 650				
PAINT SHOP	Release to Paint Shop	REQUIRED				OCR WRITTEN?				SM-4/3/11
		SHELL TO FLOOR				As per Drawings				
						As per Drawings				
FIT OUT	Painting / Coating / Insulation / Cladding	Final Fit Out & Touch Up Painting				As per Drawings				
						As per Drawings				
QC		Final Inspection verification and release				As per Drawings				SM-4/6/11

COMMENTS & NCRs ISSUED:

* AS PER PAINT & 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.



API-650 HYDROSTATIC & AIR-SOAP LEAK TEST

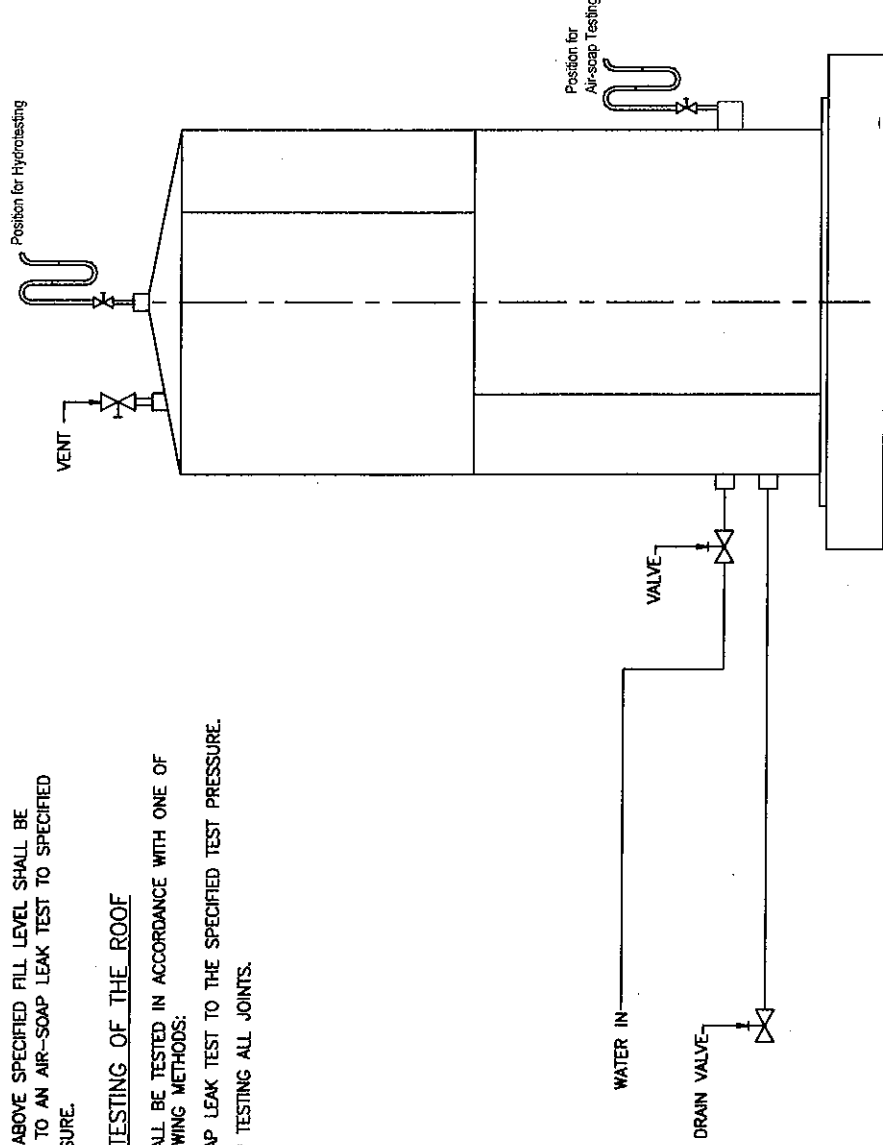
* Vital instructions required to complete this test are given in the drawing package. Refer to the drawings prior to performing any hydrostatic or pressure test.

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

- ROOFS 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: 10-797-1
CUSTOMER: HUSKY ENERGY
C/O: EXCELSIOR ENGINEERING LTD.
DESCRIPTION: 12'-0" O.D. X 20'-0" HIGH
WATER 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
ACCEPTABLE: ☒ Yes ☐ No
COMMENTS: TANK ROOF & SHELL RECEIVED
AN AIR/SOAP LEAK TEST

WITNESS: GLM
CUSTOMER: (IF NECESSARY / REQUIRED)
DATE: Apr 17 2011



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

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Calgary AB T2P 0Z1
P: (403) 231-2730
F: (403) 234-8274
TF: (800) 661-9446



Grande Prairie Facility

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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 #: 10-797-1
Date Tested: Mar 24/11
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
Completed by (Print & Sign):

SERIAL No: 10-797-1

DATE: 04-13-2011

DESCRIPTION: 700 BRC

CUSTOMER: Husky Oil

THICKNESS:

2.1

VERIFIED BY: WTA

TEMPERATURE:

20 F

SUBSTRATE TEMP:

70 F

RELATIVE HUMIDITY:

40%

DEW POINT:

37 F

INSULATION PRODUCT NAME:

BASF

PRICE: \$

RESIN NUMBER:

R2973

COUNTER READINGS:

START

0

FINISH

794

LOT NUMBER:

200338248

ISO NUMBER:

80004

COUNTER READINGS:

START

0

FINISH

794

LOT NUMBER:

2003450910

SEALER:

TowerHem I

PRICE: \$

CONSUMPTION (GALLONS)

20

COATING NAME:

TowerHem I

COATING NUMBER:

20101 Black

LOT NUMBER:

510K2502

HEAT TAPE LOCATION:

N/A

SURFACE PREP:

shop primer

GLM ACCEPTANCE:

WTA

GLM. INTERNAL/EXTERNAL COATING TRAVEL SHEET

ACCEPTANCE CRITERIA LOCATED ON QUALITY PLAN

SERIAL NO: 10-799-1 DESCRIPTION: 400 bbl
 CUSTOMER: Husky Energy CLIENT REP:
 Standard 5500 SPS Profile 2.8 mils Abrasive 6000 grade 3060 Nozzle Size 8 pressure 105 psi
 Ambient Temp. 60°F Substrate Temp. 62°F R.H. 18% Dewpoint 22°F pH Ref. No. 1
 Date 4/13 Mag. Base (where req'd) 4/13 Date: 4/13
 G.L.M. Final Substrate Inspection: 6.0. (Initial) Date: 4/13
 CQR Final Substrate Inspection: 6.0. (Initial) Date: 4/13
 Surface accepted for Lining (Applicator) 6.0. (Initial) Date: 4/13

Replicas or Min & Max Record
PRESS-O-FILM™ Made in USA
TESTEX NEWARK, DE 19715 USA
 No. 28
 Reading 2.0 mils
 or 50 µm
 X COARSE (1.5 to 6.5 mils) or (40 to 115 µm)

NOTE LOCATION:

Coat No.	Manufacturer & Product No.	Base Batch No.	Catalyst Batch No.	Gals. Used	Color
1	<u>Deise 100</u>	<u>64948 HUIH</u>	<u>59699 HUIK</u>	<u>16</u>	<u>Gray</u>
2					
3					
4					

APPLICATION (PART A)

Coat No.	Thinning Agent		Mixing Method	Induction Time	Material Temp. °F	Initials	Date M/D
	Type	Amount %					
1	<u>NP</u>	<u>---</u>	<u>NP</u>	<u>1-12</u>	<u>105</u>	<u>WA</u>	<u>04-14-2011</u>
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	<u>East</u>	<u>71°F</u>	<u>73°F</u>	<u>19%</u>	<u>28°F</u>	<u>Spray</u>	<u>extreme mix</u>	<u>423</u>	<u>NP</u>	<u>22</u>	<u>24</u>	<u>WA</u>	<u>04-14-11</u>
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 Low Nozzled Buck + Pump	14	50	26	3/7	WA	05-15-11			
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. <u>Boat</u>	Test by <u>AR</u>	date <u>04-16</u>	Area Tested <u>Complete</u>	Equip. I.D. <u>1008</u>	Discon. & Loc'n: <u></u>
Test std. <u></u>	Test by <u></u>	date <u></u>	Area Tested <u></u>	Equip. I.D. <u></u>	Discon. & Loc'n: <u></u>
Test std. <u></u>	Test by <u></u>	date <u></u>	Area Tested <u></u>	Equip. I.D. <u></u>	Discon. & Loc'n: <u></u>

Repair #	Areas Coated	Repair Proc #	Manufacturer & Product #	Base Batch #	Catalyst Batch #	Gals. Used	Color
1	Repairs	765-5-4	Oreore Oreomat 100	64948 H4117	59699 H4117	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	24	35	BRUSH			AR	04-15		
2														
3														

FINAL INSPECTIONS:

Visual by <u>Wayne Antenerko</u>	Date <u>04-16-2011</u>	G.L.M. Acceptance <u></u>
Discontinuity by <u>Andrew Rose</u>	Date <u>04-16-2011</u>	CQR Acceptance <u></u>
Cure by <u>Time & Temp</u>	Date <u>04-17-2011</u>	

INTERNAL EXTERNAL COATING TRAVEL SHEET

ACCEPTANCE CRITERIA LOCATED ON QUALITY PLAN

G.L.M. SERIAL NO: 10-797-1 DESCRIPTION: 400 bbl
 Surface Preparation (substrate): 400 bbl CLIENT REP: 400 bbl
 Standard SSPC-SP7 Profile W/A Abrasive Barrett 3060 Nozzle Size 8 Pressure 105 psi
 Ambient Temp. 41/13 Substrate Temp. 60F R.H. 18% Dewpoint 220F pH Ref. No.
 Date 4/13 Mag. Base (where req'd)

Date: 4/13 ANCHOR PROFILES
 Date:
 Date: 4/15

APPLICATION (PART A)

Coat No.	Manufacturer & Product No.	Base Batch No.	NOTE LOCATION:	Catalyst Batch No.	Gals. Used	Color
1	Cloverdale Industrial Primer	S11B3070		—	7	Grey
2	Cloverdale Industrial Enamel			—	2	Warm Grey
3						
4						

Coat No.	Thinning Agent		Mixing Method	Induction Time	Material Temp. °F	Initials	Date M/D
	Type	Amount %					
1	—		Mech	NA	71	GM	Apr 15/11
2	—		Mech	NA	74	GM	Apr 15/11
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	Complete	77	78.4	10.9	19.6	Spray	60:1	415	0	4	6	GM	Apr 15/11
2	Protectors	77	78.4	10.9	19.6	Spray	60:1	415	2.3	3	5	GM	Apr 15/11
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	2.0	3.7	2.3	15-32	GM	04-15	2007		
2	Finish	3.7	5.5	4.4	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															

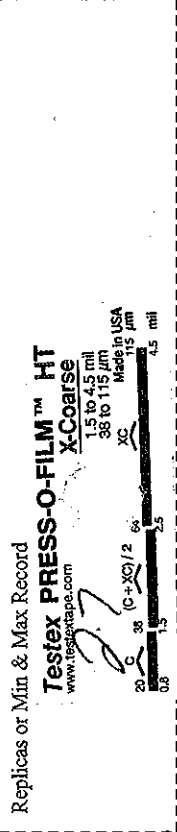
FINAL INSPECTIONS:

Visual by	WAYNE A. JONES RO	Date	04-17-2011
Discontinuity by	N/A	Date	
Cure by	Time & Temp	Date	04-18-2014
		G.L.M. Acceptance	
		CQR Acceptance	

G.L.M. INTERNAL/EXTERNAL COATING TRAVEL SHEET

ACCEPTANCE CRITERIA LOCATED ON QUALITY PLAN

SERIAL NO: 10-797-1 DESCRIPTION: 400bbi
 CUSTOMER: Husky Energy CLIENT REP:
 Surface Preparation (substrate):
 Standard SSPC-SP10 Profile 2.7 mils Abrasive 60/60 grade 30/60 Nozzle size 8 Pressure 105 psi
 Ambient Temp. 72°F Substrate Temp. 74.1°F R.H. 37.2% Dewpoint 49.2°F pH Ref. No.
 Date 6/22 Mag. Base (where req'd) N.S. Date: 6/22
 S.L.M. Final Substrate Inspection: N.S. (Initial)
 CQR Final Substrate Inspection: N.A. (Initial)
 Surface accepted for Lining (Applicator) N.A. Date: 6/22 (Initial)



APPLICATION (PART A)

Coat No.	Manufacturer & Product No.	Base Batch No.	Catalyst Batch No.	Gals. Used	Color
1	DEVCON DEUTAR SA	APV11A30251	64643 HUYA	5gal	BLACK
2					
3					
4					

Coat No.	Thinning Agent		Induction Time	Material Temp. °F	Initials	Date M/D
	Type	Amount %				
1	—	—	15min	73°F	N.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. %					Min	Max		
1	Floor	73°F	74°F	47%	4.8 ft	56.1	4.21	—	16	18	N.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	13.4	18.3	16.1	11/1	Ad	06-25	W007		
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.	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	Date	G.L.M. Acceptance	CQR Acceptance
Visual by	Date	G.L.M. Acceptance	CQR Acceptance
Discontinuity by	Date	G.L.M. Acceptance	CQR Acceptance
Cure by	Date	G.L.M. Acceptance	CQR Acceptance



GLV Inspection

FINAL FIT-OUT TRAVEL SHEET

DATE WRITTEN: April 21 / 11

REQUIRED BY: _____

CUSTOMER: Husky EnergyDESCRIPTION: 400 BBLJOB NUMBER / SERIAL NUMBER: 10-797-1

WAREHOUSE ITEMS PULLED BY: _____

DATE: _____

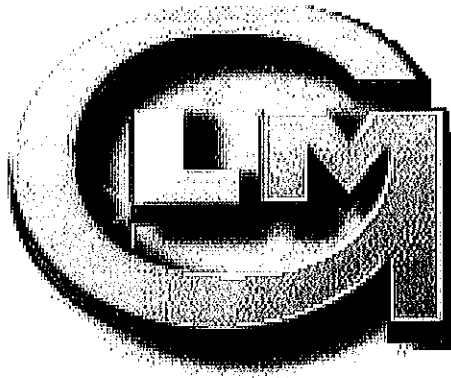
FIT-OUT VERIFIED ITEMS RECEIVED
FROM SHIPPING/RECEIVING: _____

DATE: _____

FIT-OUT	ITEM	Check for latest drawing revisions		Initials	
		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			
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:
		<u>BA</u>	<u>June 6 / 2011</u>	<u>BA</u>	<u>June 6 / 2011</u>
<input type="checkbox"/> Released for loading, 3 rd party inspector to witness loading & tie down, 24 hours notice required		<input type="checkbox"/> Ship loose items 3 rd party inspection required, 24 hours notice required			
<input checked="" type="checkbox"/> Released for loading, 3 rd party inspect after tie down, 24 hours notice required		Form received from QC by S & R:		Initial & Date:	
		Above items included for transport:		Initial:	
<input type="checkbox"/> Released for loading & shipping 3 rd 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

CLINTON CHAIRS P.A.



APR 12F ED 12 ADD. 11 MOD X

SERIAL 10-197-1 YEAR 2011

OWNER VAC NO. T-320

CERVIC WATER

NOM DIA	12.0	FT.	RIM THK	1/4	IN.
NOM IP	20.0	FT.	RIM TYP	FLAT	
NOM CAP	400	BBL	ROOF THK	3/16	IN.
PES DRK	16.0	OZ.	PKWT	NO	
DES LIQ	1.0		DES LIQ IVL	20.0	FT.
MAX TRAP	11	'F	MAX TRAP	200	'F

A-36

3116

CL. WINDUETEL U.P.

API 12F ID. 12 400 10-1997-1 2011 X

SERIAL NO. 10-1997-1

OWNER TAG NO. I-320

WATER

NOM. DIA.	12.0	FT.	1 1/4	IN.
NOM. H.	20.0	FL.	FLAT	
NOM. CAP.	400	BBL	3716	IN.
DES. PRES.	16.0	OZ.	NO	
DES. S.	1.0		20.0	FT.
NOM. H.	11	'F	200	'F

A-36

3716