UOP RUSSELL LLC
Tulsa, Oklahoma

JOB NO:	J-447	TAG NO:	V-402	DATE:	7/14/2011
CLIENT:	UOP Russell	S.O./P.O. NO:		BY:	JRG
SUBJECT:	60MM Cryo Plant	SERVICE:	Cold Separator		

PRESSURE VESSELS

MECHANICAL DESIGN

Type (vertical, horizontal, tower)	Vertical
Diameter: (inch)	78" ID
S/S Length (ft-inch)	12' - 0"
Skirt Length(ft-inch)	3' - 0"
Design Pressure (psig)	1100
Design Temperature (°F)	150
MDMT (°F) @ Pressure (psig)	-50 @ 1100
Corrosion Allowance (inch)	0.0625
Radiography	RT-1
PWHT Req'd?	Yes
Wind / Seismic Code	ASCE 7-10 / ASCE 7-10
Wind Code	Cf=0.7, V=120 mph, Exp. C, Cat. III
Seismic Code	Site D, I=1.25, S_S=100% , S_1=40%
Insulation	2"C
Fireproof	No
Code	ASME VIII, Div I
Code Stamp Req'd	Yes
Sandblast / Paint	SSPC-SP6 / TRCo Std ENG-36c
Ladder / Platform Clips Req'd?	No
Pipe Supports Req'd?	No

PROCESS DESIGN

Operating Pressure (psia)	768
Operating Temperature (°F)	-30 / -5
Vapor Flow (Lb/Hr)	77,881 / 87,818
Vapor Density (Lb/cf)	4.381 / 4.073
Liquid Flow (Lb/Hr)	32,842 / 22,912
Liquid Density (Lb/cf)	29.13 / 30.25
Liquid Residence Time (Min)	> 5 min @ NLL

MIST PAD

Req'd :	Yes	Diameter:	40"
Overall Thk:	11"	Pad Thk:	9"
Removable:	No	Grid Matl:	316SS
Wire Diameter:	0.006	Mesh Matl:	316SS

MATERIAL SPECIFICATIONS

Shell	SA-	516-70N
Head	SA-	516-70N
Nozzle Necks	SA-	333 Gr. 6
Flanges	SA-	350-LF2
Couplings	SA-	350-LF2
Studs	SA-	193-B7
Nuts	SA-	194-2H
Skirt / Baseplate	SA-	516-70

NOZZLES

SERVICE	MK	QTY	SIZE	RATING	FACE & TYPE	NOZZLE APPURTENANCES
Inlet	A	1	8."	600	RF FLG	w/ Diverter
Vapor Outlet	B	1	8."	600	RF FLG	
Liquid Outlet	C	1	▲ 4."	600	RF FLG	Syphon
LSHH	D	2	1."	6000	CPLG	
TI	E	1	.75"	6000	CPLG	
LT	F	2	1."	6000	CPLG	
LG	G	4	.75"	6000	CPLG	
Manway	H	1	18."	600	RF FLG	
TE	J	1	.75"	6000	CPLG	

INTERNALS AND APPURTENANCES

PACKING	Size (in.)	Type	Bed Height (ft.)
Top			
Middle			
Bottom			

PLATFORMS	Quantity	Angle / Area	
Access:		(deg)	Diameter (in):
Stepoff:		(deg)	Length (in):
Other:		(Sq.Ft.)	with flanges

DOME	BOOT

TRAYS	Quantity	No. of Passes	Weldins by:

Platepack Length (inch):	
Total Ladder Length (ft):	

Qty Break Flg Pairs:	
Qty of Hat Trays:	
Weir Plate:	No
Wave Baffle:	No
Nat'l Board Req'd:	Yes
Charcoal Bed Height (ft):	
Qty Catalyst bed Supports:	

NOTES:
1) See scope of supply for oversizing mist pads.
2) 5 minutes residence time at the NLL 60" (Recovery). Disengaging height 53".
3) Use TRCo Painting System 3(CS only).

REVISION	3	▲ 4	1	2
ENGINEER/DATE	TKF 7/11/13	JRG 8/13/13	BH 11/21/11	TKF 29-Oct
ISSUED FOR	Revised	Revised	Revised	Revised

UOP RUSSELL, LLC
Tulsa, Oklahoma

FORM # MST-ELM

MIST ELIMINATOR SPECIFICATION

Job Number	J-447	Spec. No.:	ME-402
		Spec. By:	SHP
Vessel Tag	V-402	Date:	07/09/13

Mistpad Installed Diameter:	40	in
Mesh Thickness:	9	in
Mesh Material:	316SS	
Density Required:	12	lbs/cf
Wire Diameter:	0.006	in
Grid Material:	316SS	
Grid Diameter:	Note 2	
Grid Thickness (Top & Bottom)	1	in
Oversized Diameter:	Note 1	
Manway I.D.:	17	in
Number of Segments:	Per Mfr	
Removeable (Yes / No):	No	

Note 1: Oversized diameter of Mist Extractor shall allow the vessel to be shipped horizontally with the extractor installed and shall be at least:

No. of segments	**Oversize (all sides of each sections)**
1 or 2	**1/2"**
3 or 4	**3/8"**
More than 4	**1/4"**

Note 2: Grid diameter shall be 1-1/2" less than the installed diameter shown above.
Note 3: OD of each grid section shall be banded.

REVISION	0							
ENGINEER/DATE	SHP	7/9/13						
ISSUED FOR	AFC							

Professional Projects Inc.
18115 Telge Rd. Cypress, TX 77429

5654-1 Databook
Manufacturer's Databook

P.P.I. Job Number: 5654

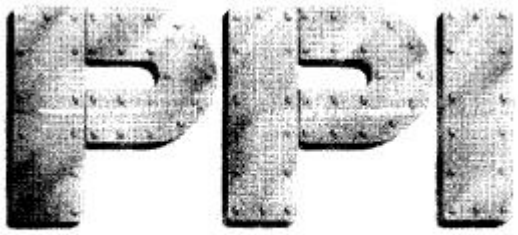
P.P.I. Shop Order: 5654-1

Customer: UOP RUSSELL

Item: V-402,

COLD SEPARATOR

Customer P.O. No. # 4500754097



Professional Projects Inc.

18115 Telge Rd. Cypress, TX 77429

5654-1 Databook

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Item: V-402, COLD SEPARATOR

Professional Projects Inc.

18115 Telge Rd. Cypress, TX 77429

5654-1 Databook

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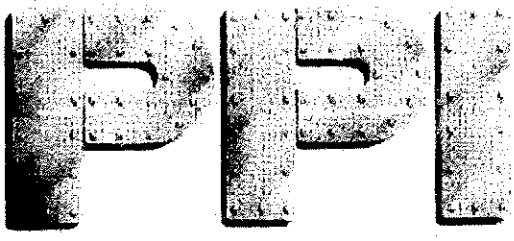
Item: V-402, COLD SEPARATOR



Professional Projects Inc.

18115 Telge Rd. Cypress, TX 77429

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Item: V-402, COLD SEPARATOR

Quality Documents

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by: Professional Projects Inc. 18115 Telge Rd. Cypress,Tx 77429 (Name and address of Manufacturer)
2. Manufactured for: UOP Russell (Name and address of Purchaser)
3. Location of installation: Unknown (Name and address)

4. Type	(Manufacturer's serial No.)	(CRN)	(Drawing number)	(National Board number)	(Year built)
Vertical Tank (Horizontal or vertical tank)	5654-1	-----	5654-1 Rev. 1	3170	2017

5. ASME Code, Section VIII, Division 1	[Edition and Addenda, if applicable (date)]	(Code Case Numbers)	[Special Service per UG 120(d)]
	2013	-----	-----

6. Shell:	(Material spec. number, grade)	(Nominal thickness, in.)	(Corrosion allowance, in.)	(Inner diameter in.)	[Length (overall)]
	SA-516-70N	2.50"	.0625"	78"	12'-0"

Body Flanges on Shells									Bolting			
No.	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Location	Num & Size	Bolting Material	Washer (OD,ID,th)	Washer Material
---	---	---	---	---	---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---	---	---	---	---	---

7. Seams:

[Long. (welded, dbl, sngl, lap, butt)]	R.T. (Spot or Full)	(Eff. %)	(H.T. Temp.)	(Time hr)	Girth (welded, dbl,sngl, lap, butt)	R.T. (spot or full)	(Eff. %)	(No. of courses)
Welded Dbl Butt	Full	1.0	1150	1.49	Welded Dbl Butt	Full	1.0	1

8. Heads: (a) Material SA-516-70N (Spec no., grade) (b) Material SA-516-70N (Spec no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	Top	2.2262"	.0625"	---	---	2:1	---	---	---	Concave
(b)	Bottom	2.2262"	.0625"	---	---	2:1	---	---	---	Concave

Body Flanges on Heads									Bolting			
	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Location	Num & Size	Bolting Material	Washer (OD,ID,th)	Washer Material
(a)	---	---	---	---	---	---	---	---	---	---	---	---
(b)	---	---	---	---	---	---	---	---	---	---	---	---

9. MAWP 1100 (Internal) --- (External) psi at max. temp. 150 (Internal) --- (External) °F

Min. design metal temp. -50 °F at 1100 psi. Hydro., pneu,, or comb. test pressure Hydro. 1430 psi.

Proof test ---

10. Nozzles, inspection and safety valve openings:

Purpose (inlet, Outlet, Drain, etc.)	No.	Diameter or Size	Type	Material		Nozzle Thickness		Reinforcement Material	Attachment Details		Location (Insp. Open.)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
Manway	1	18"	600 RFHB	SA-350-LF2	---	2.00"	.0625"	---	Type 7	---	Shell
Inlet w/ Diverter	1	8"	600 RFHB	SA-350-LF2	---	1.375"	.0625"	---	Type 7	---	Shell
Vapor Outlet	1	8"	600 RFHB	SA-350-LF2	---	1.375"	.0625"	---	Type 7	---	Top Head
Liquid Outlet w/Syphon	1	4"	600 RFHB	SA-350-LF2	---	1.00"	.0625"	---	Type 7	---	Shell
LSHH	2	1"	6000# CLPG	SA-350-LF2	---	.4675"	.0625"	---	Type 7	---	Shell
LT	2	1"	6000# CLPG	SA-350-LF2	---	.4675"	.0625"	---	Type 7	---	Shell
TI, LG, TE	6	3/4"	6000# CPLG	SA-350-LF2	---	.4675"	.0625"	---	Type 7	---	Shell

11. Supports: Skirt Yes (Yes or no) Lugs 0 (Number) Legs 0 (Number) Other --- (Describe) Attached Bottom Head/Welded (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: (Name of part, item number, Manufacturer's name and identifying stamp)

MDMT per UG-20(f).

ITEM: V-402, Cold Separator P.O.: 4500754097

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization No. 17,507 expires April 21, 2015

Date 8/17/2017 Co. name Professional Projects Inc. (Manufacturer) Signed (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Professional Projects Inc. at 18115 Telge Rd. Cypress, TX 77429 I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and employed by Travelers Indemnity Co. of CT have inspected the component described in this Manufacturer's Data Report on 8/17/2017, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 8/17/2017 Signed (Authorized Inspector) Commissions NB 7582 [National Board (incl. endorsements)]

DESCRIPTION 78" ID X 12'-0" S/S
ITEM NO. V-402, COLD SEPARATOR

SERIAL NO. 5654-1
DATE 1/17/2017
CUSTOMER UOP RUSSELL

INSPECTION TRAVELER

S/O #: 5654-1

INSPECTION, EXAMINATION PERFORMED	CODE	A.I.	Q.C.	REMARKS
1. SPECS., DESIGN CALCULATIONS, DRAWINGS & MTRS:			1-17-17 SW	
2. MATERIALS:				
a. Heads checked form forming specs. thk.			3/28/17 RC	
b. Shell specs. & thk. out-of-roundness.			3/28/17 RC	
c. CPLGS, Nozzles, Flg. specs.			4/11/17 RC	
3. WELDING:				
a. Procedures Specifications.			1-17-17 SW	
b. Procedure & Performance Qualification.			1-17-17 SW	
4. FABRICATION:				
a. Examine plate surface.			3/28/17 RC	
b. Examine cut edges.			4/4/17 RC	
c. Check weld groove preparation.			4/20/17 RC	
d. Cutting, fitting alignment.			4/20/17 RC	
e. Back-Chip.				
f. Welders symbols (See Heat Chart or Dwg).			4/11/17 RC	
g. Record Mill stamping & transfers (See Heat Chart or Dwg.).				
(1) HEAD (BTM)			3/28/17 RC	
(2) HEAD (TOP)			3/28/17 RC	
(3) SHELL			3/28/17 RC	
(4) SHELL			3/28/17 RC	
h. Verify nozzle thickness & flange ratings			4/11/17 RC	
5. FINAL INSPECTION:				
a. Weld appearence & reinforcement.			8/12/17 RC	
b. Check fillet weld sizes.			8/12/17 RC	
c. Workmanship.			8/14/17 RC	
d. Out-of-roundness. TAPE			8/14/17 RC	
e. Internal.				
f. Vacuum.				
6. POST WELD HEAT TREATMENT:			8/15/17 RC	
a. Type.				
b. Charts reviewed.			8/16/17 RC	
c. Verify up, hold & down periods.			8/15/17 RC	
7. NON-DESCTRUCTIVE EXAMINATION:				
a. Hydrostatic PSIG (1430) Gauge #: (R-37)			8/17/17 RC	
b. Radiograph Examination.			4/15/17 RC	
c. MT-Magnetic Particle Examination.			7/19/17 RC	
d. UT-Ultrasonic Examination.			6/14/17 RC	
e. PT-Liquid Penetrant Examination.				
f. Other.				
g. Soap & Air Test reinforcing pads.				
8. NON-CONFORMITY REPORT:				
9. PREPARATION FOR SHIPMENT:				
a. Nameplate attached.				
b. Check stamping on nameplate.				
c. Data report checked and signed.				
d. Customer Inspection & Release.				

P.P.I. CODE LEGEND
x in Code box indicates inspection points

PROFESSIONAL PROJECTS, INC. REV. 0 SHEET 1 OF 3 PPI. JOB #: 5654
QUALITY INSPECTION PLAN PPI S/O #: 5654-1
CUSTOMER NAME: UOP RUSSEL

P.O. # 4500754097 ITEMS: V-402 Cold Separator

	REVIEW POINTS: H= HOLD I= INSPECT R= REVIEW N/A= NOT APPLICATE	REFERENCE DOCUMENTS	Q.C.DEPARTMENT REVIEW R.P.	DATE	INITIAL	CLIENT REVIEW R.P.	DATE	INITIAL	COMMENTS
1.00	PRE-INSPECTION MEETING								
2.00	DOCUMENTS								
2.01	CUSTOMER P.O.	CUST. P.O.	R.			R			
2.02	CUSTOMER SPECIFICATIONS	CUST. SPECS.	R.			R			
2.03	P.P.I. DRAWINGS	S/O #:	R.	1-17-17	SW	R			
2.04	P.P.I. CALCULATIONS	S/O #:	R.			R			
2.05	WPS/PQR & WELD MAP	SECTION IX	R.	5-3-17	SW	R			
2.06	WELDER QUALIFICATION	SECTION IX	R.	1-17-17	SW	R			
3.00	MATERIALS								
3.01	MATERIAL TEST REPORTS/CERTS	ASME SECT II	R	3/28/17	RC	R			
3.02	THICKNESS REQUIREMENTS	CALCS / DWG	R	3/28/17	RC	R			
3.03	SURFACE CONDITIONS		I	4/4/17	RC	R			
3.04	HEAT NUMBER TRACEABILITY		I	3/28/17	RC	R			
4.00	HEADS								
4.01	FORMING SPECIFICATIONS	UCS-79 & UG-81	R	3/28/17	RC	R			
4.02	EDGE PREPARATIONS	QC-VT	I	4/4/17	RC	R			
5.00	SHELLS								
5.01	OUT-OF-ROUNDNESS Tape	UG-80	I	3/28/17	RC	I			
5.02	EDGE PREPARATIONS	QC-VT	I	4/4/17	RC	I			
6.00	NOZZLES & FITTINGS								
6.01	FLANGE RATING	DWG.	I	4/11/17	RC	I			
6.02	NOZZLE NECK REQUIREMENTS	CALCS. / DWGS.	I	4/11/17	RC	I			
6.03	EDGE PREPARATIONS	QC-VT	I	4/16/17	RC	I			
7.00	LAYOUT & FIT-UP								
7.01	SHELL LONG SEAMS	UW-33	I	4/18/17	RC	R			
7.02	SHELL GIRTH SEAMS	UW-33	I	4/18/17	RC	R			
7.03	HEAD TO SHELL SEAMS	UW-33	I	4/26/17	RC	R			
7.04	FLANGE TO NECK SEAMS	UW-33	I	5/3/17	RC	R			
7.05	NOZZLE TO SHELL/HEAD	UW-33	I	5/5/17	RC	R			
7.06	ATTACHMENTS	UW-33	I			R			

PROFESSIONAL PROJECTS, INC.
QUALITY INSPECTION PLAN
CUSTOMER NAME: UOP RUSSEL

Rev. 0 SHEET 2 OF 3

PPI. JOB #: 5654
PPI S/O #: 5654-1

P.O. # 4500754097

ITEMS:V-402
Cold Separator

REVIEW POINTS: H= HOLD I= INSPECT R= REVIEW N/A= NOT APPLICATE		REFERENCE DOCUMENTS	Q.C.DEPARTMENT REVIEW			CLIENT REVIEW			COMMENTS
			R.P.	DATE	INITIAL	R.P.	DATE	INITIAL	
8.00	WELD OUT								
8.01	LONG SEAMS SHELL	UW-35	I	4/18/17	RC	R			
8.02	GIRTH SEAMS SHELLS / HEADS	UW-35	I	4/18/17	RC	R			
8.03	NOZZLE GIRTH SEAMS	UW-35	I	5/3/17	RC	R			
8.04	NOZZLE TO SHELLS / HEADS	UW-35	I	5/5/17	RC	R			
8.05	ATTACHMENTS	UW-35	I			R			
9.00	NDE								
9.01	RT (RADIOGRAPHY)	UW11a	I	4/6/17	RC	I			
9.02	UT (ULTRASONIC)	TGRUT-1	N/A	4/14/17	RC	N/A			
9.03	MT (MAGNETIC PARTICLE)	QC-MT	I	7/19/17	RC	I			
9.04	PT (LIQUID PENETRANT)	QC-PT	N/A			N/A			
9.05	VT (VISUAL)	QC-VT	I			I			
9.06	PMI (POSITIVE MATERIAL IDENTIFICATION)	PMI 100A	N/A			N/A			
10.00	POST WELD HEAT TREATMENT			8/15/17	RC				
10.01	VERIFY TEMP. & HOLD TIMES	UCS-56	R.	8/15/17	RC	R			
10.02	REVIEW CHARTS		R.	8/16/17	RC	R			
11.00	NDE AFTER P.W.H.T.								
11.01	RT (RADIOGRAPHY)	UW11a	N/A			N/A			
11.02	UT (ULTRASONIC)	TGRUT-1	N/A			N/A			
11.03	MT (MAGNETIC PARTICLE)	QC-MT	N/A	8/15/17	RC	N/A			
11.04	PT (LIQUID PENETRANT)	QC-PT	N/A			N/A			
11.05	VT (VISUAL)	QC-VT	N/A			N/A			
11.06	BRINNELL HARDNESS TESTING	PPI-TP	N/A			N/A			
12.00	PRE-HYDRO INSPECTION								
12.01	FINAL DIMENSIONAL	DWGS.	I	8/12/17	RC	H			
12.02	AIR TEST REINFORCING PADS		I			R			
12.03	INTERNAL INSPECTION/OVERALL APPEARANCE		I			I			

PROFESSIONAL PROJECTS, INC.
QUALITY INSPECTION PLAN
CUSTOMER NAME: UOP RUSSEL

Rev. 0 SHEET 3 OF 3

PPI. JOB #: 5654
PPI S/O #: 5654-1

P.O. # 4500754097

ITEMS: V-402
Cold Separator

REVIEW POINTS: H= HOLD I=INSPECT R=REVIEW N/A=NOT APPLICABLE		REFERENCE DOCUMENTS	Q.C.DEPARTMENT REVIEW			CLIENT REVIEW			COMMENTS
			R.P.	DATE	INITIAL	R.P.	DATE	INITIAL	
13.00	HYDROSTATIC TEST								
13.01	VERIFY PRESSURE & HOLD TIME	UG-99	W	8/8/17	RC	H			8/15/17 RC
13.02	VERIFY GAUGE CALIBRATION		W	8/14/17	RC	H			
13.03	REVIEW CHARTS		W	8/16/17	RC	H			
14.00	COATING								
14.01	VERIFY REQUIREMENTS	DWG.	W	8/20/17	RC	R			
14.02	ANCHOR PROFILE / SANDBLAST		W	8/21/17	RC	R			
14.03	PRIMER		W	8/21/17	RC	R			
14.04	MIDDLE COAT		W	8/23/17	RC	R			
14.05	FINISH		W	8/24/17	RC	R			
14.06	DRY FILM THICKNESS		H	9/8/17	RC	H			
14.07	OVERALL APPEARANCE		H	9/8/17	RC	H			
15.00	PRE-SHIPMENT								
15.01	FINAL INTERNAL CLEANING		W			H			
15.02	ATTACH BLINDS & COVERS		W			H			
15.03	MARKING		W			H			
15.04	NAMEPLATE REVIEW & ATTACHED		W			H			
16.00	DATA PACKAGE REVIEW		R			H			

Professional Projects Inc.

18115 Telge Rd. Cypress, TX 77429

CERTIFICATE OF COMPLIANCE

MANUFACTURED FOR: UOP RUSSELL

P.O. NUMBER: 4500754097 ITEM #: V-402

P.P.I. JOB NO.: 5654 **P.P.I. SERIAL NO.:** 5654-1

DESCRIPTION: COLD SEPARATOR

HYDROSTATIC TESTED @ 1430 PSIG.

PROFESSIONAL PROJECTS, INC. HEREBY CERTIFIES THAT THE CHEMICAL & PHYSICAL PROPERTIES OF ALL PARTS ON THE ABOVE PRESSURE VESSEL MEETS OR EXCEEDS THE MATERIAL SPECIFICATIONS OF THE ASME CODE. THE CONSTRUCTION & WORKMANSHIP HAVE BEEN DONE IN ACCORDANCE TO SECTION VIII DIVISION 1 OF THE ASME CODE.

8/11/2017

DATE: ~~8/11/2017~~

Seth B. Westbrook
QUALITY CONTROL MANAGER

Professional Projects Inc.

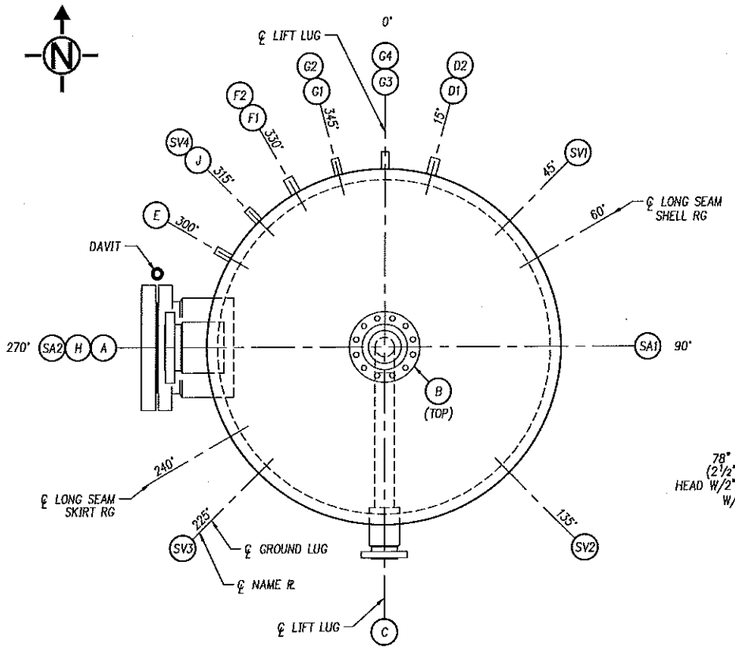
18115 Telge Rd. Cypress, TX 77429

5654-1 Databook

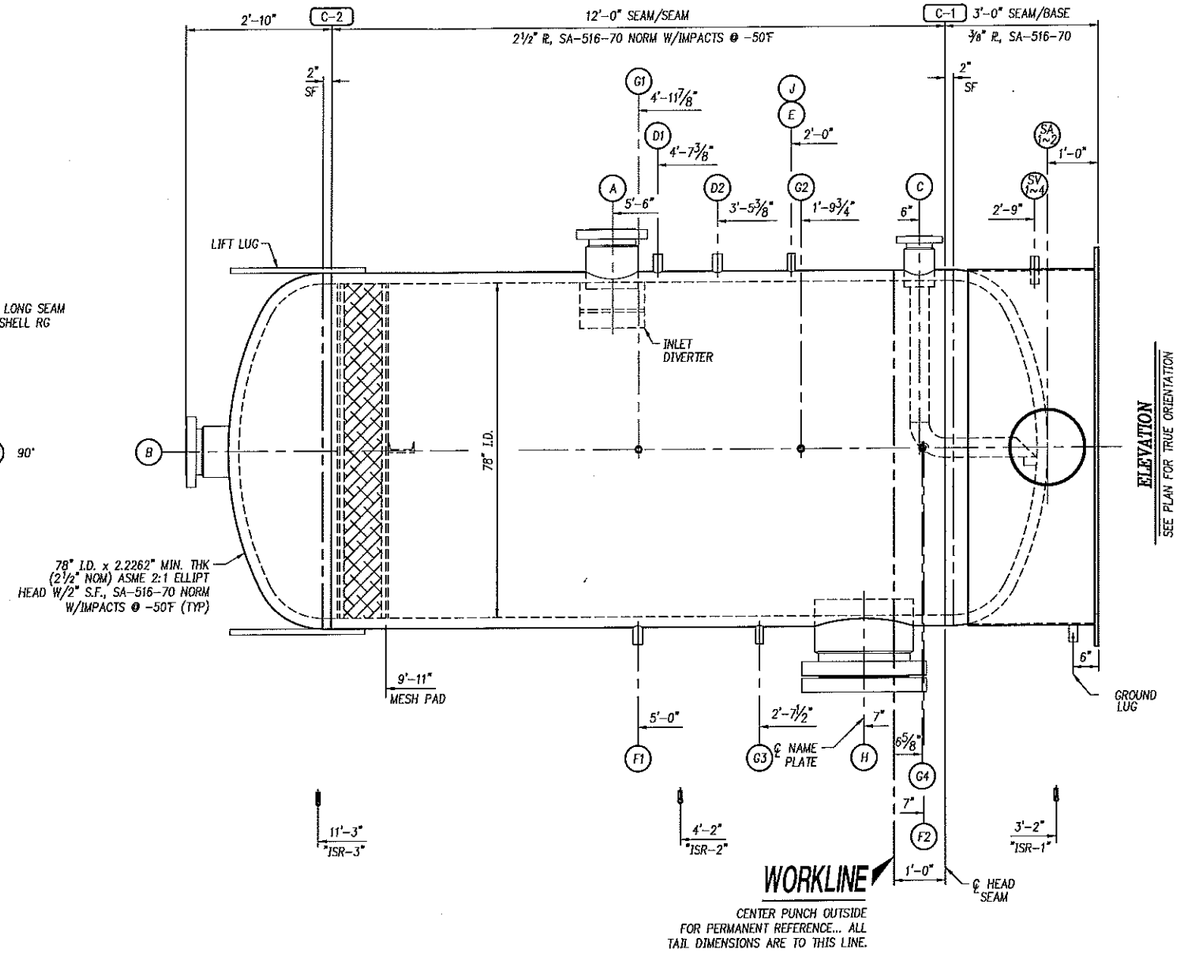
List of Contents

Item: V-402, COLD SEPARATOR

Design Documentation

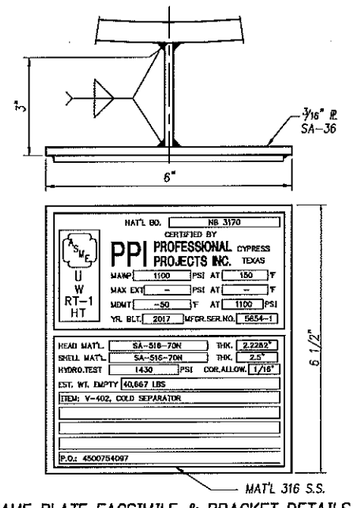


PLAN



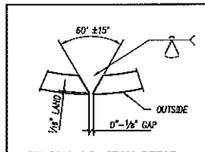
ELEVATION
SEE PLAN FOR TRUE ORIENTATION

CENTER PUNCH OUTSIDE FOR PERMANENT REFERENCE... ALL TAIL DIMENSIONS ARE TO THIS LINE.

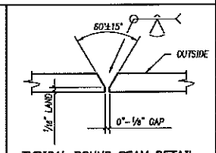


NAME PLATE FACSIMILE & BRACKET DETAILS

ONE (1) REQUIRED



TYPICAL LG. SEAM DETAIL



TYPICAL ROUND SEAM DETAIL

MARK	SIZE	TYPE	CLASS	IDENTIFIER	O.S. PROJ.	I.S. PROJ.
SV1~4	1.5			SKIRT VENT (4)		
SA1~2	18			SKIRT ACCESS (2)		
J	0.75	CPLG	6000#	TE	3¾"	–
H	18	HB	600#	MANWAY	11¾"	3¾"
G4	0.75	CPLG	6000#	LG	3¾"	–
G3	0.75	CPLG	6000#	LG	3¾"	–
G2	0.75	CPLG	6000#	LG	3¾"	–
G1	0.75	CPLG	6000#	LG	3¾"	–
F2	1	CPLG	6000#	LT	3¾"	–
F1	1	CPLG	6000#	LT	3¾"	–
E	0.75	CPLG	6000#	TI	3¾"	–
D2	1	CPLG	6000#	LSHH	3¾"	–
D1	1	CPLG	6000#	LSHH	3¾"	–
C	4	HB	600#	LIQUID OUTLET W/SYPHON	8"	1½"
B	8	HB	600#	VAPOR OUTLET	10¼"	–
A	8	HB	600#	INLET W/DIVERTER	10"	1½"

NO.	REVISION	BY	DATE
1	REVISED AS BUILT	MLR	9/11/17
0	ISSUED FOR CUSTOMER APPROVAL	MLR	1/17/17

DESIGN DATA

VESSEL DESIGNED PER THE 2015 EDITION OF THE ASME CODE SECTION VIII DIVISION 1, N/A ADDENDA
CODE STAMP: REQ'D SERIAL NO: 5654-1 NATIONAL BOARD NO: 3170

DESIGN PRESSURE INTERNAL: 1100 PSI @ 150 DEG F
DESIGN PRESSURE EXTERNAL: N/A

HYDRO TEST: SHOP 1430 PSI @ MINIMUM -25°F

MAWP: 1100 PSI @ 150 DEG F
MAP: 1100 PSI @ 70 DEG F
MDMT: -50 DEG F PWHT: REQ'D, HOLD AT 1150°F ±25°F FOR 128 MINUTES.

CORROSION ALLOWANCE: HEAD/SHELL: 1/16" NOZZLES: 1/16"

RADIOGRAPH: HEAD/SHELL: FULL UW-11(a) (BEFORE PWHT ONLY)
SHELL LONG: FULL UW-11(a)
SHELL CIRC: FULL UW-11(a)

ESTIMATED WEIGHT: FABRICATION: 39,903 LBS (BARE VESSEL WT.)
EMPTY: 40,667 LBS (FAB. WT. + INSULATION)
TEST: 70,757 LBS
OPERATING: 56,771 LBS

INSULATION: 2" THK. FIRE PROOFING: N/A INSPECTION BY: OHECIS

MATERIAL SPECIFICATIONS

SHELL SA-516-70 NORM W/IMPACTS @ -50F FLANGES SA-350-LF2 CL. 1 125-250 RMS
HEADS SA-516-70 NORM W/IMPACTS @ -50F SUPPORTS SA-516-70
CPLGS. SA-350-LF2 CL. 1 INTERNALS AS NOTED
STUDS SA-193-B7 CAD PLTD REINF. PADS N/A
NUTS SA-194-2H CAD PLTD NOZZLE NECKS SA-106B / SA-350-LF2 CL. 1
GASKETS 1/8" THK, 316 SS SPIRAL WOUND, FLEXIBLE GRAPHITE FILLED, C.S. OUTER RING

WELDING PROCEDURES

WPS No.	POR NO.	PROCESS	JOINT	COMMENTS
151 DCP	151-1 DCP	GMAW/FCAW/SAW	ROUND & LONG SEAMS	
149 DCP	149-1 DCP	GMAW/FCAW	ALL ATTACHMENTS NOZZLE TO HEAD & SHELL	

COATING REQUIREMENTS

EXTERNAL SURFACES OF VESSEL PER SYSTEM 3
1) SANDBLAST PER SSPC-SP6
2) PRIMER: SHERWIN WILLIAMS MACROPOXY 646 FAST CURE EPOXY B58-600, 4.0-6.0 MILS D.F.T.
3) INTERMEDIATE PRIMER: SHERWIN WILLIAMS MACROPOXY 646 FAST CURE EPOXY B58-600, 4.0-6.0 MILS D.F.T.

I.S. & O.S. OF SKIRT & PROTRUSIONS OUTSIDE INSULATION:
4) FINISH: SHERWIN WILLIAMS HI-SOLIDS POLYURETHANE B65 SERIES B60-V30, 3.0-4.0 MILS D.F.T.
FINISH COLOR: SHERWIN WILLIAMS STRUCTURAL GRAY SW4031.

GENERAL NOTES

1) ALL BOLT HOLES SHALL EVENLY STRADDLE NORMAL VESSEL CENTERLINES.
2) VESSELS SHALL BE THOUROUGHLY DRAINED OF TEST MEDIUM AND CLEANED INSIDE AND AND OUT AND SHALL BE FREE OF ALL DIRT AND REFUSE.
3) ALL MACHINED SURFACES AND THREADS SHALL BE PROTECTED WITH A RUST PREVENTATIVE.
4) ALL OPEN FLANGES SHALL BE SUPPLIED WITH WOODEN SHIPPING COVERS.
5) THREADED TEST HOLES SHALL BE LEFT UNPLUGGED, BUT GREASED.
6) VESSEL ITEM NUMBER SHALL BE PROMINENTLY PAINTED ON TWO SIDES OF THE VESSEL IN 3" HIGH LETTERS.
7) ALL ITEMS SHIPPED LOOSE SHALL BE TAGGED WITH THE VESSEL ITEM NUMBER, PURCHASE ORDER NUMBER, AND NAME OF THE PARTS AND SHALL BE PROPERLY PROTECTED FOR SHIPMENT.
8) MINIMUM PRODUCTION IMPACT TEST VALUES = 16ft.lbs/11ft.lbs @ -50F

UOP JOB NO.: J-447

FILE NAME: 5654-1
PLOT DATE: 1/17/17
PLOT TIME: 3:00
BY: MLR

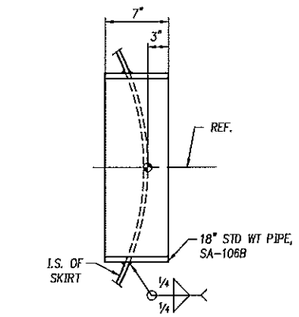
PPI Professional Projects, Inc.
P.O. BOX 618 (18115 TELGE RD.) CYPRESS, TEXAS 77429

TITLE
78" ID x 12'-0" SEAM/SEAM
ITEM: V-402, COLD SEPARATOR
PLAN, ELEVATION & GENERAL NOTES

CUSTOMER: UOP RUSSELL

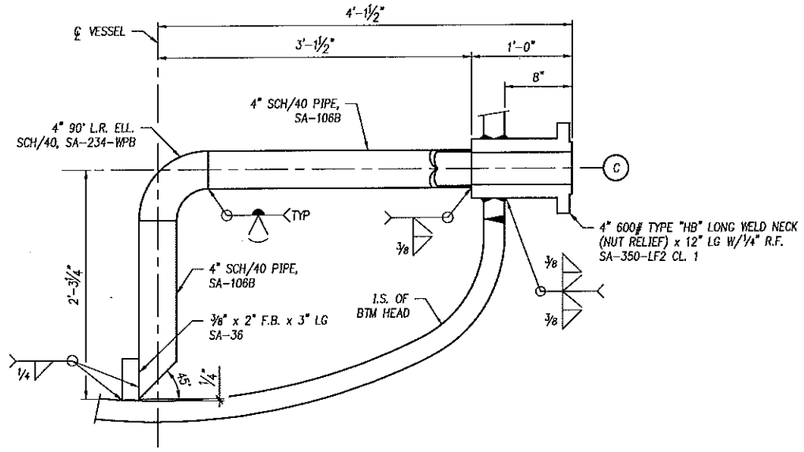
CUSTOMER P.O. NO.		PPI NO.	
4500754097		5654	
DRAWN: MLR	DATE: 1/17/17	CHECKED: MJD	DATE: 1/17/17
DRAWING NO.: S/O 5654-1		SHEET NUMBER: 1	REVISION NO.: 1

CERTIFIED AS-BUILT



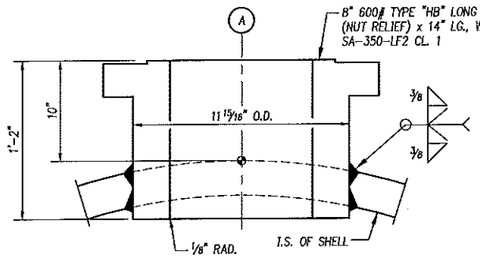
DETAIL OF 18" SKIRT ACCESS

TWO (2) REQ'D MK "SA1~2"



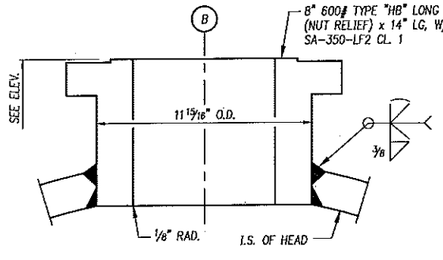
DETAIL OF 4" 600# NOZZLE MK "C" W/ SYPHON

ONE (1) REQ'D



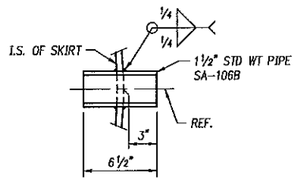
DETAIL OF 8" 600# NOZZLE MK "A"

ONE (1) REQ'D



DETAIL OF 8" 600# NOZZLE MK "B"

ONE (1) REQ'D



DETAIL OF 1½" SKIRT VENT

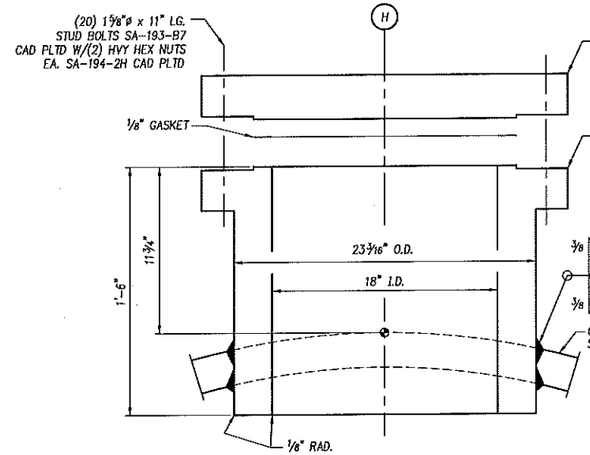
FOUR (4) REQ'D MK "SV1~4"

DETAIL OF ¾" 6000# COUPLINGS MK "E, G1, G2, G3 G4, & J"

SIX (6) REQ'D

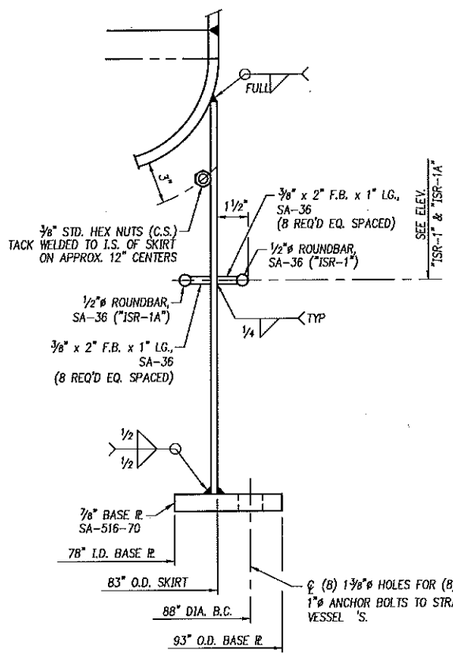
DETAIL OF 1" 6000# COUPLINGS MK "D1, D2, F1, & F2"

FOUR (4) REQ'D

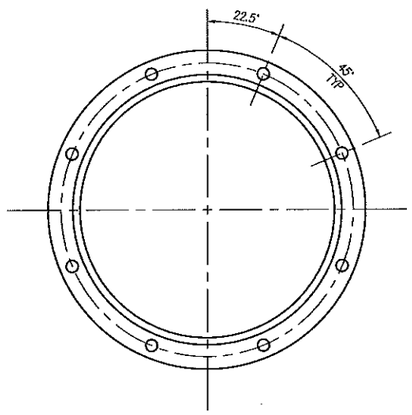


DETAIL OF 18" 600# MANWAY MK "H"

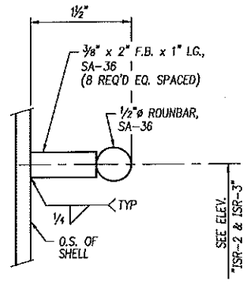
ONE (1) REQ'D



BASEPLATE DETAIL

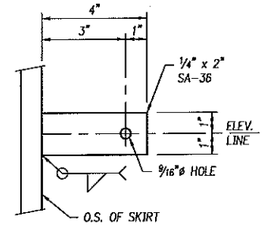


BASE PLAN



INSULATION SUPPORT RING

ONE (1) REQ'D EA. MK "ISR-2 & ISR-3"
TWO (2) TOTAL REQ'D



GROUNDING LUG DETAIL

ONE (1) REQ'D

NO.	REVISION	BY	DATE
1	ADDED P.O. NUMBER	MLR	9/11/17
0	ISSUED FOR CUSTOMER APPROVAL	MLR	1/17/17

FILE NAME: 5654-1
PLOT DATE: 1/17/17
PLOT TIME: 3:00
BY: MLR

PPI Professional Projects, Inc.
P.O. BOX 618 (18115 TELGE RD.) CYPRESS, TEXAS 77429

TITLE
78" ID x 12'-0" SEAM/SEAM
ITEM: V-402, COLD SEPARATOR
DETAILS

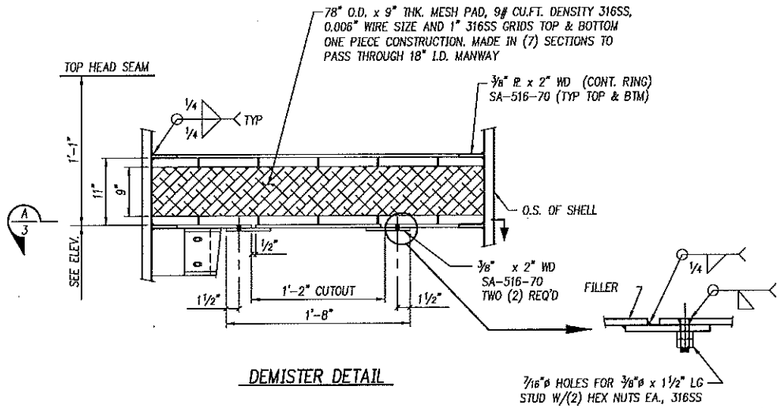
CUSTOMER: UOP RUSSELL

CUSTOMER P.O. NO.	PPI NO.
4500754097	5654

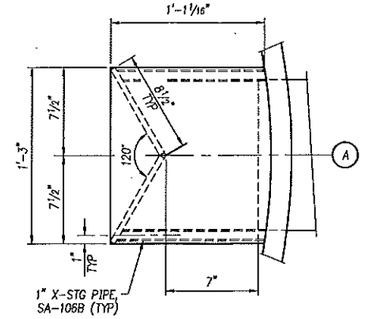
DRAWN	DATE	CHECKED	DATE
MLR	1/17/17	MJD	1/17/17

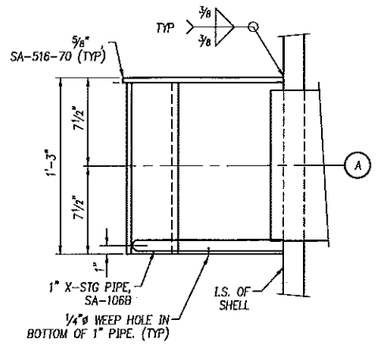
DRAWING NO.	SHEET NUMBER	REVISION NO.
S/O 5654-1	2	1

CERTIFIED AS-BUILT



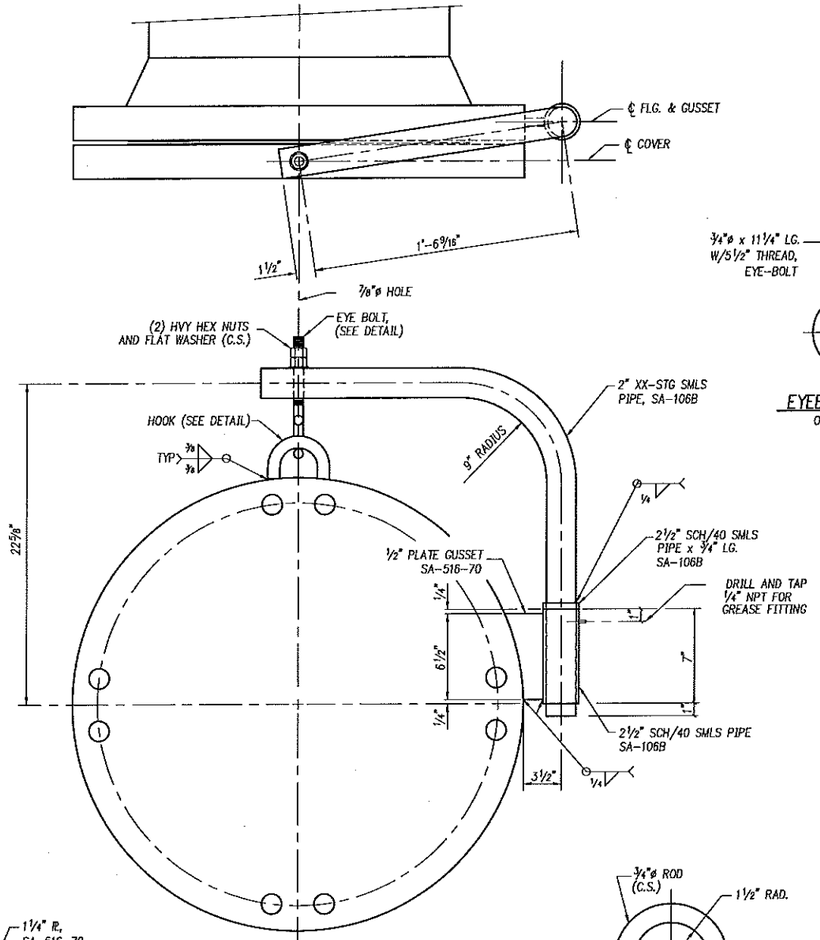
DEMISTER DETAIL





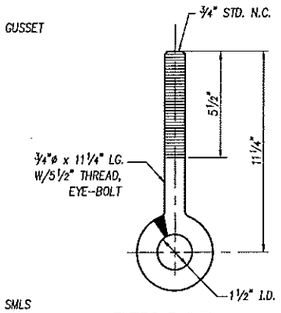
DETAIL OF INLET DIVERTER

ONE (1) REQ'D @ NOZZLE MK "A"



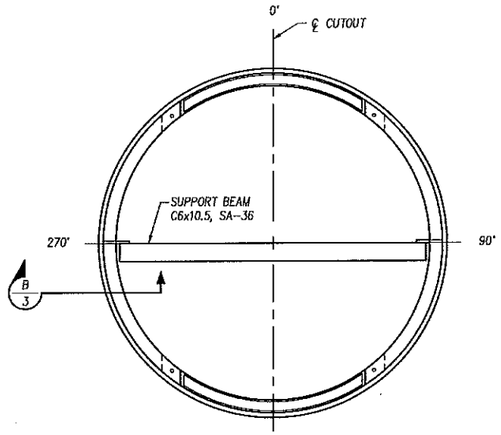
DETAIL OF 18" 600# MANHOLE DAVIT

ONE (1) REQ'D FOR MK "H"
SEE PLAN FOR TRUE ORIENTATION

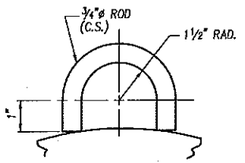


EYEBOLT DETAIL

ONE (1) REQ'D

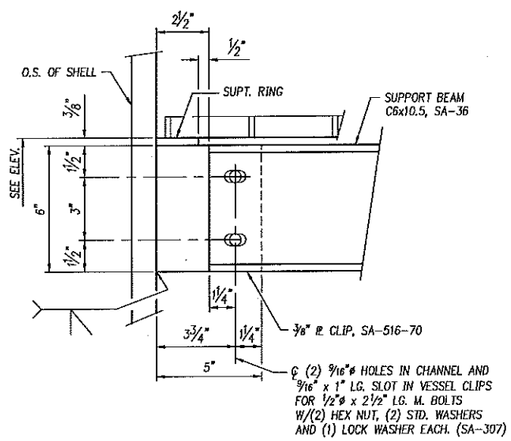


PLAN OF BOTTOM RING (A/3)

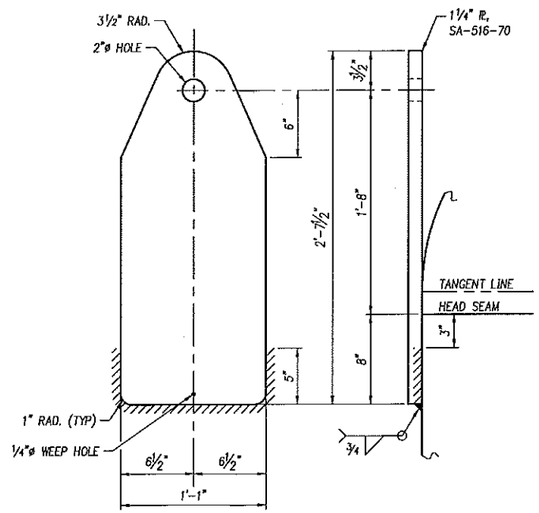


HOOK DETAIL

ONE (1) REQ'D



BEAM SUPPORT CLIP DETAIL (B/3)



DETAIL OF LIFTING LUG

TWO (2) REQ'D

FILE NAME: 5654-1
PLOT DATE: 1/17/17
PLOT TIME: 3:00
BY: MLR

NO.	REVISION	BY	DATE
1	ADDED P.O. NUMBER	MLR	9/11/17
0	ISSUED FOR CUSTOMER APPROVAL	MLR	1/17/17

PPI Professional Projects, Inc.
P.O. BOX 618 (18115 TELGE RD.) CYPRESS, TEXAS 77429

TITLE
78" ID x 12'-0" SEAM/SEAM
ITEM: V-402, COLD SEPARATOR
DETAILS

CUSTOMER: UOP RUSSELL

CUSTOMER P.O. NO.	PPI NO.
4500754097	5654

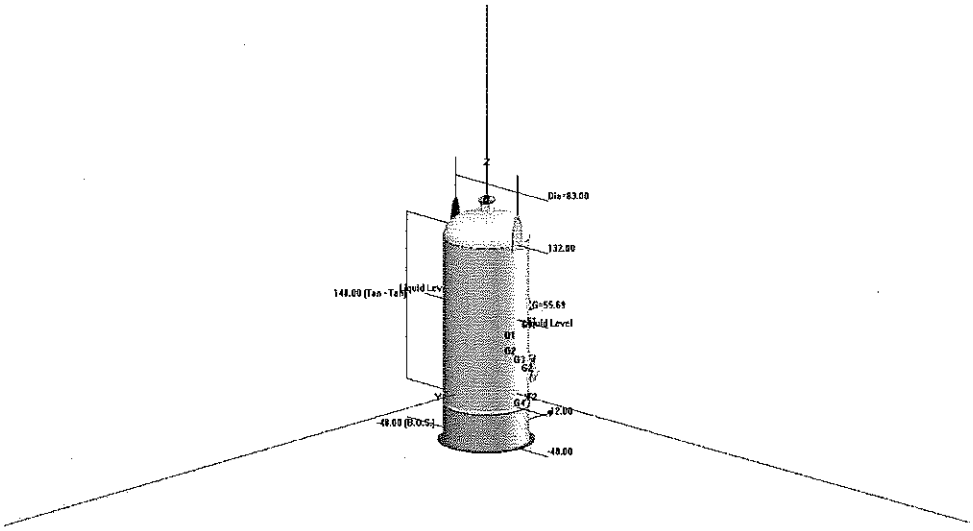
DRAWN	DATE	CHECKED	DATE
MLR	1/17/17	MUD	1/17/17

DRAWING NO.	SHEET NUMBER	REVISION NO.
S/O 5654-1	3	1

CERTIFIED AS-BUILT

PROFESSIONAL PROJECTS, INC

CYPRESS, TEXAS



COMPRESS Pressure Vessel Design Calculations

Item: V-402, COLD SEPARATOR
Shop Order: 5654-1, Job No. 5654
Customer: UOP RUSSELL LLC, J-447
Designer: Lorraine Rodriguez
Date: January 17, 2017
Vessel Name: 5654-1 CALCS

King Design Group, Inc
14011 Park Drive #113
Tomball, Tx 77377
markkdg@sbcglobal.net

Table of Contents

Table of Contents

Revision History

Revisions			
No.	Date	Operator	Notes
0	1/17/2017	KDG3	ISSUED FOR APPROVAL

Settings Summary

COMPRESS 2016 Build 7600	
ASME Section VIII Division 1, 2015 Edition	
Units	U.S. Customary
Datum Line Location	12.00" from bottom seam
Vessel Design Mode	Get Thickness from Pressure
Minimum thickness	0.0625" per UG-16(b)
Design for cold shut down only	No
Design for lethal service (full radiography required)	No
Design nozzles for	Design P only
Corrosion weight loss	100% of theoretical loss
UG-23 Stress Increase	1.20
Skirt/legs stress increase	1.0
Minimum nozzle projection	4"
Juncture calculations for $\alpha > 30$ only	No
Preheat P-No 1 Materials > 1.25" and <= 1.50" thick	Yes
UG-37(a) shell tr calculation considers longitudinal stress	No
Cylindrical shells made from pipe are entered as minimum thickness	No
Nozzles made from pipe are entered as minimum thickness	No
ASME B16.9 fittings are entered as minimum thickness	No
Butt welds	Tapered per Figure UCS-66.3(a)
Disallow Appendix 1-5, 1-8 calculations under 15 psi	No
Hydro/Pneumatic Test	
Shop Hydrotest Pressure	1.3 times vessel MAWP
Test liquid specific gravity	1.00
Field Hydrotest Pressure	1.3 times vessel MAWP
Wind load present @ field	33% of design
Maximum stress during test	90% of yield
Required Marking - UG-116	
UG-116(e) Radiography	RT1
UG-116(f) Postweld heat treatment	HT
Code Cases\Interpretations	
Use Code Case 2547	No
Use Code Case 2695	No

Apply interpretation VIII-1-83-66	No
Apply interpretation VIII-1-86-175	Yes
Apply interpretation VIII-1-01-37	Yes
Apply interpretation VIII-1-01-150	No
Apply interpretation VIII-1-07-50	Yes
No UCS-66.1 MDMT reduction	No
No UCS-68(c) MDMT reduction	No
Disallow UG-20(f) exemptions	No
UG-22 Loadings	
UG-22(a) Internal or External Design Pressure	Yes
UG-22(b) Weight of the vessel and normal contents under operating or test conditions	Yes
UG-22(c) Superimposed static reactions from weight of attached equipment (external loads)	No
UG-22(d)(2) Vessel supports such as lugs, rings, skirts, saddles and legs	Yes
UG-22(f) Wind reactions	Yes
UG-22(f) Seismic reactions	Yes
UG-22(j) Test pressure and coincident static head acting during the test:	Yes
Note: UG-22(b),(c) and (f) loads only considered when supports are present.	

License Information	
Company Name	King Design Group
License	Commercial
License Key ID	30395
Support Expires	April 21, 2017

Pressure Summary

Component Summary					
Identifier	P Design (psi)	T Design (°F)	MDMT (°F)	MDMT Exemption	Impact Tested
TOP HEAD	1,100	150	-58.9	Note 1	Yes
Straight Flange on TOP HEAD	1,100	150	-58.9	Note 2	Yes
SHELL RG	1,100	150	-58.6	Note 3	Yes
Straight Flange on BOTTOM HEAD	1,100	150	-58.6	Note 5	Yes
BOTTOM HEAD	1,100	150	-58.6	Note 4	Yes
INLET W/DIVERTER (A)	1,100	150	-55	Note 6	No
VAPOR OUTLET (B)	1,100	150	-55	Note 6	No
LIQUID OUTLET (C)	1,100	150	-55	Note 7	No
LSHH (D1)	1,100	150	-155	Note 8	No
LSHH (D2)	1,100	150	-155	Note 8	No
TI (E)	1,100	150	-155	Note 9	No
LT (F1)	1,100	150	-155	Note 10	No
LT (F2)	1,100	150	-155	Note 11	No
LG (G1)	1,100	150	-155	Note 12	No
LG (G2)	1,100	150	-155	Note 9	No
LG (G3)	1,100	150	-155	Note 9	No
LG (G4)	1,100	150	-155	Note 13	No
MANWAY (H)	1,100	150	-55	Note 14	No
TE (J)	1,100	150	-155	Note 9	No

Chamber Summary	
Design MDMT	-50 °F
Rated MDMT	-55 °F @ 1,100 psi
MAWP hot & corroded	1,100 psi
(1) This pressure chamber is not designed for external pressure.	

Notes for Maximum Pressure Rating	
Note #	Details
1.	Option to calculate MAP was not selected. See the Calculation->General tab of the Set Mode dialog.
2.	Option to calculate MAWP was not selected. See the Calculation->General tab of the Set Mode dialog.

Notes for MDMT Rating		
Note #	Exemption	Details
1.	Straight Flange governs MDMT	
2.	Material is impact tested per UG-84 to -50°F.	UCS-66(i) reduction of 8.9°F applied (ratio = 0.9115).
3.	Material is impact tested per UG-84 to -50°F.	UCS-66(i) reduction of 8.6°F applied (ratio = 0.9139).
4.	Straight Flange governs MDMT	
5.	Material is impact tested per UG-84 to -50°F.	UCS-66(i) reduction of 8.6°F applied (ratio = 0.914).
6.	Flange rating governs: Flange rated MDMT = -75.7°F Bolts rated MDMT per Fig UCS-66 note (c) = -55°F Flange is impact tested per material specification to -50°F.	UCS-66(i) reduction of 25.7°F applied (ratio = 0.7432).
7.	Flange rating governs: Flange rated MDMT = -75.5°F Bolts rated MDMT per Fig UCS-66 note (c) = -55°F Flange is impact tested per material specification to -50°F.	UCS-66(i) reduction of 25.5°F applied (ratio = 0.745).
8.	Nozzle is impact tested per material specification to -50°F.	Stress ratio = 0.1012 ≤ 0.35, MDMT per UCS-66(b)(3) = -155°F..
9.	Nozzle is impact tested per material specification to -50°F.	Stress ratio = 0.1164 ≤ 0.35, MDMT per UCS-66(b)(3) = -155°F..
10.	Nozzle is impact tested per material specification to -50°F.	Stress ratio = 0.1011 ≤ 0.35, MDMT per UCS-66(b)(3) = -155°F..
11.	Nozzle is impact tested per material specification to -50°F.	Stress ratio = 0.1014 ≤ 0.35, MDMT per UCS-66(b)(3) = -155°F..
12.	Nozzle is impact tested per material specification to -50°F.	Stress ratio = 0.1163 ≤ 0.35, MDMT per UCS-66(b)(3) = -155°F..
13.	Nozzle is impact tested per material specification to -50°F.	Stress ratio = 0.1165 ≤ 0.35, MDMT per UCS-66(b)(3) = -155°F..
14.	Flange rating governs: Flange rated MDMT = -75.5°F Bolts rated MDMT per Fig UCS-66 note (c) = -55°F Flange is impact tested per material specification to -50°F.	UCS-66(i) reduction of 25.5°F applied (ratio = 0.7447).

Nozzle Schedule

Specifications									
Nozzle mark	Identifier	Size	Materials		Impact Tested	Normalized	Fine Grain	Flange	Blind
A	INLET W/DIVERTER	11.94 OD x 2.16	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 8 Class 600 HB (or equiv.) A350 LF2 Cl.1	No
B	VAPOR OUTLET	11.94 OD x 2.16	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 8 Class 600 HB (or equiv.) A350 LF2 Cl.1	No
C	LIQUID OUTLET	7.06 OD x 1.615	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 4 Class 600 HB (or equiv.) A350 LF2 Cl.1	No
D1	LSHH	NPS 1 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
D2	LSHH	NPS 1 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
E	TI	NPS 0.75 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
F1	LT	NPS 1 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
F2	LT	NPS 1 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
G1	LG	NPS 0.75 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
G2	LG	NPS 0.75 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
G3	LG	NPS 0.75 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
G4	LG	NPS 0.75 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No
H	MANWAY	23.19 OD x 2.595	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 18 Class 600 HB (or equiv.) A350 LF2 Cl.1	NPS 18 Class 600 A350 LF2 Cl.1
J	TE	NPS 0.75 Class 6000 - threaded	Nozzle	SA-350 LF2 Cl 1	No	No	No	N/A	No

Nozzle Summary

Dimensions												
Nozzle mark	OD (in)	t_n (in)	Req t_n (in)	A_1?	A_2?	Shell			Reinforcement Pad		Corr (in)	A_a/A_r (%)
						Nom t (in)	Design t (in)	User t (in)	Width (in)	t_{pad} (in)		
A	11.94	2.16	0.3819	Yes	Yes	2.5	2.2845		N/A	N/A	0.0625	161.0
B	11.94	2.16	0.3819	Yes	Yes	2.2262*	2.0038		N/A	N/A	0.0625	144.5
C	7.06	1.615	0.3075	Yes	Yes	2.5	2.2898		N/A	N/A	0.0625	197.1
D1	2.25	0.4675	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
D2	2.25	0.4675	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
E	1.75	0.35	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
F1	2.25	0.4675	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
F2	2.25	0.4675	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
G1	1.75	0.35	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
G2	1.75	0.35	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
G3	1.75	0.35	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
G4	1.75	0.35	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
H	23.19	2.595	0.5791	Yes	Yes	2.5	2.2894		N/A	N/A	0.0625	111.9
J	1.75	0.35	0.125	Yes	Yes	2.5	N/A		N/A	N/A	0.0625	Exempt
*Head minimum thickness after forming												

Definitions	
tn	Nozzle thickness
Req tn	Nozzle thickness required per UG-45/UG-16
Nom t	Vessel wall thickness
Design t	Required vessel wall thickness due to pressure + corrosion allowance per UG-37
User t	Local vessel wall thickness (near opening)
A_a	Area available per UG-37, governing condition
A_r	Area required per UG-37, governing condition
Corr	Corrosion allowance on nozzle wall

Thickness Summary

Component Data								
Component Identifier	Material	Diameter (in)	Length (in)	Nominal t (in)	Design t (in)	Total Corrosion (in)	Joint E	Load
TOP HEAD	SA-516 70	78 ID	21.7262	2.2262*	2.2183	0.0625	1.00	Internal
Straight Flange on TOP HEAD	SA-516 70	78 ID	2	2.5	2.2843	0.0625	1.00	Internal
SHELL RG	SA-516 70	78 ID	144	2.5	2.2902	0.0625	1.00	Internal
Straight Flange on BOTTOM HEAD	SA-516 70	78 ID	2	2.5	2.2903	0.0625	1.00	Internal
BOTTOM HEAD	SA-516 70	78 ID	21.7262	2.2262*	2.2254	0.0625	1.00	Internal
SKIRT	SA-516 70	82.25 ID	32.47	0.375	0.0588	0	0.55	Seismic
*Head minimum thickness after forming								

Definitions	
Nominal t	Vessel wall nominal thickness
Design t	Required vessel thickness due to governing loading + corrosion
Joint E	Longitudinal seam joint efficiency
Load	
Internal	Circumferential stress due to internal pressure governs
External	External pressure governs
Wind	Combined longitudinal stress of pressure + weight + wind governs
Seismic	Combined longitudinal stress of pressure + weight + seismic governs

Weight Summary

Weight (lb) Contributed by Vessel Elements											
Component	Metal New*	Metal Corroded	Insulation	Insulation Supports	Lining	Piping + Liquid	Operating Liquid		Test Liquid		Surface Area ft²
							New	Corroded	New	Corroded	
TOP HEAD	5,024.9	4,894	115.1	100	0	0	0	0	2,597.3	2,613.2	60
SHELL RG	25,338.1	24,724.1	534.1	100	0	0	13,516.2	13,560.8	24,905	24,986.2	257
BOTTOM HEAD	5,095.4	4,962.5	115.1	100	0	0	2,587.3	2,602.8	2,587.3	2,602.8	61
SKIRT	870.4	870.4	0	0	0	0	0	0	0	0	118
BASE RING	496	496	0	0	0	0	0	0	0	0	30
TOTAL:	**36,824.7**	**35,946.9**	**764.3**	**300**	**0**	**0**	**16,103.5**	**16,163.5**	**30,089.6**	**30,202.2**	**525**
*Shells with attached nozzles have weight reduced by material cut out for opening.											

Weight (lb) Contributed by Attachments											
Component	Body Flanges		Nozzles & Flanges		Packed Beds	Ladders & Platforms	Trays	Tray Supports	Rings & Clips	Vertical Loads	Surface Area ft²
	New	Corroded	New	Corroded							
TOP HEAD	0	0	296.8	291	0	0	0	0	0	0	4
SHELL RG	0	0	2,220.7	2,188.3	0	0	0	0	248.2	0	29
BOTTOM HEAD	0	0	0	0	0	0	0	0	0	0	0
SKIRT	0	0	0	0	0	0	0	0	12.6	0	1
TOTAL:	**0**	**0**	**2,517.4**	**2,479.4**	**0**	**0**	**0**	**0**	**260.7**	**0**	**35**

Vessel Totals		
	New	Corroded
Operating Weight (lb)	56,771	55,915
Empty Weight (lb)	40,667	39,751
Test Weight (lb)	70,757	69,954
Surface Area (ft2)	559	-
Capacity** (US gal)	3,599	3,613
**The vessel capacity does not include volume of nozzle, piping or other attachments.		

Vessel Lift Condition	
Vessel Lift Weight, New (lb)	39,903
Center of Gravity from Datum (in)	55.6867
Note: Vessel lift weight includes weight of insulation supports as they are assumed to be shop installed.	

Hydrostatic Test

Horizontal shop hydrostatic test based on MAWP per UG-99(b)

Gauge pressure at 70°F =
1.3*MAWP*LSR
= 1.3*1,100*1
= 1,430 psi

Horizontal shop hydrostatic test							
Identifier	Local test pressure (psi)	Test liquid static head (psi)	UG-99(b) stress ratio	UG-99(b) pressure factor	Stress during test (psi)	Allowable test stress (psi)	Stress excessive?
TOP HEAD (1)	1,433.05	3.05	1	1.30	22,595	34,200	No
Straight Flange on TOP HEAD	1,433.05	3.05	1	1.30	23,065	34,200	No
SHELL RG	1,433.05	3.05	1	1.30	23,065	34,200	No
Straight Flange on BOTTOM HEAD	1,433.05	3.05	1	1.30	23,065	34,200	No
BOTTOM HEAD	1,433.05	3.05	1	1.30	22,595	34,200	No
INLET W/DIVERTER (A)	1,431.78	1.78	1	1.30	25,147	51,300	No
LG (G1)	1,430.2	0.2	1	1.30	38,077	51,300	No
LG (G2)	1,430.2	0.2	1	1.30	38,077	51,300	No
LG (G3)	1,430.144	0.144	1	1.30	38,075	51,300	No
LG (G4)	1,430.144	0.144	1	1.30	38,075	51,300	No
LIQUID OUTLET (C)	1,433.429	3.429	1	1.30	23,272	51,300	No
LSHH (D1)	1,430.202	0.202	1	1.30	37,251	51,300	No
LSHH (D2)	1,430.202	0.202	1	1.30	37,251	51,300	No
LT (F1)	1,430.357	0.357	1	1.30	37,255	51,300	No
LT (F2)	1,430.357	0.357	1	1.30	37,255	51,300	No
MANWAY (H)	1,431.967	1.967	1	1.30	27,136	51,300	No
TE (J)	1,430.597	0.597	1	1.30	38,087	51,300	No
TI (E)	1,430.91	0.91	1	1.30	38,095	51,300	No
VAPOR OUTLET (B)	1,431.78	1.78	1	1.30	29,056	51,300	No

(1) TOP HEAD limits the UG-99(b) stress ratio.
(2) P_L stresses at nozzle openings have been estimated using the method described in Division 2 Part 4.5.
(3) $1.5*0.9*S_y$ used as the basis for the maximum local primary membrane stress at the nozzle intersection P_L.
(4) The zero degree angular position is assumed to be up, and the test liquid height is assumed to the top-most flange.

The test temperature of 70 °F is warmer than the minimum recommended temperature of -25 °F so the brittle fracture provision of UG-99(h) has been met.

Vertical field hydrostatic test based on MAWP per UG-99(b)

Gauge pressure at 70°F =
1.3*MAWP*LSR
= 1.3*1,100*1
= 1,430 psi

Vertical field hydrostatic test							
Identifier	Local test pressure (psi)	Test liquid static head (psi)	UG-99(b) stress ratio	UG-99(b) pressure factor	Stress during test (psi)	Allowable test stress (psi)	Stress excessive?
TOP HEAD (1)	1,431.227	1.227	1	1.30	22,566	34,200	No
Straight Flange on TOP HEAD	1,431.227	1.227	1	1.30	23,035	34,200	No
SHELL RG	1,436.425	6.425	1	1.30	23,119	34,200	No
Straight Flange on BOTTOM HEAD	1,436.498	6.498	1	1.30	23,120	34,200	No
BOTTOM HEAD	1,437.201	7.201	1	1.30	22,660	34,200	No
INLET W/DIVERTER (A)	1,433.747	3.747	1	1.30	25,181	51,300	No
LG (G1)	1,433.85	3.85	1	1.30	38,174	51,300	No
LG (G2)	1,435.226	5.226	1	1.30	38,210	51,300	No
LG (G3)	1,434.874	4.874	1	1.30	38,201	51,300	No
LG (G4)	1,436.25	6.25	1	1.30	38,238	51,300	No
LIQUID OUTLET (C)	1,436.278	6.278	1	1.30	23,318	51,300	No
LSHH (D1)	1,434.017	4.017	1	1.30	37,350	51,300	No
LSHH (D2)	1,434.522	4.522	1	1.30	37,363	51,300	No
LT (F1)	1,433.85	3.85	1	1.30	37,346	51,300	No
LT (F2)	1,436.269	6.269	1	1.30	37,409	51,300	No
MANWAY (H)	1,436.064	6.064	1	1.30	27,214	51,300	No
TE (J)	1,435.145	5.145	1	1.30	38,208	51,300	No
TI (E)	1,435.145	5.145	1	1.30	38,208	51,300	No
VAPOR OUTLET (B)	1,430.371	0.371	1	1.30	29,028	51,300	No

(1) TOP HEAD limits the UG-99(b) stress ratio.
(2) P_L stresses at nozzle openings have been estimated using the method described in Division 2 Part 4.5.
(3) $1.5*0.9*S_y$ used as the basis for the maximum local primary membrane stress at the nozzle intersection P_L.

The test temperature of 70 °F is warmer than the minimum recommended temperature of -25 °F so the brittle fracture provision of UG-99(h) has been met.

Building Code: ASCE 7-10		
Elevation of base above grade		1.00 ft
Increase effective outer diameter by		1.50 ft
Wind Force Coefficient, Cf		0.7000
Risk Category (Table 1.5-1)		III
Basic Wind Speed, V		150.00 mph
Exposure category		C
Wind Directionality Factor, Kd		0.9500
Topographic Factor, Kzt		1.0000
Enforce min. loading of 16 psf		Yes
Vessel Characteristics		
Height, h		16.9773 ft
Minimum Diameter, b	Operating, Corroded	7.2500 ft
	Empty, Corroded	7.2500 ft
	Hydrotest, New, Field	7.2500 ft
Fundamental Frequency, n_1	Operating, Corroded	34.3783 Hz
	Empty, Corroded	38.1890 Hz
	Hydrotest, New, Field	28.7008 Hz
Damping coefficient, β	Operating, Corroded	0.0250
	Empty, Corroded	0.0210
	Hydrotest, New, Field	0.0260

Table Lookup Values

2.4.1 Basic Load Combinations for Allowable Stress Design	
Load combinations considered in accordance with ASCE section 2.4.1:	
5.	$D + P + P_s + 0.6W$
7.	$0.6D + P + P_s + 0.6W$
Parameter Description	
D	= Dead load
P	= Internal or external pressure load
P_s	= Static head load
W	= Wind load

Wind Deflection Reports:

Operating, Corroded
Empty, Corroded
Hydrotest, New, field
Wind Pressure Calculations

Wind Deflection Report: Operating, Corroded								
Component	Elevation of Bottom above Base (in)	Effective OD (ft)	Elastic Modulus E (10^6 psi)	Inertia I (ft^4)	Platform Wind Shear at Bottom (lb_f)	Total Wind Shear at Bottom (lb_f)	Bending Moment at Bottom (lb_f-ft)	Deflection at Top (in)
TOP HEAD	180.0014	8.73	29.0	*	0	271	239	0.0011
SHELL RG	36.0014	8.75	29.0	24.16	0	2,124	23,813	0.0009
BOTTOM HEAD (top)	32.47	8.73	29.0	*	0	2,169	24,445	0.0001
SKIRT	0	8.42	26.0	4.006	0	2,569	30,855	0.0001
*Moment of Inertia I varies over the length of the component								

Wind Deflection Report: Empty, Corroded								
Component	Elevation of Bottom above Base (in)	Effective OD (ft)	Elastic Modulus E (10^6 psi)	Inertia I (ft^4)	Platform Wind Shear at Bottom (lb_f)	Total Wind Shear at Bottom (lb_f)	Bending Moment at Bottom (lb_f-ft)	Deflection at Top (in)
TOP HEAD	180.0014	8.73	29.4	*	0	271	239	0.001
SHELL RG	36.0014	8.75	29.4	24.16	0	2,124	23,813	0.0008
BOTTOM HEAD (top)	32.47	8.73	29.4	*	0	2,169	24,445	0.0001
SKIRT	0	8.42	29.4	4.006	0	2,569	30,855	0.0001
*Moment of Inertia I varies over the length of the component								

Wind Deflection Report: Field Hydrotest, New								
Component	Elevation of Bottom above Base (in)	Effective OD (ft)	Elastic Modulus E (10^6 psi)	Inertia I (ft^4)	Platform Wind Shear at Bottom (lb_f)	Total Wind Shear at Bottom (lb_f)	Bending Moment at Bottom (lb_f-ft)	Deflection at Top (in)
TOP HEAD	180.0014	8.73	29.4	*	0	140	123	0.0007
SHELL RG	36.0014	8.75	29.4	24.72	0	1,148	17,116	0.0006
BOTTOM HEAD (top)	32.47	8.73	29.4	*	0	1,172	17,458	0.0001
SKIRT	0	8.42	29.4	4.006	0	1,391	20,926	0.0001
*Moment of Inertia I varies over the length of the component								

Wind Pressure (WP) Calculations

Gust Factor ($\bar{G}$) Calculations

$Kz = 2.01 * (Z/\underline{Zg})^{2/\underline{\alpha}}$
$= 2.01 * (Z/900.00)^{0.2105}$
$qz = 0.00256 * Kz * Kzt * Kd * \underline{V}^2$
$= 0.00256 * Kz * 1.0000 * 0.9500 * 150.0000^2$
$= 54.7200 * Kz$
$WP = 0.6 * qz * \underline{G} * \underline{Cf}$ (Minimum 16 lb/ft^2)
$= 0.6 * qz * \underline{G} * 0.7000$ (Minimum 16 lb/ft^2)

Design Wind Pressures							
Height Z (')	Kz	qz (psf)	WP (psf)				
			Operating	Empty	Hydrotest New	Hydrotest Corroded	Vacuum
15.0	0.8489	46.45	17.55	17.55	9.60	N.A.	N.A.
20.0	0.9019	49.35	18.65	18.65	9.60	N.A.	N.A.
Design Wind Force determined from: F = Pressure * Af , where Af is the projected area.							

Gust Factor Calculations

Operating, Corroded
Empty, Corroded
Hydrotest, New, field

Gust Factor Calculations: Operating, Corroded

Vessel is considered a rigid structure as n_1 = 34.3783 Hz ≥ 1 Hz.

z^- = max (0.60 * $\underline{h}$, $\underline{z_{min}}$)
= max (0.60 * 16.9773 , 15.0000)
= 15.0000
I_{z^-} = $\underline{c}$ * (33 / z^-)$^{1/6}$
= 0.2000 * (33 / 15.0000)$^{1/6}$
= 0.2281
L_{z^-} = $\underline{l}$ * (z^- / 33)$^{\underline{ep}}$
= 500.0000 * (15.0000 / 33)$^{0.2000}$
= 427.0566
Q = Sqr(1 / (1 + 0.63 * (($\underline{b}$ + $\underline{h}$) / L_{z^-})$^{0.63}$))
= Sqr(1 / (1 + 0.63 * ((7.2500 + 16.9773) / 427.0566)$^{0.63}$))
= 0.9520
G = 0.925 * (1 + 1.7 * $\underline{g_Q}$ * I_{z^-} * Q) / (1 + 1.7 * $\underline{g_v}$ * I_{z^-})
= 0.925 * (1 + 1.7 * 3.40* 0.2281 * 0.9520) / (1 + 1.7 * 3.40 * 0.2281)
= 0.8998

Gust Factor Calculations: Empty, Corroded

Vessel is considered a rigid structure as n_1 = 38.1890 Hz ≥ 1 Hz.

z^- = max (0.60 * $\underline{h}$, $\underline{z_{min}}$)
= max (0.60 * 16.9773 , 15.0000)
= 15.0000
I_{z^-} = $\underline{c}$ * (33 / z^-)$^{1/6}$
= 0.2000 * (33 / 15.0000)$^{1/6}$
= 0.2281
L_{z^-} = $\underline{l}$ * (z^- / 33)$^{\underline{ep}}$
= 500.0000 * (15.0000 / 33)$^{0.2000}$
= 427.0566

$Q = Sqr(1 / (1 + 0.63 * ((\underline{b} + \underline{h}) / L_{z^-})^{0.63}))$
$= Sqr(1 / (1 + 0.63 * ((7.2500 + 16.9773) / 427.0566)^{0.63}))$
$= 0.9520$
$G = 0.925 * (1 + 1.7 * \underline{g_Q} * I_{z^-} * Q) / (1 + 1.7 * \underline{g_v} * I_{z^-})$
$= 0.925 * (1 + 1.7 * 3.40 * 0.2281 * 0.9520) / (1 + 1.7 * 3.40 * 0.2281)$
$= 0.8998$

Gust Factor Calculations: Hydrotest, New, field

Vessel is considered a rigid structure as $n_1 = 28.7008$ Hz ≥ 1 Hz.

$z^- = \max (0.60 * \underline{h} , \underline{z_{min}})$
$= \max (0.60 * 16.9773 , 15.0000)$
$= 15.0000$
$I_{z^-} = \underline{c} * (33 / z^-)^{1/6}$
$= 0.2000 * (33 / 15.0000)^{1/6}$
$= 0.2281$
$L_{z^-} = \underline{l} * (z^- / 33)^{\underline{ep}}$
$= 500.0000 * (15.0000 / 33)^{0.2000}$
$= 427.0566$
$Q = Sqr(1 / (1 + 0.63 * ((\underline{b} + \underline{h}) / L_{z^-})^{0.63}))$
$= Sqr(1 / (1 + 0.63 * ((7.2500 + 16.9773) / 427.0566)^{0.63}))$
$= 0.9520$
$G = 0.925 * (1 + 1.7 * \underline{g_Q} * I_{z^-} * Q) / (1 + 1.7 * \underline{g_v} * I_{z^-})$
$= 0.925 * (1 + 1.7 * 3.40 * 0.2281 * 0.9520) / (1 + 1.7 * 3.40 * 0.2281)$
$= 0.8998$

Table Lookup Values	
$\alpha = 9.5000$, $z_g = 900.00$ ft	[Table 26.9-1, page 256]
c = 0.2000, l = 500.0000, ep = 0.2000	[Table 26.9-1, page 256]
$a^- = 0.1538$, $b^- = 0.6500$	[Table 26.9-1, page 256]
$z_{min} = 15.0000$ ft	[Table 26.9-1, page 256]
$g_Q = 3.40$	[26.9.4 page 254]
$g_v = 3.40$	[26.9.4 page 254]

Seismic Code

Building Code: ASCE 7-10 ground supported		
Site Class		D
Importance Factor, I_e		1.2500
Spectral Response Acceleration at short period (% g), S_s		100.00%
Spectral Response Acceleration at period of 1 sec (% g), S_1		40.00%
Response Modification Coeficient from Table 15.4-2, R		3.0000
Acceleration-based Site Coefficient, F_a		1.1000
Velocity-based Site Coefficient, F_v		1.6000
Long-period Transition Period, T_L		12.0000
Redundancy factor, ρ		1.0000
Risk Category (Table 1.5-1)		III
User Defined Vertical Accelerations Considered		No
Vessel Characteristics		
Height		16.9773 ft
Weight	Operating, Corroded	55,915 lb
	Empty, Corroded	39,751 lb
Period of Vibration Calculation		
Fundamental Period, T	Operating, Corroded	0.029 sec (f = 34.4 Hz)
	Empty, Corroded	0.026 sec (f = 38.2 Hz)

The fundamental period of vibration T (above) is calculated using the Rayleigh method of approximation

$T = 2 * PI * Sqr(\{Sum(W_i * y_i^2)\} / \{g * Sum(W_i * y_i)\})$, where

W_i is the weight of the i^{th} lumped mass, and
y_i is its deflection when the system is treated as a cantilever beam.

12.4.2.3 Basic Load Combinations for Allowable Stress Design			
Load combinations considered in accordance with ASCE section 2.4.1:			
5.	$D + P + P_s + 0.7E$	$= (1.0 + 0.14S_{DS})D + P + P_s + 0.7\rho Q_E$	
8.	$0.6D + P + P_s + 0.7E$	$= (0.6 - 0.14S_{DS})D + P + P_s + 0.7\rho Q_E$	
Parameter description			
D	= Dead load		
P	= Internal or external pressure load		
P_s	= Static head load		
E	= Seismic load	$= E_h +/- E_v$	$= \rho Q_E +/- 0.2S_{DS}D$

Seismic Shear Reports:

Operating, Corroded
Empty, Corroded
Base Shear Calculations

Seismic Shear Report: Operating, Corroded					
Component	Elevation of Bottom above Base (in)	Elastic Modulus E (10^6 psi)	Inertia I (ft^4)	Seismic Shear at Bottom (lb_f)	Bending Moment at Bottom (lb_f-ft)
TOP HEAD	180.0014	29.0	*	2,180	2,285
SHELL RG	36.0014	29.0	24.1588	10,102	87,488
BOTTOM HEAD (top)	32.47	29.0	*	10,197	90,476
SKIRT	0	26.0	4.006	10,764	119,122
*Moment of Inertia I varies over the length of the component					

Seismic Shear Report: Empty, Corroded					
Component	Elevation of Bottom above Base (in)	Elastic Modulus E (10^6 psi)	Inertia I (ft^4)	Seismic Shear at Bottom (lb_f)	Bending Moment at Bottom (lb_f-ft)
TOP HEAD	180.0014	29.4	*	1,961	2,055
SHELL RG	36.0014	29.4	24.1588	7,237	72,566
BOTTOM HEAD (top)	32.47	29.4	*	7,285	74,703
SKIRT	0	29.4	4.006	7,652	95,063
*Moment of Inertia I varies over the length of the component					

11.4.3: Maximum considered earthquake spectral response acceleration

The maximum considered earthquake spectral response acceleration at short period, S_{MS}
$S_{MS} = F_a * S_s = 1.1000 * 100.00 / 100 = 1.1000$
The maximum considered earthquake spectral response acceleration at 1 s period, S_{M1}
$S_{M1} = F_v * S_1 = 1.6000 * 40.00 / 100 = 0.6400$

11.4.4: Design spectral response acceleration parameters

Design earthquake spectral response acceleration at short period, S_{DS}
$S_{DS} = 2 / 3 * S_{MS} = 2 / 3 * 1.1000 = 0.7333$
Design earthquake spectral response acceleration at 1 s period, S_{D1}

$S_{D1} = 2 / 3 * S_{M1} = 2 / 3 * 0.6400 = 0.4267$

11.6 Seismic Design Category

The Risk Category is III.
From Table 11.6-1, the Seismic Design Category based on $S_{DS} = 0.7333$ is D.
From Table 11.6-2, the Seismic Design Category based on $S_{D1} = 0.4267$ is D.
This vessel is assigned to Seismic Design Category D.

12.4.2.3: Seismic Load Combinations: Vertical Term

Factor is applied to dead load.

Compressive Side: $= 1.0 + 0.14 * S_{DS}$
$= 1.0 + 0.14 * 0.7333$
$= 1.1027$
Tensile Side: $= 0.6 - 0.14 * S_{DS}$
$= 0.6 - 0.14 * 0.7333$
$= 0.4973$

Base Shear Calculations

Operating, Corroded
Empty, Corroded

Base Shear Calculations: Operating, Corroded

Paragraph 15.4.2: $I < 0.06$, so:
$V = 0.30 * S_{DS} * W * I_e$
$= 0.30 * 0.7333 * 55,914.8359 * 1.2500$
$= 15,376.58$ lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E_h
$Q_E = V$
$E_h = 0.7 * \rho * Q_E$ (Only 70% of seismic load considered as per Section 2.4.1)
$= 0.70 * 1.0000 * 15,376.58$
$= 10,763.61$ lb

Base Shear Calculations: Empty, Corroded

Paragraph 15.4.2: $I < 0.06$, so:
$V = 0.30 * S_{DS} * W * I_e$
$= 0.30 * 0.7333 * 39,751.2969 * 1.2500$
$= 10,931.61$ lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E_h
$Q_E = V$
$E_h = 0.7 * \rho * Q_E$ (Only 70% of seismic load considered as per Section 2.4.1)
$= 0.70 * 1.0000 * 10,931.61$

= 7,652.12 lb

TOP HEAD

ASME Section VIII Division 1, 2015 Edition				
Component		Ellipsoidal Head		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Attached To		SHELL RG		
Impact Tested	Normalized	Fine Grain Practice	PWHT	Optimize MDMT/ Find MAWP
Yes (-50°F)	Yes	No	Yes	No
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)
Internal		1,100	150	-50

Static Liquid Head			
Condition	P_s (psi)	H_s (in)	SG
Test horizontal	3.05	84.5	1
Test vertical	1.16	32	1

Dimensions		
Inner Diameter		78"
Head Ratio		2
Minimum Thickness		2.2262"
Corrosion	Inner	0.0625"
	Outer	0"
Length L_{sf}		2"
Nominal Thickness t_{sf}		2.5"

Weight and Capacity		
	Weight (lb)[1]	Capacity (US gal)[1]
New	5,024.85	310.28
Corroded	4,893.95	312.14

Insulation			
	Thickness (in)	Density (lb/ft^3)	Weight (lb)
Insulation	2	12	115.1
	Spacing(in)	Individual Weight (lb)	Total Weight (lb)
Insulation Supports	145	100	100

Radiography	
Category A joints	Seamless No RT
Head to shell seam	Full UW-11(a) Type 1

[1] includes straight flange

Results Summary	
Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2183"
Straight Flange governs MDMT	-58.9°F

Factor K		
$K = (1/6)*[2 + (D / (2*h))^2]$		
Corroded	$K = (1/6)*[2 + (78.125 / (2*19.5625))^2]$	0.9979
New	$K = (1/6)*[2 + (78 / (2*19.5))^2]$	1

Design thickness for internal pressure, (Corroded at 150 °F) Appendix 1-4(c)

$t = P*D*K / (2*S*E - 0.2*P) + Corrosion$
$= 1{,}100*78.125*0.997872 / (2*20{,}000*1 - 0.2*1{,}100) + 0.0625$
$= 2.2182"$

% Extreme fiber elongation - UCS-79(d)

$EFE = (75*t / R_f)*(1 - R_f / R_o)$
$= (75*2.5 / 14.51)*(1 - 14.51 / \infty)$
$= 12.9221\%$

Straight Flange on TOP HEAD

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	Normalized	Fine Grain Practice	PWHT	Optimize MDMT/ Find MAWP
Yes (-50°F)	Yes	No	Yes	No
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)
Internal		1,100	150	-50
Static Liquid Head				
Condition		P_s (psi)	H_s (in)	SG
Test horizontal		3.05	84.5	1
Test vertical		1.23	34	1
Dimensions				
Inner Diameter		78"		
Length		2"		
Nominal Thickness		2.5"		
Corrosion	Inner	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		Capacity (US gal)
New		357.85		41.37
Corroded		349.18		41.5
Insulation				
		Thickness (in)	Density (lb/ft^3)	Weight (lb)
Insulation		2	12	0
		Spacing(in)	Individual Weight (lb)	Total Weight (lb)
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Seamless No RT		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2843"
Design thickness due to combined loadings + corrosion	0.9493"
Rated MDMT	-58.9 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-50°F
t_r = 1,100*39.0625 / (20,000*1 - 0.6*1,100) =	2.2218"
Stress ratio = t_r*E* / (t_n - c) = 2.2218*1 / (2.5 - 0.0625) =	0.9115
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	8.9°F
MDMT = max[T_{impact} - T_R, -155] = max[-50 - 8.9 , -155] =	-58.9°F
Design MDMT of -50°F is acceptable.	

Design thickness, (at 150 °F) UG-27(c)(1)

t = P*R / (S*E - 0.60*P) + Corrosion
= 1,100*39.0625 / (20,000*1.00 - 0.60*1,100) + 0.0625
= 2.2843"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.5 / 40.25)*(1 - 40.25 / ∞)
= 3.1056%

The extreme fiber elongation does not exceed 5%.

Thickness Required Due to Pressure + External Loads								
Condition	Pressure P (psi)	Allowable Stress Before UG-23 Stress Increase (psi)		Temperature (°F)	Corrosion C (in)	Load	Req'd Thk Due to Tension (in)	Req'd Thk Due to Compression (in)
		S_t	S_c					
Operating, Hot & Corroded	1,100	20,000	17,295	150	0.0625	Wind	0.8866	0.8862
						Seismic	0.8868	0.8859
Operating, Hot & New	1,100	20,000	17,301	150	0	Wind	0.8851	0.8847
						Seismic	0.8854	0.8844
Hot Shut Down, Corroded	0	20,000	17,295	150	0.0625	Wind	0.0006	0.001
						Seismic	0.0002	0.0014
Hot Shut Down, New	0	20,000	17,301	150	0	Wind	0.0006	0.0011
						Seismic	0.0002	0.0014
Empty, Corroded	0	20,000	17,295	70	0.0625	Wind	0.0006	0.001
						Seismic	0.0003	0.0013
Empty, New	0	20,000	17,301	70	0	Wind	0.0006	0.0011
						Seismic	0.0003	0.0014
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	17,295	150	0.0625	Weight	0.0012	0.0012

SHELL RG

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	Normalized	Fine Grain Practice	PWHT	Optimize MDMT/ Find MAWP
Yes (-50°F)	Yes	No	Yes	No
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)
Internal		1,100	150	-50
Static Liquid Head				
Condition		P_s (psi)	H_s (in)	SG
Operating		2.82	78	1
Test horizontal		3.05	84.5	1
Test vertical		6.43	178	1
Dimensions				
Inner Diameter		78"		
Length		144"		
Nominal Thickness		2.5"		
Corrosion	Inner	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		Capacity (US gal)
New		25,338.07		2,978.72
Corroded		24,724.12		2,988.27
Insulation				
		Thickness (in)	Density (lb/ft^3)	Weight (lb)
Insulation		2	12	534.07
		Spacing(in)	Individual Weight (lb)	Total Weight (lb)
Insulation Supports		145	100	100
Radiography				
Longitudinal seam		Full UW-11(a) Type 1		
Top Circumferential seam		Full UW-11(a) Type 1		
		Full UW-11(a) Type 1		

Bottom Circumferential seam	

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2902"
Design thickness due to combined loadings + corrosion	0.9554"
Rated MDMT	-58.6 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-50°F
t_r = 1,102.82*39.0625 / (20,000*1 - 0.6*1,102.82) =	2.2276"
Stress ratio = t_r*E* / (t_n - c) = 2.2276*1 / (2.5 - 0.0625) =	0.9139
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	8.6°F
MDMT = max[T_{impact} - T_R, -155] = max[-50 - 8.6 , -155] =	-58.6°F
Design MDMT of -50°F is acceptable.	

Design thickness, (at 150 °F) UG-27(c)(1)

t = P*R / (S*E - 0.60*P) + Corrosion
= 1,102.82*39.0625 / (20,000*1.00 - 0.60*1,102.82) + 0.0625
= 2.2902"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.5 / 40.25)*(1 - 40.25 / ∞)
= 3.1056%

The extreme fiber elongation does not exceed 5%.

Thickness Required Due to Pressure + External Loads								
Condition	Pressure P (psi)	Allowable Stress Before UG-23 Stress Increase (psi)		Temperature (°F)	Corrosion C (in)	Load	Req'd Thk Due to Tension (in)	Req'd Thk Due to Compression (in)
		S_t	S_c					
Operating, Hot & Corroded	1,100	20,000	17,295	150	0.0625	Wind	0.8861	0.8793
						Seismic	0.8929	0.8725
Operating, Hot & New	1,100	20,000	17,301	150	0	Wind	0.8846	0.8777
						Seismic	0.8916	0.8707
Hot Shut Down, Corroded	0	20,000	17,295	150	0.0625	Wind	0.0011	0.009
						Seismic	0.0059	0.0169
Hot Shut Down, New	0	20,000	17,301	150	0	Wind	0.0011	0.0092
						Seismic	0.006	0.0172
Empty, Corroded	0	20,000	17,295	70	0.0625	Wind	0.0011	0.009
						Seismic	0.0044	0.0152
Empty, New	0	20,000	17,301	70	0	Wind	0.0011	0.0092
						Seismic	0.0045	0.0155
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	17,295	150	0.0625	Weight	0.0063	0.0088

Straight Flange on BOTTOM HEAD

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	Normalized	Fine Grain Practice	PWHT	Optimize MDMT/ Find MAWP
Yes (-50°F)	Yes	No	Yes	No
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)
Internal		1,100	150	-50
Static Liquid Head				
Condition		P_s (psi)	H_s (in)	SG
Operating		2.89	80	1
Test horizontal		3.05	84.5	1
Test vertical		6.5	180	1
Dimensions				
Inner Diameter		78"		
Length		2"		
Nominal Thickness		2.5"		
Corrosion	Inner	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		Capacity (US gal)
New		357.85		41.37
Corroded		349.18		41.5
Insulation				
		Thickness (in)	Density (lb/ft^3)	Weight (lb)
Insulation		2	12	0
		Spacing(in)	Individual Weight (lb)	Total Weight (lb)
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Seamless No RT		
Top Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2903"
Design thickness due to combined loadings + corrosion	0.9556"
Rated MDMT	-58.6 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-50°F
t_r = 1,102.89*39.0625 / (20,000*1 - 0.6*1,102.89) =	2.2278"
Stress ratio = t_r*E* / (t_n - c) = 2.2278*1 / (2.5 - 0.0625) =	0.914
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	8.6°F
MDMT = max[T_{impact} - T_R, -155] = max[-50 - 8.6 , -155] =	-58.6°F
Design MDMT of -50°F is acceptable.	

Design thickness, (at 150 °F) UG-27(c)(1)

t = P*R / (S*E - 0.60*P) + Corrosion
= 1,102.89*39.0625 / (20,000*1.00 - 0.60*1,102.89) + 0.0625
= 2.2903"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.5 / 40.25)*(1 - 40.25 / ∞)
= 3.1056%

The extreme fiber elongation does not exceed 5%.

Thickness Required Due to Pressure + External Loads								
Condition	Pressure P (psi)	Allowable Stress Before UG-23 Stress Increase (psi)		Temperature (°F)	Corrosion C (in)	Load	Req'd Thk Due to Tension (in)	Req'd Thk Due to Compression (in)
		S_t	S_c					
Operating, Hot & Corroded	1,100	20,000	17,295	150	0.0625	Wind	0.8861	0.8792
						Seismic	0.8931	0.8722
Operating, Hot & New	1,100	20,000	17,301	150	0	Wind	0.8846	0.8776
						Seismic	0.8918	0.8705
Hot Shut Down, Corroded	0	20,000	17,295	150	0.0625	Wind	0.0011	0.0091
						Seismic	0.006	0.0171
Hot Shut Down, New	0	20,000	17,301	150	0	Wind	0.0011	0.0093
						Seismic	0.0061	0.0175
Empty, Corroded	0	20,000	17,295	70	0.0625	Wind	0.0011	0.0091
						Seismic	0.0045	0.0154
Empty, New	0	20,000	17,301	70	0	Wind	0.0011	0.0093
						Seismic	0.0046	0.0157
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	17,295	150	0.0625	Weight	0.0064	0.0089

BOTTOM HEAD

ASME Section VIII Division 1, 2015 Edition				
Component		Ellipsoidal Head		
Material		SA-516 70 (II-D p. 18, In. 37)		
Attached To		SHELL RG		
Impact Tested	Normalized	Fine Grain Practice	PWHT	Optimize MDMT/ Find MAWP
Yes (-50°F)	Yes	No	Yes	No
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)
Internal		1,100	150	-50
Static Liquid Head				
Condition		P_s (psi)	H_s (in)	SG
Operating		3.59	99.5625	1
Test horizontal		3.05	84.5	1
Test vertical		7.2	199.5	1
Dimensions				
Inner Diameter		78"		
Head Ratio		2		
Minimum Thickness		2.2262"		
Corrosion	Inner	0.0625"		
	Outer	0"		
Length L_{sf}		2"		
Nominal Thickness t_{sf}		2.5"		
Weight and Capacity				
		Weight (lb)[1]		Capacity (US gal)[1]
New		5,095.4		310.28
Corroded		4,962.51		312.14
Insulation				
		Thickness (in)	Density (lb/ft^3)	Weight (lb)
Insulation		2	12	115.1
		Spacing(in)	Individual Weight (lb)	Total Weight (lb)
Insulation Supports		145	100	100
Radiography				
Category A joints		Seamless No RT		

Head to shell seam	Full UW-11(a) Type 1

[1] includes straight flange

Results Summary	
Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2254"
Straight Flange governs MDMT	-58.6°F

Factor K		
$K = (1/6)*[2 + (D / (2*h))^2]$		
Corroded	$K = (1/6)*[2 + (78.125 / (2*19.5625))^2]$	0.9979
New	$K = (1/6)*[2 + (78 / (2*19.5))^2]$	1

Design thickness for internal pressure, (Corroded at 150 °F) Appendix 1-4(c)

t = P*D*K / (2*S*E - 0.2*P) + Corrosion
= 1,103.59*78.125*0.997872 / (2*20,000*1 - 0.2*1,103.59) + 0.0625
= 2.2253"

% Extreme fiber elongation - UCS-79(d)

EFE = $(75*t / R_f)*(1 - R_f / R_o)$
= $(75*2.5 / 14.51)*(1 - 14.51 / \infty)$
= 12.9221%

SKIRT

ASME Section VIII Division 1, 2015 Edition		
Component		Support Skirt
Material		SA-516 70 (II-D p. 18, ln. 37)
Skirt is Attached To		BOTTOM HEAD
Skirt Attachment Offset		3.5314" down from the top seam
Design Temperature		
Internal		650°F
Dimensions		
Inner Diameter	**Top**	82.25"
	Botttom	82.25"
Length (includes base ring thickness)		32.47"
Nominal Thickness		0.375"
Corrosion	**Inner**	0"
	Outer	0"
Weight		
New		870.36 lb
Corroded		870.36 lb
Joint Efficiency		
Top		0.55
Bottom		0.8

Skirt design thickness, largest of the following + corrosion = 0.0588 in

The governing condition is due to seismic, compressive stress at the base, operating & new.

The skirt thickness of 0.375 in is adequate.

Results Summary							
Loading	Condition	Tensile or Compressive Side	Governing Skirt Location	Temperature (°F)	Allowable Stress (psi)	Calculated Stress/E (psi)	Required thickness (in)
Wind	operating, corroded	Tensile	top	650	8,676.92	-190.27	0.0082
		Compressive	bottom			753.35	0.0326
	operating, new	Tensile	top	650	8,676.92	-194.83	0.0084
		Compressive	bottom			762.86	0.033
	empty, corroded	Tensile	top	70	12,736.46	-90.64	0.0027
		Compressive	bottom			587.3	0.0173
	empty, new	Tensile	top	70	12,736.46	-95.56	0.0028
		Compressive	bottom			597.42	0.0176
	test, new	Tensile	top	70	12,736.46	-323.45	0.0095
		Compressive	bottom			846.56	0.0249
Seismic	operating, corroded	Tensile	bottom	650	18,800	534.81	0.0107
		Compressive			8,676.92	1,338.57	0.0579
	operating, new	Tensile	bottom	650	18,800	544.7	0.0109
		Compressive			8,676.92	1,360.55	0.0588
	empty, corroded	Tensile	bottom	70	20,000	458.56	0.0086
		Compressive			12,736.46	1,011.89	0.0298
	empty, new	Tensile	bottom	70	20,000	468.48	0.0088
		Compressive			12,736.46	1,034.88	0.0305

Loading due to seismic, operating & new

Tensile side

Required thickness, tensile stress at base:

$t = -(0.6 - 0.14*S_{DS})*W / (\pi*D*S_t*E) + 48*M / (\pi*D^2*S_t*E)$

$= -(0.6 - 0.14*0.7333)*56{,}262.03 / (\pi*82.625*18{,}800*0.8) + 48*121{,}180.1 / (\pi*82.625^2*18{,}800*0.8)$

$= 0.0109$ in

Required thickness, tensile stress at the top:

$t = -(0.6 - 0.14*S_{DS})*W_t / (\pi*D_t*S_t*E) + 48*M_t / (\pi*D_t^2*S_t*E)$

$= -(0.6 - 0.14*0.7333)*55{,}391.67 / (\pi*82.625*18{,}800*0.55) + 48*91{,}649 / (\pi*82.625^2*18{,}800*0.55)$

$= 0.0096$ in

Compressive side

Required thickness, compressive stress at base:

$t = (1 + 0.14*S_{DS})*W / (\pi*D*S_c*E_c) + 48*M / (\pi*D^2*S_c*E_c)$

$= (1 + 0.14*0.7333)*56{,}262.03 / (\pi*82.625*8{,}677*1) + 48*121{,}180.1 / (\pi*82.625^2*8{,}677*1)$

$= 0.0588$ in

Required thickness, compressive stress at the top:

$t = (1 + 0.14*S_{DS})*W_t / (\pi*D_t*S_c*E_c) + 48*M_t / (\pi*D_t^2*S_c*E_c)$

$= (1 + 0.14*0.7333)*55{,}391.67 / (\pi*82.625*8{,}677*1) + 48*91{,}649 / (\pi*82.625^2*8{,}677*1)$

$= 0.0508$ in

BASE RING

Inputs	
Base configuration	single base plate without gussets
Base plate material	SA-516-70
Base plate allowable stress, S_p	20,000 psi
Foundation compressive strength	1,658 psi
Concrete ultimate 28-day strength	3,000 psi
Bolt circle, BC	88"
Base plate inner diameter, D_i	78"
Base plate outer diameter, D_o	93"
Base plate thickness, t_b	0.875"
Anchor Bolts	
Material	
Allowable stress, S_b	20,000 psi
Bolt size and type	1" series 8 threaded
Number of bolts, N	8
Corrosion allowance (applied to root radius)	0"
Anchor bolt clearance	0.375"
Bolt root area (corroded), A_b	0.55 in^2
Diameter of anchor bolt holes, d_b	1.375"
Initial bolt preload	0% (0 psi)
Bolt at 0°	No

Results Summary							
Load	Vessel condition	Base V (lb_f)	Base M (lb_f-ft)	W (lb)	Required bolt area (in^2)	t_r Base (in)	Foundation bearing stress (psi)
Wind	operating, corroded	2,568.9	30,855	55,914.8	0	0.3735	37.2
Wind	operating, new	2,568.9	30,974.9	56,770.6	0	0.3758	37.66
Wind	empty, corroded	2,568.9	30,855	39,751.3	0	0.3305	29.13
Wind	empty, new	2,568.9	30,974.9	40,667.1	0	0.3333	29.62
Wind	test, new	1,390.9	20,925.7	70,756.7	0	0.3951	41.63
Seismic	operating, corroded	10,763.6	119,122	55,914.8	0.2323	0.7263	140.65
Seismic	operating, new	10,928.3	121,180.1	56,770.6	0.2367	0.7325	143.08
Seismic	empty, corroded	7,652.1	95,062.9	39,751.3	0.2005	0.6477	111.86
Seismic	empty, new	7,828.4	97,176.7	40,667.1	0.2049	0.6548	114.35

Anchor bolt load (governing)

$P = -(0.6 - 0.14*S_{DS})*W / N + 48 * M / (N*BC)$
$= -(0.6 - 0.14*0.7333)*56,770.58 / 8 + 48 * 121,180.1 / (8*88)$
$= 4,733.04\ lb_f$

Required area per bolt = P / S_b = 0.2367 in^2

The area provided (0.551 in^2) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, governing)

Base plate width, t_c:	7.5	in
Average base plate diameter, d:	85.5	in
Base plate elastic modulus, E_s:	29.0E+06	psi
Base plate yield stress, S_y:	38,000	psi

$E_c = 57,000*Sqr(3,000) = 3,122,019$ psi

$n = E_s/E_c = 29.0E+06 / 3,122,019 = 9.2889$

$t_s = (N*A_b) / (\pi*d)$
$= (8*0.551) / (\pi*85.5)$
$= 0.0164$ in

From table 12.4 for k = 0.283685:

$K_1 = 2.4774$, $K_2 = 1.4651$
$L_1 = 18.4882$, $L_2 = 47.4955$, $L_3 = 19.231$

Total tensile force on bolting

$T = (12*M - (0.6 - 0.14*S_{DS})*W *(L_1 + L_3)) / (L_2 + L_3)$
$= (12*121,180.1 - (0.6 - 0.14*0.7333)*56,770.58 *(18.4882 + 19.231)) / (47.4955 + 19.231)$
$= 5,832.81\ lb_f$

Tensile stress in bolts use the larger of f_s or bolt preload = 0 psi

$f_s = T / (t_s * (d / 2) * K_1)$
$= 5,832.81 / (0.0164 * (85.5 / 2) * 2.4774)$
$= 3,356$ psi

Total compressive load on foundation

$C_c = T + (1 + 0.14*S_{DS})*W + \text{Bolt Preload}$
$= 5,832.81 + (1 + 0.14*0.7333)*56,770.58 + 0$
$= 68,431.84$ lb$_f$

Foundation bearing stress

$f_c = C_c / (((t_c - t_s) + n*t_s)*(d / 2)*K_2)$
$= 68,431.84 / (((7.5 - 0.0164) + 9.2889*0.0164)*(85.5 / 2)*1.4651)$
$= \underline{143}$ psi

As $f_c <= 1,658$ psi the base plate width is satisfactory.

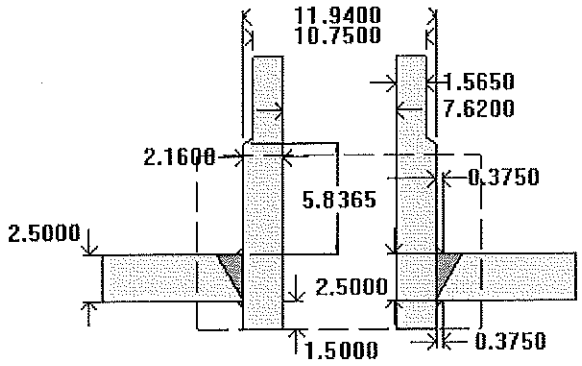
$k = 1 / (1 + f_s / (n*f_c))$
$= 1 / (1 + 3,356 / (9.2889*143))$
$= 0.283685$

Base plate required thickness (governing)

$t_r = (3*f_c*L^2 / S_p)^{0.5}$
$= (3*143*5^2 / 20,000)^{0.5}$
$= \underline{0.7325}$ in

The base plate thickness is satisfactory.

INLET W/DIVERTER (A)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	270°
Nozzle center line offset to datum line	66"
End of nozzle to shell center	51.5"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	7.62"
Wall thickness, t_n	2.16"
Minimum wall thickness	1.565"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	7.56"
Heavy barrel length, L_{hb}	5.8365"
Internal projection, h_{new}	1.5"
Projection available outside vessel to flange face, Lf	10"
Local vessel minimum thickness	2.5"
Liquid static head included	0.14 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

Lower fillet, Leg_{43}	0.375"
Nozzle to vessel groove weld	2.5"

ASME B16.5-2013 Flange	
Description	NPS 8 Class 600 FVC HB A350 LF2 Cl.1 (Nut Relief)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	No
Rated MDMT	-55°F
Liquid static head	0 psi
MAWP rating	1,420 psi @ 150°F
MAP rating	1,480 psi @ 70°F
Hydrotest rating	2,225 psi @ 70°F
PWHT performed	Yes
Impact Tested	No
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 25.7°F applied (ratio = 0.7432). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
Impact test temperature per material specification =	-50°F
t_r = 1,100.14*3.8725 / (20,000*1 - 0.6*1,100.14) =	0.2203"
Stress ratio = t_r*E* / (t_n - c) = 0.2203*1 / (2.16 - 0.0625) =	0.105
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,100.14*3.8725 / (20,000*1 - 0.6*1,100.14) =	0.2203"
Stress ratio = t_r*E* / (t_n - c) = 0.2203*1 / (1.565 - 0.0625) =	0.1466
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

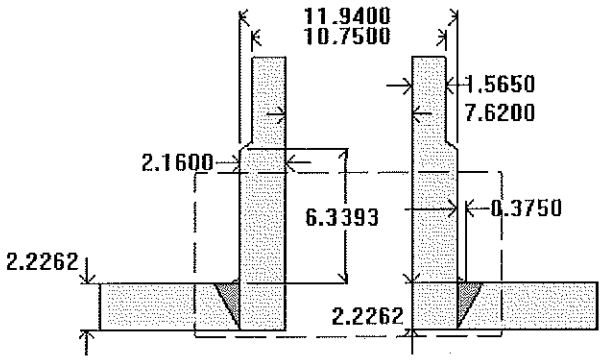
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.14 psi @ 150 °F The opening is adequately reinforced							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
17.2097	27.7141	1.9542	19.6871	5.8506	--	0.2222	0.3819	1.565

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(1)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.25	0.2625	weld size is adequate

VAPOR OUTLET (B)

ASME Section VIII Division 1, 2015 Edition	
	
Note: Per UW-16(b) minimum inside corner radius r_1 = min [1 / 4*t , 0.125 in] = 0.125 in	
Location and Orientation	
Located on	TOP HEAD
Orientation	0°
End of nozzle to datum line	166"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	7.62"
Wall thickness, t_n	2.16"
Minimum wall thickness	1.565"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	8.0628"
Heavy barrel length, L_{hb}	6.3393"
Projection available outside vessel to flange face, Lf	10.5028"
Local vessel minimum thickness	2.2262"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

Nozzle to vessel groove weld	2.2262"

ASME B16.5-2013 Flange	
Description	NPS 8 Class 600 FVC HB A350 LF2 Cl.1 (Nut Relief)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	No
Rated MDMT	-55°F
Liquid static head	0 psi
MAWP rating	1,420 psi @ 150°F
MAP rating	1,480 psi @ 70°F
Hydrotest rating	2,225 psi @ 70°F
PWHT performed	Yes
Impact Tested	No
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 25.7°F applied (ratio = 0.7432). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
Impact test temperature per material specification =	-50°F
t_r = 1,100*3.8725 / (20,000*1 - 0.6*1,100) =	0.2203"
Stress ratio = t_r*E* / (t_n - c) = 0.2203*1 / (2.16 - 0.0625) =	0.105
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,100*3.8725 / (20,000*1 - 0.6*1,100) =	0.2203"
Stress ratio = t_r*E* / (t_n - c) = 0.2203*1 / (1.565 - 0.0625) =	0.1466
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

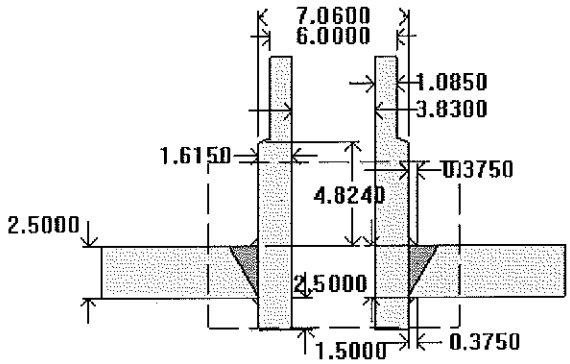
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100 psi @ 150 °F The opening is adequately reinforced							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
15.0351	21.7234	1.8957	19.6871	--	--	0.1406	0.3819	1.565

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(1)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.25	0.2625	weld size is adequate

LIQUID OUTLET (C)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	180°
Nozzle center line offset to datum line	-6"
End of nozzle to shell center	49.5"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	3.83"
Wall thickness, t_n	1.615"
Minimum wall thickness	1.085"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	6.25"
Heavy barrel length, L_{hb}	4.824"
Internal projection, h_{new}	1.5"
Projection available outside vessel to flange face, Lf	8"
Local vessel minimum thickness	2.5"
Liquid static head included	2.67 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

Lower fillet, Leg_{43}	0.375"
Nozzle to vessel groove weld	2.5"

ASME B16.5-2013 Flange	
Description	NPS 4 Class 600 FVC HB A350 LF2 Cl.1 (Nut Relief)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, In. 31)
Blind included	No
Rated MDMT	-55°F
Liquid static head	2.6 psi
MAWP rating	1,420 psi @ 150°F
MAP rating	1,480 psi @ 70°F
Hydrotest rating	2,225 psi @ 70°F
PWHT performed	Yes
Impact Tested	No
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 25.5°F applied (ratio = 0.745). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
Impact test temperature per material specification =	-50°F
t_r = 1,102.67*1.9775 / (20,000*1 - 0.6*1,102.67) =	0.1128"
Stress ratio = t_r*E* / (t_n - c) = 0.1128*1 / (1.615 - 0.0625) =	0.0726
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

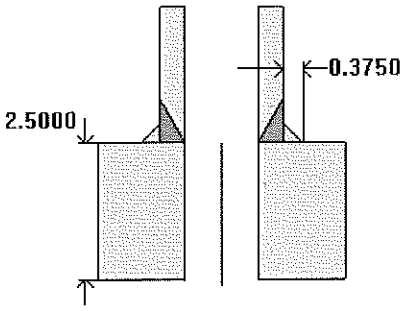
UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,102.67*1.9775 / (20,000*1 - 0.6*1,102.67) =	0.1128"
Stress ratio = t_r*E* / (t_n - c) = 0.1128*1 / (1.085 - 0.0625) =	0.1103
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,102.67 psi @ 150 °F The opening is adequately reinforced							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
8.8091	17.3589	1.6772	11.1757	4.2838	--	0.2222	0.3075	1.085

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(1)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.25	0.2625	weld size is adequate

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	15°
Nozzle center line offset to datum line	55.375"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	0.41 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,100.41*0.72 / (20,000*1 - 0.6*1,100.41) =	0.041"
Stress ratio = t_r*E* / (t_n - c) = 0.041*1 / (0.4675 - 0.0625) =	0.1012
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.41 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.4675

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.25	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

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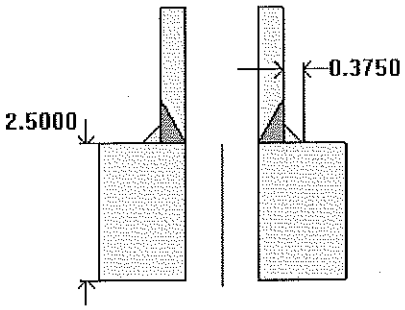

Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	SHELL RG
Orientation	15°
Nozzle center line offset to datum line	41.375"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No

Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	0.91 psi
Longitudinal joint efficiency	1

Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,100.91*0.72 / (20,000*1 - 0.6*1,100.91) =	0.041"
Stress ratio = t_r*E* / (t_n - c) = 0.041*1 / (0.4675 - 0.0625) =	0.1012
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

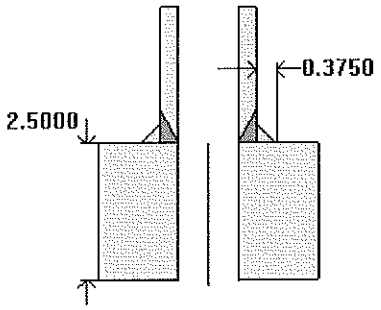
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.91 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.4675

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.25	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	300°
Nozzle center line offset to datum line	24"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	1.54 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,101.54*0.5875 / (20,000*1 - 0.6*1,101.54) =	0.0335"
Stress ratio = t_r*E* / (t_n - c) = 0.0335*1 / (0.35 - 0.0625) =	0.1164
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,101.54 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.2012	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

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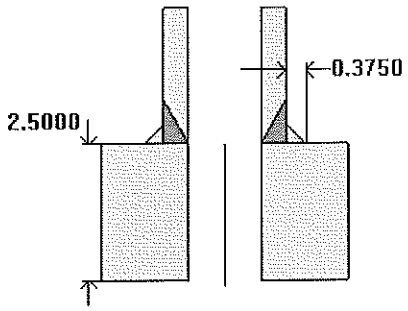
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	330°
Nozzle center line offset to datum line	60"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	0.24 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,100.24*0.72 / (20,000*1 - 0.6*1,100.24) =	0.041"
Stress ratio = t_r*E* / (t_n - c) = 0.041*1 / (0.4675 - 0.0625) =	0.1011
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

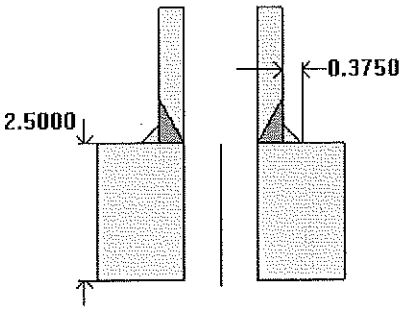
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.24 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.4675

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.25	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	330°
Nozzle center line offset to datum line	-7"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	2.66 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,102.66*0.72 / (20,000*1 - 0.6*1,102.66) =	0.0411"
Stress ratio = t_r*E* / (t_n - c) = 0.0411*1 / (0.4675 - 0.0625) =	0.1014
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

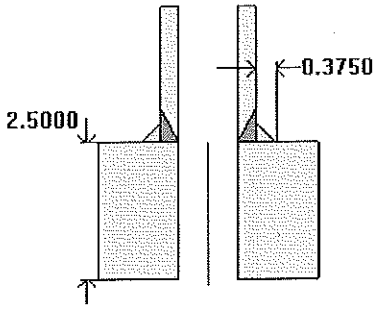
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,102.66 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.4675

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.25	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	345°
Nozzle center line offset to datum line	59.875"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	0.24 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,100.24*0.5875 / (20,000*1 - 0.6*1,100.24) =	0.0334"
Stress ratio = t_r*E* / (t_n - c) = 0.0334*1 / (0.35 - 0.0625) =	0.1163
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

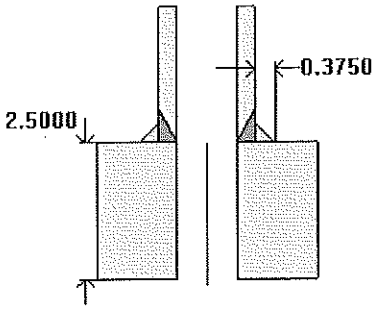
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.24 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.2012	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	345°
Nozzle center line offset to datum line	21.75"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	1.62 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,101.62*0.5875 / (20,000*1 - 0.6*1,101.62) =	0.0335"
Stress ratio = t_r*E* / (t_n - c) = 0.0335*1 / (0.35 - 0.0625) =	0.1164
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

Reinforcement Calculations for Internal Pressure

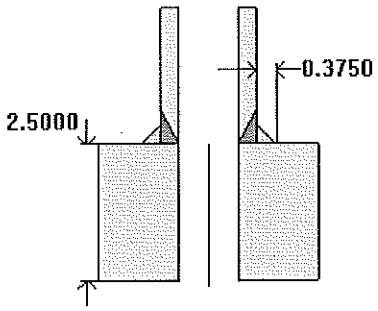
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,101.62 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.2012	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

LG (G3)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	0°
Nozzle center line offset to datum line	31.5"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	1.26 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,101.26*0.5875 / (20,000*1 - 0.6*1,101.26) =	0.0335"
Stress ratio = t_r*E* / (t_n - c) = 0.0335*1 / (0.35 - 0.0625) =	0.1164
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

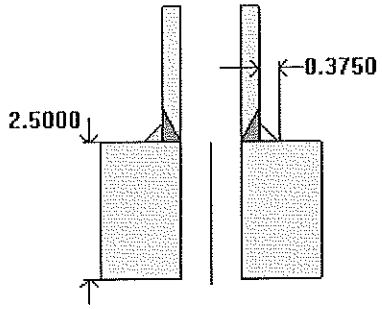
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in²)							UG-45 Summary (in)	
For P = 1,101.26 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.2012	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	0°
Nozzle center line offset to datum line	-6.625"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	2.64 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,102.64*0.5875 / (20,000*1 - 0.6*1,102.64) =	0.0335"
Stress ratio = t_r*E* / (t_n - c) = 0.0335*1 / (0.35 - 0.0625) =	0.1165
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

Reinforcement Calculations for Internal Pressure

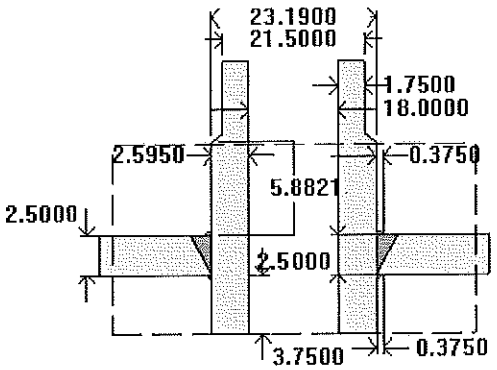
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,102.64 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.2012	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

MANWAY (H)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	270°
Nozzle center line offset to datum line	7"
End of nozzle to shell center	53.25"
Passes through a Category A joint	No
Nozzle	
Access opening	Yes
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	18"
Wall thickness, t_n	2.595"
Minimum wall thickness	1.75"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	8.25"
Heavy barrel length, L_{hb}	5.8821"
Internal projection, h_{new}	3.75"
Projection available outside vessel to flange face, Lf	11.75"
Local vessel minimum thickness	2.5"
Liquid static head included	2.45 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

Lower fillet, Leg_{43}	0.375"
Nozzle to vessel groove weld	2.5"

ASME B16.5-2013 Flange	
Description	NPS 18 Class 600 FVC HB A350 LF2 Cl.1 (Nut Relief)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	Yes
Rated MDMT	-55°F
Liquid static head	2.13 psi
MAWP rating	1,420 psi @ 150°F
MAP rating	1,480 psi @ 70°F
Hydrotest rating	2,225 psi @ 70°F
PWHT performed	Yes
Impact Tested	No
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 25.5°F applied (ratio = 0.7447). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
Impact test temperature per material specification =	-50°F
t_r = 1,102.45*39.0625 / (20,000*1 - 0.6*1,102.45) =	2.2269"
Stress ratio = t_r*E* / (t_n - c) = 2.2269*1 / (2.5 - 0.0625) =	0.9136
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	8.6°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, max[T_{impact} - T_R, -155]] = min[-50 - 5, max[-50 - 8.6 , -155]] =	-58.6°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

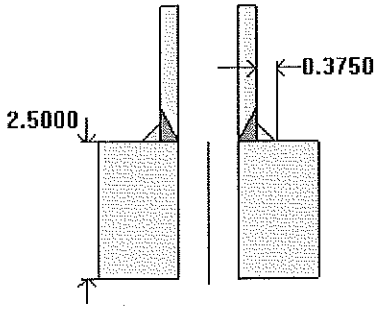
UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,102.45*9.0625 / (20,000*1 - 0.6*1,102.45) =	0.5166"
Stress ratio = t_r*E* / (t_n - c) = 0.5166*1 / (1.75 - 0.0625) =	0.3062
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,102.45 psi @ 150 °F The opening is adequately reinforced							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
40.3622	45.1661	3.8175	22.9101	18.2163	--	0.2222	0.5791	1.75

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(1)

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.25	0.2625	weld size is adequate

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	SHELL RG
Orientation	315°
Nozzle center line offset to datum line	24"
End of nozzle to shell center	45.5"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	4"
Local vessel minimum thickness	2.5"
Liquid static head included	1.54 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1,101.54*0.5875 / (20,000*1 - 0.6*1,101.54) =	0.0335"
Stress ratio = t_r*E' / (t_n - c) = 0.0335*1 / (0.35 - 0.0625) =	0.1164
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -50°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,101.54 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
The nozzle is exempt from weld strength calculations per UW-15(b)(2)

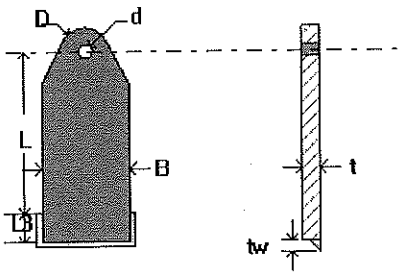
UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.2012	0.2625	weld size is adequate

This opening does not require reinforcement per UG-36(c)(3)(a)

Liquid Level

ASME Section VIII Division 1, 2015 Edition	
Location from Datum (in)	66
Operating Liquid Specific Gravity	1

LIFTING LUG

Geometry Inputs	
	
Attached To	SHELL RG
Material	SA-516-70
Distance of Lift Point From Datum	155"
Angular Position	0° and 180°
Length, L	23"
Width, B	13"
Thickness, t	1.25"
Hole Diameter, d	2"
Pin Diameter, Dp	1.625"
Diameter at Pin, D	7"
Load Angle from Vertical, ϕ	0°
Has Brace Plate	No
Welds	
Size, t_w	0.75"
Weld Length, L_3	5"

Intermediate Values	
Load Factor	1.5000
Vessel Weight (new, incl. Load Factor), W	59,854.3 lb
Lug Weight (new), W_{lug}	248.2 lb (Qty=2)
Distance from Center of Gravity to Top Lug, l_1	99.3133"
Distance from Center of Gravity to Tail Lug, l_2	96.813"
Distance from Vessel Center Line to Tail Lug, l_3	44.5"
Allowable Stress, Tensile, σ_t	19,980 psi
Allowable Stress, Shear, σ_s	13,320 psi
Allowable Stress, Bearing, σ_p	29,970 psi
Allowable Stress, Bending, σ_b	22,201 psi
Allowable Stress, Weld Shear, $\tau_{allowable}$	13,320 psi
Allowable Stress set to 1/3 Sy per ASME B30.20	No

Summary Values	
Required Lift Pin Diameter, d_{reqd}	1.196"
Required Lug Thickness, t_{reqd}	0.6145"
Lug Stress Ratio, σ_{ratio}	0.46
Weld Shear Stress Ratio, τ_{ratio}	0.73
Lug Design	Acceptable
Local Stresses WRC 107	Acceptable
Maximum Out of Plane Lift Angle - Weak Axis Bending	6.23°

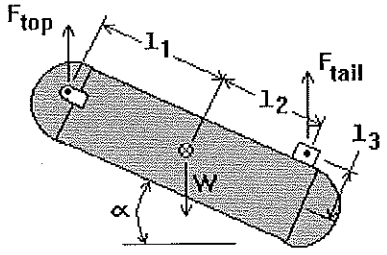
COMPRESS recommends a spreader beam be used to prevent weak axis bending of the top lugs.
No consideration is given for any bracing plate from the lug to the vessel.

Lift Forces

Lift force on lugs during rotational lift ($0° \le \alpha \le 90°$):

$2*F_{top} = W*(l_2*\cos(\alpha) + l_3*\sin(\alpha)) / (l_1*\cos(\alpha) + l_2*\cos(\alpha) + l_3*\sin(\alpha))$

$F_{tail} = W - (2*F)$



α [°]	F_{top} [lbf]	F_{tail} [lbf]
0	14,773	30,309
15	15,641	28,572
30	16,528	26,798
45	17,575	24,704
60	19,048	21,758
75	21,722	16,411
90	29,927	0
18[1]	15,813	28,228
18[2]	15,813	28,228
[1]Lift angle at maximum lug stress.		
[2]Lift angle at maximum weld stress.		
Shell angle at lift lug	0.00°	

Lug Pin Diameter - Shear stress

$d_{reqd} = (2*F_v / (\pi*\sigma_s))^{0.5}$
$= (2*29,927 / (\pi*13,320))^{0.5} = \underline{1.196"}$

$d_{reqd} / D_p = 1.196 / 1.625 = 0.74$ Acceptable

$\sigma = F_v / A$
$= F_v / (2*(0.25*\pi*D_p^2))$
$= 29,927 / (2*(0.25*\pi*1.625^2)) = 7,215$ psi

$\sigma / \sigma_s = 7,215 / 13,320 = 0.54$ Acceptable

Lug Thickness - Tensile stress

$t_{reqd} = F_v / ((D - d)*\sigma_t)$
$= 29,927 / ((7 - 2)*19,980) = 0.2996"$

$t_{reqd} / t = 0.2996 / 1.25 = 0.24$ Acceptable

$\sigma = F_v / A$
$= F_v / ((D - d)*t)$
$= 29,927 / ((7 - 2)*1.25) = 4,788$ psi

$\sigma / \sigma_t = 4,788 / 19,980 = 0.24$ Acceptable

Lug Thickness - Bearing stress

$t_{reqd} = F_v / (D_p*\sigma_p)$
$= 29,927 / (1.625*29,970) = \underline{0.6145"}$

t_{reqd} / t = 0.6145 / 1.25 = 0.49 Acceptable

σ = $F_v / A_{bearing}$
= $F_v / (D_p*(t))$
= 29,927 / (1.625*(1.25)) = 14,733 psi

σ / σ_p = 14,733 / 29,970 = 0.49 Acceptable

Lug Thickness - Shear stress

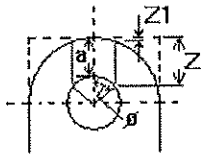
t_{reqd} = $[F_v / \sigma_s] / (2*L_{shear})$
= (29,927 / 13,320) / (2*2.6879) = 0.4179"

t_{reqd} / t = 0.4179 / 1.25 = 0.33 Acceptable

τ = F_v / A_{shear}
= $F_v / (2*t*L_{shear})$
= 29,927 / (2*1.25*2.6879) = 4,454 psi

τ / σ_s = 4,454 / 13,320 = 0.33 Acceptable

Shear stress length (per Pressure Vessel and Stacks, A. Keith Escoe)



ϕ = $55*D_p / d$
= 55*1.625 / 2
= 44.6875°

Z = $0.5*(D - d) + 0.5*D_p*(1 - \cos(\phi))$
= $0.5*(7 - 2) + 0.5*1.625*(1 - \cos(44.6875))$
= 2.7349"

Z1 = $0.5*D - \text{sqr}(0.25*D*D - (0.5*D_p*\sin(\phi))^2)$
= $0.5*7 - \text{sqr}(0.25*7*7 - (0.5*1.625*\sin(44.6875))^2)$
= 0.047"

L_{shear} = Z - Z1
= 2.6879"

Lug Plate Stress

Lug stress, tensile + bending, during rotational lift:

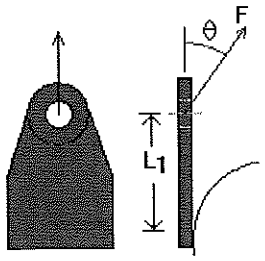
σ_{ratio} = $[F_{ten} / (A_{ten}*\sigma_t)] + [M_{bend} / (Z_{bend}*\sigma_b)] \le 1$
= $[(F_{top}(\alpha)*\sin(\alpha)) / (t*B*\sigma_t)] + [(6*F_{top}(\alpha)*L*\cos(\alpha)) / (t*B^2 * \sigma_b)] \le 1$

$= \frac{15{,}813*\sin(18.0)}{(1.25*13*19{,}980)} + \frac{6*(15{,}813)*23*\cos(18.0)}{(1.25*13^2*22{,}201)}$

$= \underline{0.46}$ Acceptable

Weak Axis Bending Stress

Maximum lift cable angle from vertical $\theta = 6.23°$



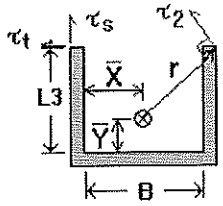
$\sigma_b = M / Z = (F*\sin(\theta)* L_1) / Z$

$F*\cos(\theta) = 0.5*W \Rightarrow F = 0.5*W / \cos(\theta)$

$\theta = \arctan((2*\sigma_b*Z) / (W* L_1))$

$\theta = \arctan((2*22{,}201*(13*1.25^2/6)) / (59{,}854*23)) = 6.23°$

Weld Stress



Weld stress, direct and torsional shear, during rotational lift:

Direct shear:

Maximum weld shear stress occurs at lift angle 18.00°; lift force = 15,813 lb_f

$A_{weld} = 0.707*t_w*(2*L_3 + B)$

$= 0.707*0.75*(2*5 + 13) = 12.1958 \text{ in}^2$

$\tau_t = F_{lug}*\cos(\alpha) / A_{weld}$

$= 15{,}813*\cos(18.0) / 12.1958 = 1{,}233 \text{ psi}$

$\tau_s = F_{lug}*\sin(\alpha) / A_{weld}$

$= 15{,}813*\sin(18.0) / 12.1958 = 401 \text{ psi}$

Torsional shear:

Weld centroid:

$Y_{bar} = L_3^2 / (2*L_3 + B)$
$= 5^2 / (2*5 + 13) \quad = 1.087"$

Second polar moment of area:

$J = 0.707*t_w*((8*L_3^3 + 6*L_3*B^2 + B^3) / 12 - L_3^4 / (2*L_3 + B))$
$= 0.707*0.75* ((8*5^3 + 6*5*13^2 + 13^3) / 12 - 5^4 / (2*5 + 13)) \quad = 350.89 \text{ in}^4$

Radial distance from centroid to weld:

$r = sqr((X_{bar})^2 + (L_3 - Y_{bar})^2)$
$= sqr((0.5*13)^2 + (5 - 1.087)^2) \quad = 7.587"$

$\theta_r = \arctan((L_3 - Y_{bar}) / (X_{bar}))$
$= \arctan(3.913 / 6.5) \quad = 31.05°$

$\tau_2 = M * r / J$
$= [F(\alpha)*\cos(\alpha)*(L + L_3 - Y_{bar})] * r / J$
$= (15{,}813*\cos(18.0)*26.913)*7.587 / 350.8891$
$= 8{,}752 \text{ psi}$

$\tau_{ratio} = sqr((\tau_t + \tau_2*\sin(\theta_r))^2 + (\tau_s + \tau_2*\cos(\theta_r))^2) / \tau_{allowable} \leq 1$
$= sqr ((1{,}233 + 8{,}752*\sin(31.05))^2 + (401 + 8{,}752*\cos(31.05))^2) / 13{,}320$
$= \underline{0.73}$ Acceptable

WRC 107 Analysis

Maximum stress ratio occurs at lift angle = 90.00° with lift force = 29,927 lb_f

Geometry	
Height (radial)	1.25"
Width (circumferential)	13"
Length	5"
Fillet Weld Size:	0.75"
Located On	SHELL RG (5" from top end)
Location Angle	0.00° and 180.00°

Applied Loads	
Radial load, P_r	0 lb_f
Circumferential moment, M_c	0 lb_f-in
Circumferential shear, V_c	0 lb_f
Longitudinal moment, M_L	18,704.5 lb_f-in
Longitudinal shear, V_L	29,927.13 lb_f
Torsion moment, M_t	0 lb_f-in
Internal pressure, P	0 psi
Mean shell radius, R_m	40.25"
Design factor	3

Maximum stresses due to the applied loads at the lug edge

$\gamma = R_m / T = 40.25 / 2.5 = 16.1$

$C_1 = 7.25$, $C_2 = 3.25$ in

Local circumferential pressure stress = $P*R_i / T = 0$ psi

Local longitudinal pressure stress = $P*R_i / (2*T) = 0$ psi

Maximum combined stress $(P_L+P_b+Q) = 1,842$ psi
Allowable combined stress $(P_L+P_b+Q) = \pm 3*S = \pm 60,000$ psi

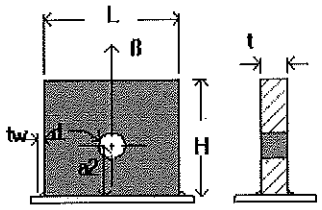
The maximum combined stress (P_L+P_b+Q) is within allowable limits.

Maximum local primary membrane stress $(P_L) = -47$ psi
Allowable local primary membrane stress $(P_L) = \pm 1.5*S = \pm 30,000$ psi

The maximum local primary membrane stress (P_L) is within allowable limits.

Stresses at the lug edge per WRC Bulletin 107										
Figure	value	β	A_u	A_l	B_u	B_l	C_u	C_l	D_u	D_l
3C*	2.808	0.1161	0	0	0	0	0	0	0	0
4C*	2.8391	0.1542	0	0	0	0	0	0	0	0
1C	0.1169	0.1582	0	0	0	0	0	0	0	0
2C-1	0.0848	0.1582	0	0	0	0	0	0	0	0
3A*	0.4457	0.1379	0	0	0	0	0	0	0	0
1A	0.0957	0.1696	0	0	0	0	0	0	0	0
3B*	1.238	0.1055	-47	-47	47	47	0	0	0	0
1B-1	0.0512	0.1295	-176	176	176	-176	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-223	129	223	-129	0	0	0	0
Primary membrane circumferential stress*			-47	-47	47	47	0	0	0	0
3C*	2.4854	0.1542	0	0	0	0	0	0	0	0
4C*	3.0075	0.1161	0	0	0	0	0	0	0	0
1C-1	0.1403	0.1305	0	0	0	0	0	0	0	0
2C	0.1041	0.1305	0	0	0	0	0	0	0	0
4A*	0.6306	0.1379	0	0	0	0	0	0	0	0
2A	0.0568	0.1354	0	0	0	0	0	0	0	0
4B*	0.3288	0.1055	-10	-10	10	10	0	0	0	0
2B-1	0.0863	0.114	-338	338	338	-338	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-348	328	348	-328	0	0	0	0
Primary membrane longitudinal stress*			-10	-10	10	10	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-921	-921	921	921
Total Shear stress			0	0	0	0	-921	-921	921	921
Combined stress (P_L+P_b+Q)			-348	328	348	-328	1,842	1,842	1,842	1,842
* denotes primary stress.										

TAILING LUG

Geometry Inputs	
	
Attached To	SKIRT
Material	SA-516-70
Orientation	Longitudinal
Distance of Lift Point From Datum	-41.1264"
Angular Position	270°
Length, L	8"
Height, H	6.875"
Thickness, t	0.81"
Hole Diameter, d	1.5"
Pin Diameter, Dp	1.25"
Load Eccentricity, a_1	0"
Distance from Load to Shell or Pad, a_2	3"
Load Angle Normal to Vessel, β	0°
Load Angle from Vertical, ϕ	0°
Welds	
Size, t_w	0.375"

Intermediate Values	
Load Factor	1.5000
Vessel Weight (new, incl. Load Factor), W	59,854.3 lb
Lug Weight (new), W_{lug}	12.6 lb
Distance from Center of Gravity to Top Lug, l_1	99.3133"
Distance from Center of Gravity to Tail Lug, l_2	96.813"
Distance from Vessel Center Line to Tail Lug, l_3	44.5"
Allowable Stress, Tensile, σ_t	19,980 psi
Allowable Stress, Shear, σ_s	13,320 psi
Allowable Stress, Bearing, σ_p	29,970 psi
Allowable Stress, Bending, σ_b	22,201 psi
Allowable Stress, Weld Shear, $\tau_{allowable}$	13,320 psi
Allowable Stress set to 1/3 Sy per ASME B30.20	No

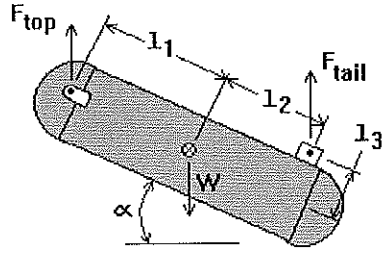
Summary Values	
Required Lift Pin Diameter, d_{reqd}	1.2036"
Required Lug Thickness, t_{reqd}	0.809"
Lug Stress Ratio, σ_{ratio}	0.41
Weld Shear Stress Ratio, τ_{ratio}	0.86
Lug Design	Acceptable
Local Stresses WRC 107	**Unacceptable**

Lift Forces

Lift force on lugs during rotational lift ($0° \le \alpha \le 90°$):

$2*F_{top} = W*(l_2*\cos(\alpha) + l_3*\sin(\alpha)) / (l_1*\cos(\alpha) + l_2*\cos(\alpha) + l_3*\sin(\alpha))$

$F_{tail} = W - (2*F)$



α [°]	F_{top} [lbf]	F_{tail} [lbf]
0	14,773	30,309
15	15,641	28,572
30	16,528	26,798
45	17,575	24,704
60	19,048	21,758
75	21,722	16,411
90	29,927	0
44[1]	17,497	24,861
46[2]	17,656	24,543
[1]Lift angle at maximum lug stress.		
[2]Lift angle at maximum weld stress.		

Lug loading at α = 0°	
Total lift force	
$F = F_{top} / \cos(\phi)$	
$F = 30,309 / \cos(0.0) =$	30,309 lb_f
Tensile force (parallel to lug normal)	
$F_t = F^*\cos(\beta)$	
$F_t = 30,309^*\cos(0.0) =$	30,309 lb_f
Shear force (parallel to lug weld)	
$F_s = F^*\sin(\beta)$	
$F_s = 30,309^*\sin(0.0) =$	0 lb_f

Lug Pin Diameter - Shear stress

$d_{reqd} = (2^*F / (\pi^*\sigma_s))^{0.5}$
$= (2^*30,309 / (\pi^*13,320))^{0.5} = \underline{1.2036"}$

$d_{reqd} / D_p = 1.2036 / 1.25 = 0.96$ Acceptable

$\sigma = F / A$
$= F / (2^*(0.25^*\pi^*D_p^2))$
$= 30,309 / (2^*(0.25^*\pi^*1.25^2)) = 12,349$ psi

$\sigma / \sigma_s = 12,349 / 13,320 = 0.93$ Acceptable

Lug Thickness - Tensile stress

$t_{reqd} = F_r / ((L - d)^*\sigma_t)$
$= 30,309 / ((8 - 1.5)^*19,980) = 0.2334"$

t_{reqd} / t = 0.2334 / 0.81 = 0.29 Acceptable

σ = F_r / A
= $F_r / ((L - d)*t)$
= 30,309 / ((8 - 1.5)*0.81) = 5,757 psi

σ / σ_t = 5,757 / 19,980 = 0.29 Acceptable

Lug Thickness - Bearing stress

t_{reqd} = $F / (D_p*\sigma_p)$
= 30,309 / (1.25*29,970) = 0.809"

t_{reqd} / t = 0.809 / 0.81 = 1.00 Acceptable

σ = $F / A_{bearing}$
= $F / (D_p*(t))$
= 30,309 / (1.25*(0.81)) = 29,934 psi

σ / σ_p = 29,934 / 29,970 = 1 Acceptable

Lug Thickness - Shear stress

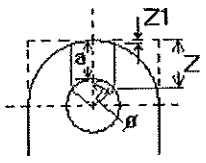
t_{reqd} = $[F_v / \sigma_s] / (2*L_{shear})$
= (30,309 / 13,320) / (2*3.3145) = 0.3432"

t_{reqd} / t = 0.3432 / 0.81 = 0.42 Acceptable

τ = F_v / A_{shear}
= $F_v / (2*t*L_{shear})$
= 30,309 / (2*0.81*3.3145) = 5,645 psi

τ / σ_s = 5,645 / 13,320 = 0.42 Acceptable

Shear stress length (per Pressure Vessel and Stacks, A. Keith Escoe)



ϕ = $55*D_p / d$
= 55*1.25 / 1.5
= 45.8333°

L_{shear} = $(H - a2 - 0.5*d) + 0.5*D_p*(1 - \cos(\phi))$

$= (6.875 - 3 - 0.5*1.5) + 0.5*1.25*(1 - \cos(45.8333))$

$= 3.3145"$

Lug Plate Stress

Lug stress tensile + bending during lift:

$\sigma_{ratio} = [F_{ten} / (A_{ten}*\sigma_t)] + [M_{bend} / (Z_{bend}*\sigma_b)] \le 1$

$= [(F_{tail}(\alpha)*\cos(\alpha)) / (t*L*\sigma_t)] + [(6*\text{abs}(F_{tail}(\alpha)*\sin(\alpha)*Hght - F_{tail}(\alpha)*\cos(\alpha)*a_1)) / (t*L^2*\sigma_b)] \le 1$

$= 24{,}861*\cos(44.0) / (0.81*8*19{,}980) + 6*\text{abs}(24{,}861*\sin(44.0)*3 - 24{,}861*\cos(44.0)*0) / (0.81*8^2*22{,}201)$

$= \underline{0.41}$ Acceptable

Weld Stress

Weld stress, tensile, bending and shear during lift:

Direct shear:

Maximum shear stress occurs at lift angle 46.00°; lift force = 24,543 lb_f

$F_{lug} = F_{top} / \cos(\phi)$

$= 24{,}543 / \cos(0.0) = 24{,}543\ lb_f$

$A_{weld} = 2*(0.707)*t_w*(L + t)$

$= 2*(0.707)*0.375*(8 + 0.81) = 4.6715\ in^2$

$\tau_t = F_{tail}*\cos(\alpha) / A_{weld}$

$= 24{,}543*\cos(46.0) / 4.6715 = 3{,}650\ psi$

$\tau_s = F_{tail}*\sin(\alpha) / A_{weld}$

$= 24{,}543*\sin(46.0) / 4.6715 = 3{,}779\ psi$

$\tau_b = M * c / I$

$= 3*(F_{lug}*\sin(\beta)*Hght - F_{lug}*\cos(\beta)*a_1) / (0.707*h*L*(3*t + L))$

$= 3*\text{abs}(24{,}543*\sin(46.0)*3 - 24{,}543*\cos(46.0)*(0)) / (22.1220)$

$= 7{,}183\ psi$

$\tau_{ratio} = \text{sqr}((\tau_t + \tau_b)^2 + \tau_s^2) / \tau_{allowable} \le 1$

$= \text{sqr}((3{,}650 + 7{,}183)^2 + (3{,}779)^2) / 13{,}320$

$= \underline{0.86}$ Acceptable

WRC 107 Analysis

Maximum stress ratio occurs at lift angle = 0.00° with lift force = 30,309 lb_f

Geometry	
Height (radial)	6.875"
Width (circumferential)	0.81"
Length	8"
Fillet Weld Size:	0.375"
Located On	SKIRT (2.875" from bottom end)
Location Angle	270.00°

Applied Loads	
Radial load, P_r	-30,308.65 lb_f
Circumferential moment, M_c	0 lb_f-in
Circumferential shear, V_c	0 lb_f
Longitudinal moment, M_L	0 lb_f-in
Longitudinal shear, V_L	0 lb_f
Torsion moment, M_t	0 lb_f-in
Internal pressure, P	0 psi
Mean shell radius, R_m	41.3125"
Design factor	3

Maximum stresses due to the applied loads at the lug edge

$\gamma = R_m / T = 41.3125 / 0.375 = 110.1667$

$C_1 = 0.78$, $C_2 = 3.12$ in

Note: Actual lug $C_1 / C_2 < 1 / 4$, $C_1 / C_2 = 1 / 4$ used as this is the minimum ratio covered by WRC 107.

Local circumferential pressure stress = $P*R_i / T = 0$ psi

Local longitudinal pressure stress = $P*R_i / (2*T) = 0$ psi

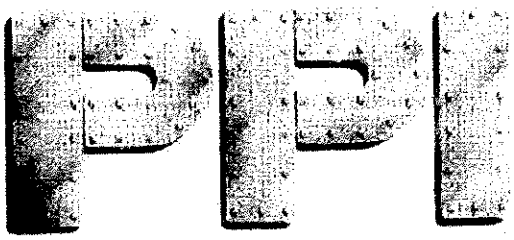
Maximum combined stress (P_L+P_b+Q) = 290,444 psi
Allowable combined stress $(P_L+P_b+Q) = \pm 3*S = \pm 60{,}000$ psi

WRC 107: The combined stress (P_L+P_b+Q) is excessive

Maximum local primary membrane stress (P_L) = 38,742 psi
Allowable local primary membrane stress $(P_L) = \pm 1.5*S = \pm 30{,}000$ psi

WRC 107: The local primary membrane stress (P_L) is excessive

Stresses at the lug edge per WRC Bulletin 107										
Figure	value	β	A_u	A_l	B_u	B_l	C_u	C_l	D_u	D_l
3C*	18.1103	0.0559	0	0	0	0	35,431	35,431	35,431	35,431
4C*	19.6782	0.0453	38,498	38,498	38,498	38,498	0	0	0	0
1C	0.1972	0.0332	0	0	0	0	255,013	-255,013	255,013	-255,013
2C-1	0.1436	0.0332	185,699	-185,699	185,699	-185,699	0	0	0	0
3A*	1.6356	0.03	0	0	0	0	0	0	0	0
1A	0.1002	0.0346	0	0	0	0	0	0	0	0
3B*	9.2612	0.0476	0	0	0	0	0	0	0	0
1B-1	0.0552	0.0382	0	0	0	0	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			224,197	-147,201	224,197	-147,201	290,444	-219,582	290,444	-219,582
Primary membrane circumferential stress*			38,498	38,498	38,498	38,498	35,431	35,431	35,431	35,431
3C*	19.8031	0.0453	38,742	38,742	38,742	38,742	0	0	0	0
4C*	19.0774	0.0559	0	0	0	0	37,323	37,323	37,323	37,323
1C-1	0.1549	0.0472	200,312	-200,312	200,312	-200,312	0	0	0	0
2C	0.1142	0.0472	0	0	0	0	147,680	-147,680	147,680	-147,680
4A*	1.9536	0.03	0	0	0	0	0	0	0	0
2A	0.059	0.043	0	0	0	0	0	0	0	0
4B*	2.6738	0.0476	0	0	0	0	0	0	0	0
2B-1	0.08	0.0526	0	0	0	0	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			239,054	-161,570	239,054	-161,570	185,003	-110,357	185,003	-110,357
Primary membrane longitudinal stress*			38,742	38,742	38,742	38,742	37,323	37,323	37,323	37,323
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	0	0	0	0
Total Shear stress			0	0	0	0	0	0	0	0
Combined stress (P_L+P_b+Q)			239,054	-161,570	239,054	-161,570	290,444	-219,582	290,444	-219,582
* denotes primary stress.										



Professional Projects Inc.

18115 Telge Rd. Cypress, TX 77429

5654-1 Databook

List of Contents

Item: V-402, COLD SEPARATOR

Materials

Professional Projects Inc.
18115 Telge Rd. Cypress, TX 77429

MANUFACURER'S MTR + WELDER ID MAP

CUSTOMER
UOP THOMAS RUSSELL

JOB # 5654 S/O# 5654-1

WELD IDENTIFIER	DESCRIPTION	MATERIAL	HEAT NO. / HEAT CODE	WELDER ID.
	HEAD MATERIAL			
C-1(CAT.B)	78"ID X 2.2262" MIN THK ELLIP HD	SA-516-70N	3W893 (HBZ-06)	K
C-2(CAT.B)	78"ID X 2.2262" MIN THK ELLIP HD	SA-516-70N	3W893 (HBZ-06)	K
	SHELL & SKIRT RING MATERIAL			
L-1(CAT.A)	2.5" X 78" ID CYLINDER	SA-516-70N	3W963 (HBZ-05)	K
SKIRT(CAT.B)	3/8" X 83" OD X 3'	SA-516-70	813W61910 (HBZ-109)	Q
	FALNGES & NOZZLES			
A(CAT.C)	8" 600# "HB" LWN X 14" LG	SA-350-LF2-CL.1	Z573 (XAN-83)	K
B(CAT.C)	8" 600# "HB" LWN X 14" LG	SA-350-LF2-CL.1	Z573 (XAN-83)	Q
C(CAT.C)	4" 600# "HB" LWN X 12" LG	SA-350-LF2-CL.1	W353 (XAN-84)	DOT.T
C-PIPE(CAT.D)	4" SCH/40 SMLS PIPE	SA-106B	1013341771 (AFC-140)	DOT.T
C-WELD ELL(CAT.D)	4" LR 90° WELD ELL	SA-234-WPB	LW14 (XAN-85)	DOT.T
D1(CAT.C)	1" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LRB4 (XAN-86)	Q
D2(CAT.C)	1" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LRB4 (XAN-86)	Q
E(CAT.C)	3/4" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LSJ4 (XAN-87)	Q
F1(CAT.C)	1" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LRB4 (XAN-86)	Q
F2(CAT.C)	1" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LRB4 (XAN-86)	Q
G1(CAT.C)	3/4" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LSJ4 (XAN-87)	Q
G2(CAT.C)	3/4" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LSJ4 (XAN-87)	Q
G3(CAT.C)	3/4" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LSJ4 (XAN-87)	Q
G4(CAT.C)	3/4" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LSJ4 (XAN-87)	Q
H(CAT.C)	18" 600# RF "HB" LWN X 18" LG	SA-350-LF2-CL.1	Z580 (XAN-88)	DOT.T
J(CAT.C)	3/4" X 4" LG 6M THD CPLTS	SA-350-LF2-CL.1	LSJ4 (XAN-87)	Q
	PIPE MATERIAL			
SKIRT ACCESS	18" STD WT. SMLS PIPE	SA-106B	M33891 (AFI-59)	I
SKIRT VENT	1-1/2" STD WT. SMLS PIPE	SA-106B	1013347382 (AFB-37)	I
INLET DIV. PIPE	1" X-STG SMLS PIPE	SA-106B	1016386730 (AFI-61)	E
	PLATE MATERIAL			
GROUNDING LUG	1/4" X 2" PLATE	SA-36	A3R1772-03 (YAK-21)	E
LIFTING LUG	1-1/4" PLATE	SA-516-70	E5E005-C47 (HBZ-77)	E

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

Professional Projects Inc.
18115 Telge Rd. Cypress, TX 77429

MANUFACURER'S MTR + WELDER ID MAP

JOB # 5654 S/O# 5654-1 CUSTOMER UOP THOMAS RUSSELL

WELD IDENTIFIER	DESCRIPTION	MATERIAL	HEAT NO. / HEAT	WELDER ID.
	PLATE MATERIAL			
ISR-1A PLATE	3/8" X 2" X 1" LG	SA-36	JW15101084 (YAL-5)	I
ISR-2 PLATE	3/8" X 2" X 1" LG	SA-36	JW15101084 (YAL-5)	I
ISR-3 PLATE	3/8" X 2" X 1" LG	SA-36	JW15101084 (YAL-5)	I
INLET DIVERTER	5/8" PLATE	SA-516-70	812B34840 (HBZ-76)	I
BASEPLATE	7/8" PL	SA-516-70	821P00650 (HBZ-74)	E
DEMISTER DETAIL	3/8" PLATE	SA-516-70	E6K162-A10 (HBZ-75)	E
	BAR MATERIAL			
ISR-1A	1/2" ROUND BAR	SA-36	JW14105769 (YAK-125)	I
ISR-2	1/2" ROUND BAR	SA-36	JW14105769 (YAK-125)	I
ISR-3	1/2" ROUND BAR	SA-36	JW14105769 (YAK-125)	I
	BLIND FLANGE			
H BLIND	18" 600# RF BLIND	SA-350-LF2-CL.1	91436 (XAN-89)	N/A

Tank Head Manufacturing Complex
10703 Sheldon Road
Houston, TX 77044

UNI-FORM COMPONENTS CO.

(281) 456-9310
(800) 231-3272 toll-free
(281) 456-0245 fax

Packlist No.	Customer ID
PL-84599	PROPRO

MATERIAL CERTIFICATION

Customer PO No.	UCC Job No.	Date Cert. Originated
5654-1	128421	3/27/2017

Sold To:
PROFESSIONAL PROJECTS
18115 TELGE RD
CYPRESS TX 77410

Ship To:
PROFESSIONAL PROJECTS
18115 TELGE RD
CYPRESS TX 77410

Ln	Order Qty	Ship Qty	B/O Qty	Part Description
1	2	2	0	**HEAD 2:1 ELLIP, 78 ID X 2-1/2 SA516-70 2.2317" MIN** **Unit of Measure: EA**

Code: 3W893 **HEAT/SLAB:** 813V65970 / E043960 **GRADE:** SA516-70 **Size:** 2.5 X 108 X 216 **MILL:** ARCELOR MITTAL

3/28/17 PPI Q.C. F.W. HBZ-06

MILL TEST REPORTS ATTACHED

The chemical and physical properties as indicated on the attached report are the results of the Mill Tests of the raw material used in the manufacture of these products and are certified to meet only the minimum requirements of the ASME and/or ASTM specifications for the material.

1. We hereby certify that these heads were hot formed at the required normalizing temperature and air cooled, in accordance with all applicable specifications.
2. We hereby certify that these heads comply with tolerances of UG-81 of ASME Section VIII, Div. 1.

WE HEREBY CERTIFY THAT THIS REPORT COVERING THE ABOVE AND ATTACHED INFORMATION IS TRUE AND CORRECT AS SHOWN AND CONTAINED IN OUR RECORDS.

Stephen Cobb PS

Quality Control

UQP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

C-1 & C-2 HEADS

ArcelorMittal Burns Harbor Plate 5W892-893 Us Hwy 12 Burns Harbor, Indiana

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.		PAGE
803-16765	02-14-17	CSS-CHGO-UP	BVRY 062149	2

SOLD TO
UNI-FORM COMPONENTS CO
10703 SHELDON RD
HOUSTON TX 77044-6003

SHIP TO
UNI-FORM COMPONENTS CO
THEIR SIDING
HOUSTON TX

NOTE	SERIAL NUMBER	PAT NO.	HEAT NUMBER	NO. PCS.	SIZE AND QUANTITY THICKNESS	WIDTH OR DIA.	LENGTH	WEIGHT	YIELD POINT	TENSILE STRENGTH	AF FRAC. ELONG.	RED.
					INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN	% %

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASME SA516 GR 70 PVQ KLD FINE GRAIN
PRAC 2015 EDITION --- GAS CUT 4
SIDES MILL TEST PCS NORM 1650F FOR
1HR/IN AIRCL --- TEST CERTS ARE
PREPARED IN ACCORD WITH PROCEDURES
OUTLINED IN EN 10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
MFST - MFST PPI 0069378- 0001 MFST TEST CERTS ARE
PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN
EN MFST 10204:2004 TYPE 3.1
- LIFT MAX 10
TON UNLDG FORK LIFT-SIDE
CO# 35158 GH 353-1631K

TEST SPECIMENS LABORATORY HEAT TREATED AND YIELD STRENGTH @ .5% E.U.L.

E043959	813V65960	1	2	1/2	108	216	16540	50800	74100	2	39	5W892
E043960	823V65970	1	2	1/2	108	216	16540	48500	74900	2	37	5W893

Q-QUENCH TEMPERATURE T-TEMPER TEMPERATURE N-NORMALIZE TEMPERATURE

SERIAL NUMBER	PAT NO.	HEAT NUMBER	HARD BHN	BEND	THICKNESS INCHES	TYPE	SIZE	DIR	TEST TEMP F	CHARPY IMPACT ENERGY FT LBS 1	2	3	SHEAR(%) 1	2	3	LAT. EXP MILS 1	2	3

3/28/17 PPI Q.C. HBZ-06 F,W,

HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MQUAID GRAIN SIZE
813V65960	.19	1.10	.012	.004	.32	1.227	.18	.03	.040	.002	.002	.036	.0002	.003	.004		
823V65970	.18	1.08	.011	.004	.32	2.227	.18	.03	.039	.002	.002	.033	.0002	.002	.005	.004	

I certify that the above results are a true and correct copy of actual results contained in records maintained by ArcelorMittal Burns Harbor and are in full compliance with the requirements of the specification cited above. This test report cannot be altered and must be transmitted intact with any subsequent third party test reports, if required.

R. SPANGLER II PER LSS

BHPLTRPT.TIF SUPV. QUALITY ASSURANCE

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

C-1 & C-2 HEADS

GOOLSBY TESTING, INC.

2620 WILSON ROAD - P.O. BOX 1416
HUMBLE, TEXAS 77347-1416
(281) 540-1255 FAX (281) 540-8125

CLIENT: UNIFORM COMPONENTS	DATE RECEIVED: 3-24-17
10703 SHELDON RD.	DATE TESTED: 3-24-17
HOUSTON, TEXAS 77044	REPORT DATE: 3-24-17
PURCHASE ORDER: 143120	LABORATORY TEST NO: 17-03-108584
GT# :3003 SHOP ORDER#:128421	PROCEDURE: #15 #16
HEAT # : 3W893 SLAB # : N/A	LIGHTING: 205FC
HUMIDITY: 53.0	TEMP: 72.1°F
ENVIRONMENTAL CONDITIONS: BP: 30.0	
MATERIAL THICKNESS: 2-1/2"	
MATERIAL/DESCRIPTION: SA516-70N BASE PLATE	
SPECIFICATIONS: ASME SECT. VIII DIV. 1	
SPECIAL REQUIREMENTS: N/A	

CHARPY IMPACT TEST

TESTING MACHINE: BALDWIN SATEC S1-1 K3 S/N 1706	
LINEAR VELOCITY OF HAMMER: 17 FT/SEC.	TEST METHOD: SIMPLE BEAM CHARPY
COOLANT BATH: FTS SYSTEMS S/N G6-1	EFFECTIVE ENERGY: 300 FT/LBS./406.7 JOULES
SPECIMEN TYPE: ASTM TYPE A LVNC	SPECIMEN SIZE: 10 MM X 10 MM
SPECIMEN TEMP: -50° F	ACCEPTANCE CRITERIA: 15/12 FT/LBS

SPECIMEN LOCATION	WIDTH	EFFECTIVE SECTION SIZE	IMPACT VALUES FOOT POUNDS	% SHEAR FRACTURE	LATERAL EXPANSION
BASE	.394	.315	40	20	.028
BASE	.394	.315	49	20	.034
BASE	.394	.315	44	20	.031

MATERIALS TESTED ARE: [☑] ACCEPTABLE [☐] REJECTABLE [☐] RECORDABLE

TECHNICIAN:	GOOLSBY TESTING, INC.
CHARLES WILLIAMS	PER:
	APPROVED SIGNEE
Accepted by:	Company:

3/28/17 PPI HBZ-06
Q.C.
F.W.

C-1 & C-2 HEADS

Tank Head Manufacturing Complex
10703 Sheldon Road
Houston, TX 77044

UNI-FORM COMPONENTS CO.

(281) 456-9310
(800) 231-3272 toll-free
(281) 456-0245 fax

Packlist No.	Customer ID
PL-84479	PROPRO

MATERIAL CERTIFICATION

Customer PO No.	UCC Job No.	Date Cert. Originated
5654-1	128420	3/21/2017

Sold To:
PROFESSIONAL PROJECTS
18115 TELGE RD
CYPRESS TX 77410

Ship To:
PROFESSIONAL PROJECTS
18115 TELGE RD
CYPRESS TX 77410

Ln	Order Qty	Ship Qty	B/O Qty	Part Description
1	1	1	0	**CYLINDER, 78 ID X 2-1/2 SA 516-70** **Unit of Measure: SQFT**

Code: 3W963 **HEAT/SLAB:** S22326 / 03B1 **GRADE:** SA516-70 **Size:** 2.5 X 144 X 261 **MILL:** JSW

3/28/17 PPI Q.C. F.W. HBZ-05

MILL TEST REPORTS ATTACHED

The chemical and physical properties as indicated on the attached report are the results of the Mill Tests of the raw material used in the manufacture of these products and are certified to meet only the minimum requirements of the ASME and/or ASTM specifications for the material.

1. Cylinder/Cone comply with tolerances of ASME Section VIII, Div 1, UG-80

WE HEREBY CERTIFY THAT THIS REPORT COVERING THE ABOVE AND ATTACHED INFORMATION IS TRUE AND CORRECT AS SHOWN AND CONTAINED IN OUR RECORDS.

Stephen Cable pp

Quality Control

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

L-1 SHELL RING

JSW Steel (USA) INC.
5200,East McKinney Road,
BAYTOWN, TX 77520

METALLURGICAL TEST REPORT

3W963

MET - 05
3/6/2017

Bulletin	Order Item	Heat	PO No.	Shipping Mode		Order Dimensions	Slab Origin	TC No.
T011559	JSW07400-01	S22326	35191A	TRUCK		2.5x144x261		T011559-2326-1

100% UT PER A435 / A435M

USE AS APPROVED

Plates Certified for the Following grades	Specifications	Marking Instructions
ASME-SA516-70 PN LCVNUT 2015 EDITION Hot Rolled Carbon Steel Plates Plates Manufactured In the USA	PLATE NORMALIZED AT 1650°F FOR 75 MINS.	Stencil in 2 location(s): X Loc. 18 Y Loc. 30; CUST; MADEINUSA PN PO; DIM GRADE; FREIGHT ORDERITEM PLATEID SHIPWEEK SLABID TRANSMODE Stamp in 2 location(s): X Loc. 18 Y Loc. 12; Slab ID; Slab ID; Slab ID

Sold To: UNI-FORM COMPONENTS CO. 16969 OLD BEAUMONT HWY 90 HOUSTON, TX 77049

Ship To: UNI-FORM COMPONENTS 10703 SHELDON RD HOUSTON, TX 77044

Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Nb	Ca	CE
LADLE	0.24	1.12	0.015	0.010	0.21	0.007	0.009	0.011	0.001	0.009	0.030	0.0058	0.001	0.0002	0.003	0.001	0.0021	0.43

Carbon Equivalent: CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15
PCM = C + Si/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + 5B

Plate	Slab Identity	Gauge Tested	Test Cond	Test Dir.	Yield Point	Tensile Stgth.	Elong in 2"	YS/UTS Ratio	Yield Strenght Determind At	Charpy Impact Test (LCVN) Full Energy in Ft/Lb °F								
										Temp	Test1	Test2	Test3	Avg	Test1	Test2	Test3	Avg
1028877A	03B1	2.5000	PN	T	45	78	31.0%	0.58	0.2%	-50	32	40	32	35				

Plates Certified For The Above Tests

Material	Thick(IN)	Width (IN)	Len(IN)	Wgt(LB)	Material	Thick(IN)	Width(IN)	Len (IN)	Wgt(LB)	Material	Thick(IN)	Width(IN)	Len(IN)	Wgt(LB)
1028877A	2.5000	144.000	261.00	26647										

3/28/17 PPI Q.C. HBZ-05 F.W.

DIN: EN 10204 2004 3.1 This is to certify that the product decribed herein was manufactured, sampled, and tested in accordance with the specifications and requirements in such specifications. Fine Grain, Si-Al Fully Killed Steel. We certify that delivery of this product with the requirement of the specification and purchase order received from customer.

Jackie Tamayo 281-383-5325 Jackie.Tamayo@jswsteel.us

L-1 SHELL RING

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

	CUSTOMER INDIVIDUAL ULTRASONIC OBSERVATION REPORT	Form # MS 15B Rev: 0 Date: 2/24/11 Pg 1 of 1

Order Item: JSW07400-01 PO:35191A Part No.

Customer Name:	UNI-FORM COMPON
Technique:	LONGITUDINAL
Equipment Make:	KRUATKRAMER
Equipment Number:	USN-58
Surface Condition:	125-RMS
Couplet Used:	WATER-COLUMN
Procedure Code:	PL-QA-009 Meets or exceeds the requirements of ASTM A-435 A-578 A, B, C
Acceptance Standard:	1"

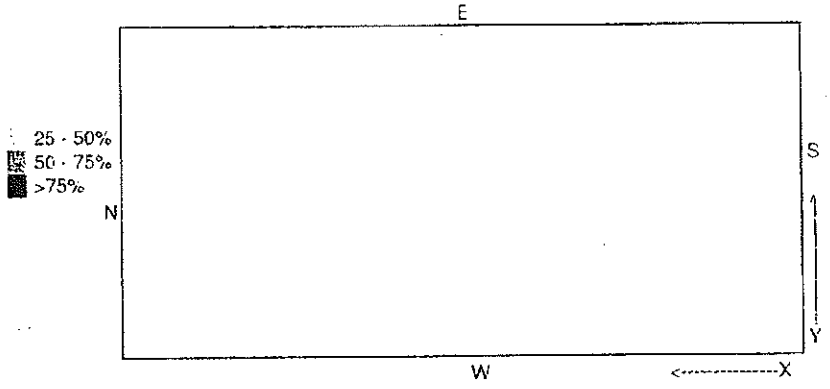
Inspection Report Number:	1028877A
Date:	2/22/2017
Probe Type:	TECHSONIC
Probe Frequency:	2.25MHZ
Probe Diameter:	1"
Type of Crystal:	SINGLE
Gains:	39-55

Gauge	2.5000
Heat	S22326
Material Grade(s)	
Grade(s) if applicable	

PL-QA-009
Meets or exceeds the requirements of
ASTM
A-435
A-578 A, B, C

Linearity / Horizontal Vertical
Deviation Performed Daily

Indicate the defect location on the sketch below



- Accept
- Reject
- Manual Hold

3/28/17 PPI Q.C. F.W. HBZ-05

Signature

Phillip Martin 2-22-17 3:12 am

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

L-1 SHELL RING

06/09/2017 From: AMERICAN ALLOY STEEL, INC. To: PROFESSIONAL PROJECTS INC
P.O.#: 5654-6 S.O.#: 573999 AA PL#: 5183481
Item: 1 (1 PC) 3/8" X 36" X 264"
TAG #5654

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

SKIRT RING

ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

US HWY 12 Burns Harbor, Indiana

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.	PAGE
804-00295	03-31-17	AMERICAN COMMERCIAL	1

SOLD TO
AMERICAN ALLOY STEEL INC
PO BOX 40469
HOUSTON TX 77240-0469

SHIP TO
AMERICAN ALLOY STEEL INC
C/O FREIGHT MANAGEMENT & LOGISTICS
INBESA TERMINAL-PORT OF HOUSTON
16335 PENINSULA BLVD
HOUSTON TX 77015

NOTE	SERIAL NUMBER	PAT NO.	HEAT NUMBER	NO. PCS.	SIZE AND QUANTITY: THICKNESS	WIDTH OR DIA.	LENGTH	WEIGHT	YIELD POINT	TENSILE STRENGTH	AF FRAC. ELONG.	RED.
					INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN	% %

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC, ASTM A516-06 GR 65 PVQ, ASME SA516 GR 70 PVQ 2015 EDITION, ASME SA516 GR 65 PVQ 2015 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL --- TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# 110777 GH 354-5455A

→ E549376	813W61910	4	.375	96	360	14700	51700	77800	8	23		
							51700	73500	8	24		
(M55)MFST REF#:2												
E549377	813W61910	4	.375	96	360	14700	54400	78500	8	24		
							52100	75100	8	26		
(M55)MFST REF#:2												

PPI
6/9/17 Q.C. HBZ-109
F.W.

Q-QUENCH TEMPERATURE T-TEMPER TEMPERATURE N-NORMALIZE TEMPERATURE

SERIAL NUMBER	PAT NO.	HEAT NUMBER	HARD SURF. BHN	BEND	THICKNESS INCHES	TYPE	SIZE	DIR	TEST TEMP °F	CHARPY IMPACT: ENERGY FT LBS 1	2	3	SHEAR(%) 1	2	3	LAT. EXP MILS 1	2	3

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
JK 5/4/2017

HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MOUAID GRAIN SIZE
813W61910	.18	1.10	.010	.006	.325	.020	.01	.13	.081	.001	.002	.034	.0002	.002	.005	.004	

AMERICAN ALLOY PLATE #5654-1

I certify that the above results are a true and correct copy of actual results contained in records maintained by ArcelorMittal Burns Harbor and are in full compliance with the requirements of the specification cited above. This test report cannot be altered and must be transmitted intact with any subsequent third party test reports, if required.

R. SPANGLER II PER LSS

BHPLTRPT.TIF

SUPV. QUALITY ASSURANCE

FCI FORGED COMPONENTS INC. 24/7

14527 Smith Rd.
Humble, Texas 77396
TEL: (281) 441-4088
FAX: (281) 441-8699

REPORT # 17-030307
DATE: 5/1/2017
FCI ORDER # 77823
I.A.W. ASME 2015 ED.

CUSTOMER ORDER # 1287649-JG
SOLD / SHIPPED TO: NORTH SHORE STEEL

Item	Quantity	Description
1	2	8" X 600 X 14" LG RF HB WITH NUT RELIEF

Heat Number: Z573
Material Type: SA350LF2CL1

CHEMICAL ANALYSIS

C	.160
Mn	1.190
P	.0100
S	.0020
Si	.220
Cr	.140
Mo	.030
V	.046
Cu	.240
Ni	.100
Cb(Nb)	.001
N	.0118
Sn	.011
As	.006
Sb	.001
Ti	.0022
Al	.029
B	.0001
C E	.424

PHYSICAL PROPERTIES

Yield PSI		51,500
Tensile PSI		78,100
Elongation		33.8
Reduction of Area		67.7
Hardness		163/163 HBW
CVN -50 °F	FT LBS	118/115/83
	% Shear	100/100/100
	MLE	.083/.075/.056

Heat Treatment	NORMALIZED
Temperature	1650 °F
Time at Temperature	1/2 HR/IN THK MIN
Cooling Media	AIR

4/11/17 PPI
Q.C.
F.W. XAN-83

We hereby certify that all test results and process information contained herein are correct and true as contained in the records of the company.

Prepared by: Erika Marquez

Name: Erika Marquez Title: QA Representative

A & B

Date printed: 5/1/2017 10:34:15 AM

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

FCI FORGED COMPONENTS INC. 24/7
14627 Smith Rd.
Humble, Texas 77396
TEL: (281) 441-4088
FAX: (281) 441-8899

PAGE: 1 of 1
REPORT # 17-030308
DATE: 5/1/2017
FCI ORDER # 77823
I.A.W. ASME 2015 ED.

CUSTOMER ORDER # 1287649-JG
SOLD / SHIPPED TO: NORTH SHORE STEEL

Item	Quantity	Description
2	1	4" X 600 X 12" LG RF HB WITH NUT RELIEF

Heat Number: W353
Material Type: SA350LF2CL1

CHEMICAL ANALYSIS

C	.180
Mn	1.100
P	.0080
S	.0030
Si	.200
Cr	.140
Mo	.010
V	.017
Cu	.200
Ni	.080
Cb(Nb)	.001
Sn	.011
As	.004
Sb	.001
Ti	.0020
Al	.020
B	.0001
C E	.415
Other	Ca=18ppm

PHYSICAL PROPERTIES

Yield PSI		47,900
Tensile PSI		74,000
Elongation		36.1
Reduction of Area		72.4
Hardness		156/156 HBW
CVN -50 °F	FT LBS	97/62/93
	% Shear	100/100/100
	MLE	.072/.052/.073

Heat Treatment	**NORMALIZED**
Temperature	1650 °F
Time at Temperature	1/2 HR/IN THK MIN
Cooling Media	AIR

4/11/17 PPI Q.C. F.W. XAN-84

We hereby certify that all test results and process information contained herein are correct and true as contained in the records of the company.

Prepared by: Erika Marquez

Name: Erika Marquez. Title: QA Representative

Page 1 of 1

Date printed: 5/1/2017 10:34:10 AM

Doc#: W511 Rev#:A Rev Date:11/3/11

UOP RUSSELL – P.O. # 4500754097 – S/O # 56541 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

voestalpine Tubulars GmbH & Co KG

Alpinestrasse 17
8662 Kindberg-Aumuehl
T. +43/3865/22 15-0
F. +43/3865/2215-532
www.vatubulars.com

Legal Structure: Limited Partnership
Location: Kindberg/Austria
Company Registry Number 165400k
Commercial Court of Leoben
DPR 0592684, VAT Nr. ATU 43630406

General Partner: voestalpine Tubulars GmbH
Legal Structure: Limited Liability Company
Location: Linz, Company Registry Number 106933f
Commercial Court of Linz

5546-21

MIP00010MTA$1/1

Material Test Report (MTR)

FSVAT4STBSL

INSPECTION - CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

No. 88776

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

Hersteller; Manufacturer: Producteur:	voestalpine Tubulars GmbH & Co KG, Austria
Besteller: Purchaser: Acheteur:	VOEST-ALPINE TUBULAR CORPORATION USA-77042 HOUSTON TEXAS INDUSTRIAL PIPING SPEC., TULSA OK 74158-1270
Pruefgegenstand: Object of tests: Eprouvette:	SEAMLESS STEEL TUBES, LINE PIPE
Werkstoff: Material: Matières:	GRADE B / GRADE X42/ GRADE C LP-USA-02
Anforderungen: Requirements: Exigence:	Gr B acc. ASTM A 106 / A 106 M - ASME SA 106-2011 Gr B acc. ASTM A 53 / A 53 M - ASME SA 53-2012 Gr B acc. API SPEC 5 L (PSL1)-2007 X42 acc. API SPEC 5 L (PSL1)-2007 NACE MR 0175 / ISO 15156-2009 NACE MR0103-2010 (latest edition) LINEPIPE-01.0
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE, BOTH ENDS BEVELLED ACC. TO API/ASTM
Wärmebehandlung: Heat treatment: Traitment de chaleur:	AS ROLLED
Coupl.die stamped:	
Coupl.paint stencilling:	
Colour coding:	Fully painted: Bands:
Tube die stamped:	
Tube paint stencilling:	heat va SPEC 5L-0033 "API" 04/13 API 5L B/API 5L X42 PSL1 A/SA 53 GRADE B S A/SA 106 GRADE B 4,500" x 0,237" SCHED 40 2660 PSI length ft heat no PO# MIP00010/() MADE IN AUSTRIA/().
Colour coding:	Fully painted: Bands: Purple
Label:	PO # MIP 00010, DAT POrt of Houston, TX
Remarks:	*) Grade C without marking on tubes

Auftrags-Nr.: 12977 / 7
Our works order No.:
No usine:

Bestellnr.: MIP00010/VATC
Your order No.: PO#302628

No de la commande:

Zeichen des Lieferwerks: va
Marking of producer:
Marque du fabricant:

Erschmelzungsart: BOF
Melting process: fully killed, produced to fine grain practice
Procédé d'élaboration:

AFC-140
PPI
Q.C.
F.W.
3/16/15

Kindberg, 26.04.2013

voestalpine Tubulars GmbH & Co KG
Qualitätswesen / Quality Department
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du contrôle

voestalpine
ONE STEP AHEAD.

voestalpine Tubulars GmbH & Co KG

Umfang der Lieferung / Volume of delivery / Contenu de la livraison:

Versandanzeige: Dispatch advice No. Avis d'expédition:	Pos.: Pos.:	Abmessung: Dimension: Dimension:	Bundnr.: Bundle No.: Nombre Fret:	Stückzahl: Number Of: Pièces:	Länge: Length: Longueur:	Gewicht: Weight: Poids:	Los: Lot: Lot:	Schmelze: Heat: Soufflage:
	7	4,500 in x 0,237 in 10,79 lbs/ft	1-38	666	15259,556 ft	74968,60 kg		

Volume of delivery

Heat	Lot		Remark
1013341444	172813	AD 01	
1013341445	172814	AD 01	
1013341771	172812	AD 01	
1013341794	172811	AD 01	

Test results

1 Visuelle Inspektion/ Visual inspection: o.B./satisfactory

2 Dimensionskontrolle/ Dimensional inspection: o.B./satisfactory

3 Wasserinnendruckversuch/Hydrostatic test: 2660 (duration min. 5 sec.) o.B./satisfactory

4 Ringfaltversuch/Flattening test:o.B./satisfactory

5 Streuflusspruefung gem. ASTM E 570 / Flux leakage testing acc. ASTM E 570 (N 12,5 longitudinal, type and size of reference indicator used):o.B./satisfactory

Test remarks

Wir bestätigen, dass die gelieferten Erzeugnisse den Anforderungen der Bestellung entsprechen.
We hereby certify that the goods delivered are in compliance with the requirements of the order.

AFC-140
PPI
Q.C.
F.W.
3/16/15

Kindberg, 26.04.2013

Page 2 of 5

No. 88776

voestalpine Tubulars GmbH & Co KG
Qualitätswesen / Quality Department
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du contrôle

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C PIPE NOZZLE

voestalpine Tubulars GmbH & Co KG

Tensile testing

Lot No	Test Type	Heat treatment	Temp	Specimen			Yield Strength	Tensile Strength	Elong.	Reduct. in area	RI/Rm
			[°C]	No.	Type	Dimension [mm]	[PSI]	[PSI]	[%]	[%]	
						Requ. from	42061	60190	23.50		
						Requ. to					
172811	AD 01 Standard	as rolled	20	1	Strip	25.39 x 6.30	Rt0.50 51198	73824	31.60		0.69
172812	AD 01 Standard	as rolled	20	1	Strip	25.13 x 6.18	Rt0.50 46847	71648	33.30		0.65
172813	AD 01 Standard	as rolled	20	1	Strip	25.31 x 6.29	Rt0.50 51198	71938	31.90		0.71
172814	AD 01 Standard	as rolled	20	1	Strip	25.17 x 6.40	Rt0.50 49022	72228	31.20		0.68

yield strength:
Gr B: 35500 PSI
X42: 42100 PSI
Gr C: 40000 PSI

tensile strength:
Gr B: 60200 PSI
X42: 60200 PSI
Gr C: 70000 PSI

Hardness testing

Lot No	Test Type	Heat treatment	Specimen No.	Location	Test Method	Hardness Number from	to	Mean Hardness Number from	to	Variation
					Requ.:				99.50	
172811	AD 01 Standard	as rolled	1	Body	HRB	80.50	81.50	80.67	81.33	0.67
172812	AD 01 Standard	as rolled	1	Body	HRB	78.90	80.50	79.60	80.30	0.70
172813	AD 01 Standard	as rolled	1	Body	HRB	80.00	80.90	80.30	80.43	0.13
172814	AD 01 Standard	as rolled	1	Body	HRB	79.80	80.90	80.10	80.50	0.40

AFC-140

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Q.C.
F.W.
3/6/15

Kindberg, 26.04.2013

No. 88776

voestalpine Tubulars GmbH & Co KG
Quality System / Quality Department
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du contrôle

voestalpine
ONE STEP AHEAD.

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

C PIPE NOZZLE

voestalpine Tubulars GmbH & Co KG

Chemical test results

Heat analysis

	C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
max	0.2300		1.0600	0.0300	0.0300	0.4000	0.4000	0.4000			0.1500	0.0800						0.4000
min	0.0000	0.1000	0.2900															
1013341444	0.1772	0.2625	0.9790	0.0168	0.0044	0.0384	0.0210	0.0197	0.0231	0.0019	0.0108	0.0015	0.0018	0.0000	0.0045	0.0368	0.0015	0.3532
1013341445	0.1670	0.2629	0.9713	0.0160	0.0033	0.0417	0.0183	0.0207	0.0255	0.0020	0.0051	0.0014	0.0020	0.0000	0.0048	0.0379	0.0021	0.3411
1013341771	0.1717	0.2578	0.9562	0.0165	0.0047	0.0470	0.0196	0.0157	0.0256	0.0018	0.0035	0.0016	0.0031	0.0001	0.0055	0.0353	0.0025	0.3438
1013341794	0.1730	0.2553	0.9629	0.0134	0.0057	0.0316	0.0178	0.0211	0.0324	0.0019	0.0036	0.0018	0.0028	0.0001	0.0064	0.0380	0.0021	0.3435

AFC-140 PPI Q.C. F.W. 3/6/15

Chemical test results

Product analysis

	C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
Lot No. 172811 AD 01 1 Standard Heat No. 1013341794	0.1778	0.2491	0.9613	0.0120	0.0067	0.0302	0.0189	0.0218	0.0303	0.0025	0.0034	0.0039	0.0024	0.0003	0.0000	0.0401	0.0000	0.3482
Lot No. 172811 AD 01 2 Standard Heat No. 1013341794	0.1760	0.2446	0.9541	0.0119	0.0071	0.0301	0.0189	0.0216	0.0297	0.0023	0.0036	0.0038	0.0020	0.0003	0.0000	0.0380	0.0000	0.3452
Lot No. 172812 AD 01 1 Standard Heat No. 1013341771	0.1689	0.2242	0.9400	0.0127	0.0040	0.0334	0.0224	0.0141	0.0207	0.0017	0.0034	0.0025	0.0011	0.0003	0.0000	0.0292	0.0000	0.3359
Lot No. 172812 AD 01 2 Standard Heat No. 1013341771	0.1683	0.2566	0.9448	0.0144	0.0041	0.0354	0.0217	0.0157	0.0242	0.0023	0.0041	0.0040	0.0022	0.0003	0.0000	0.0347	0.0000	0.3370
Lot No. 172813 AD 01 1 Standard Heat No. 1013341444	0.1777	0.2566	0.9527	0.0148	0.0045	0.0374	0.0195	0.0202	0.0232	0.0024	0.0058	0.0039	0.0016	0.0003	0.0000	0.0361	0.0000	0.3486
Lot No. 172813 AD 01 2 Standard Heat No. 1013341444	0.1777	0.2561	0.9601	0.0155	0.0039	0.0376	0.0199	0.0205	0.0224	0.0024	0.0058	0.0037	0.0015	0.0003	0.0000	0.0372	0.0000	0.3498

Klndberg, 26.04.2013

voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du controle

voestalpine
ONE STEP AHEAD.

No. 88776

C PIPE NOZZLE

voestalpine Tubulars GmbH & Co KG

Chemical test results

Product analysis

Lot No. 172814 AD 01 1 Standard Heat No. 1013341445

0.1758	0.2295	0.9018	0.0133	0.0034	0.0347	0.0198	0.0192	0.0202	0.0019	0.0051	0.0025	0.0008	0.0004	0.0000	0.0322	0.0000	0.3372

Lot No. 172814 AD 01 2 Standard Heat No. 1013341445

0.1744	0.2326	0.9137	0.0139	0.0035	0.0351	0.0199	0.0204	0.0206	0.0019	0.0051	0.0026	0.0009	0.0004	0.0000	0.0339	0.0000	0.3379

AFC-140

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Q.C.
F.W.
3/6/15

Kindberg, 26.04.2013

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No. 88776

voestalpine Tubulars GmbH & Co KG
Qualitätssicherung / Quality Department
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du contrôle

voestalpine
ONE STEP AHEAD.

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

C PIPE NOZZLE

vallourec

GQ-0001Y

N° de Cde Usine
Mill Ref / Works-Nr 1500241 004 / 1502911

N° Certificat
Certificate Nr / Zeugnis Nr 15-08823

Vallourec Fittings

B.P 10132 59602 MAUBEUGE FRANCE
Tél : 03.27.69.11.01
Raccords à Souder
Butt Welding Fittings
Schweissformstücke

Client :
Consignee
Bestoller

VALLOUREC USA CORPORATION
4424 West Sam Houston Parkway North
Suite 150
Etats Unis

INSPECTION CERTIFICATE
EN 10204 3.1

Cde Client N° : SAP 21005986 - PO 107477/000
Your Order Nr
Gestell-Nr

Spécifications :
Specifications :
Spezifikationen :

Acier et Normes
Steel and Standard
Werkstoff und Norm

WPB ASTM A234 (2014) ASTM A960 (2014)
ASME SA234 SII PART A (2013)
ASME B16-9 (2012) ASME B16-25 (2012)
NACE MR0175 / ISO 15156 (2009) NACE MR0103 (2012)

PED 97/23/EC Annex 1 par.4.3 + 7.6
Certificate No : 01 202 FIQ-02 0035
ASME SA 234 Section II - Part D - Table Y1 (2013)

Matière de départ
Raw Material / Werkstoff

Tubes sans soudure / Seamless Tube / Nahtlose Rohre
Acier procédé Oxygène / Oxygen Steel / Sauerstoff Stahl

VALLOUREC TUBES FRANCE - Saint Saulve
Acier calmé / Killed Steel / beruhigter Stahl

Etat de livraison
Delivery Condition / Lieferzustand

Formés à chaud entre / Hot formed between / Warmverformt / 780° C - 900 ° C

Marquage
Marking / Stempelung

Sur pièces en creux low stress
Low stress hard stamp
Kennzeichnung auf dem Fitting durch kerbfreie Einprägung

V° 4" STD WPB FRANCE LW14

Poste N° / Item Nr / Pos Nr	Nombre / Number / Stückzahl	N° Certificat Matière / Raw Material / Rohmaterial Nr	Code / Marking / Markierung	Coulée N° / Heat Nr / Schmelze	Dimensions / Sizes / Abmessungen
004	1000	5074Sv15	LW14	337131	90° LONG RADIUS ELBOW 4" STD

CARACTERISTIQUES CHIMIQUES - CHEMICAL ANALYSIS - SCHMELZENANALYSE

Sur Coulée / On pipe analysis

Coulée N° / Heat Nr / Schmelze		C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	Al	Sn	Ti	Nb	B
	mini		0,100	0,280												
	maxi	0,300		1,060	0,050	0,050	0,400	0,150	0,400	0,400	0,080				0,030	0,0005
337131		0,160	0,20	0,98	0,011	0,001	0,07	0,02	0,05	0,03	0,001		0,003	0,004	0,001	

Carbone équivalent / Carbon equivalent / Kohlenstoffäquivalent (Maxi : 0,41)

C_F : $C + \frac{Mn}{6} =$ 0,310

L_F : $C + \frac{Mn}{6} + \frac{Cr + V + Mo}{5} + \frac{Cu + Ni}{15} =$ 0,334

CARACTERISTIQUES MECANIQUES
MECHANICAL PROPERTIES - MECHANISCHE EIGENSCHAFTEN

Sur Matière de départ
from Raw Material
vom Vormaterial

Essais de Traction / Tensile Tests / Zugversuch (longitudinal direction)

Limite Elastique Yield Point / Streckgrenze	Résistance Rupture Tensile strength / Zugfestigkeit	Allongement Elongation / Dehnung	Dureté Hardness test on fittings Härte HBW
Re ≥ 240 MPa	415 ≤ Rm ≤ 570 MPa	2" A% ≥ 30	
321 MPa	460 MPa	2" 39,8 %	146 144 144

Résilience / Impact Test / Kerbschlagarbeit : Sur pièces / On fittings / am Fittings

Essai / Test / Versuch	Test 1	Test 2	Test 3	Moyenne : Unité / Mean : Units / Mittelwert : Einheit	Type : KV Specimen Muster	Température / Pas de résiliences

Date : 07/09/2015
LE RESPONSABLE QUALITE
P. LEFEBVRE

WE CERTIFY THAT THE DELIVERED PRODUCTS WERE MANUFACTURED, SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE SPECIFICATION OF THE ORDER.

4/11/17 PPI Q.C. XAN-85 F.W.

ISO 9001 / ISO 14001 / OHSAS 18001

Doc#: W511 Rev#:A Rev Date:11/3/11

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

C WELD ELL

CGP MFG, INC.
8363 MARKET STREET ROAD
HOUSTON, TX 77029
Phone: 713-641-5544
FAX: 713-641-5564

Material Test Report

SALES ORDER # : 111650

SOLD TO:
NORTHSHORE SUPPLY
P.O. BOX 9940
HOUSTON, TX 77213

SHIP TO:

CUST P.O.#: 1287649-JG1 TAG NUMBER: DATE SHIPPED:

ITEM #	QUANTITY	ITEM DESCRIPTION
1	4 EA	1 X 4 6M THD CPLET PER DWG SA350-2008A LF2 CL1

CHEMICAL ANALYSIS

ITEM #	HEAT CODE	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	C.Eqv
1	LRB4	.20	1.06	.011	.025	.23	.22	.09	.19	.06	.003	.000	.45

PHYSICAL PROPERTIES

ITEM #	TENSILE (PSI)	YIELD (PSI)	ELONG (2 IN)	REDUCTION OF AREA. %	HARDNESS		CHARPY V-NOTCH	
1	73700	48400	30.00	65.00	152 BHN	CVN@-50'F	74/50/39	FT LBS

ITEM #	SUPPLEMENTAL INFORMATION
1	NORMALIZED@1670'F/ 3.5HRS AIR COOL FORGED RD EN 10204-3.1B

4/11/17 PPI Q.C. XAN-86

WE CERTIFY THAT THE FITTINGS COVERED BY THIS REPORT WERE MANUFACTURED PER THE SPECIFICATIONS NOTED & THAT THE PHYSICAL & CHEMICAL PROPERTIES ARE THOSE REFLECTED IN THE RECORDS OF THE COMPANY. MERCURY FREE MFG IN THE USA

JORGE GARCIA, JR.- Q.A. MGR. 04/28/2017

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

D1, D2, F1 & F2

CGP MFG, INC.
8363 MARKET STREET ROAD
HOUSTON, TX 77029
Phone: 713-641-5544
FAX: 713-641-5564

Material Test Report

SALES ORDER #.: 111650

SOLD TO:
NORTHSHORE SUPPLY
P.O. BOX 9940
HOUSTON, TX 77213

SHIP TO:

CUST P.O.#: 1287649-JG1 | TAG NUMBER: | DATE SHIPPED:

ITEM #	QUANTITY	ITEM DESCRIPTION
2	6 EA	3/4 X 4 6M THD CPLET PER DWG SA350-2008A LF2 CL1

		CHEMICAL ANALYSIS											
ITEM #	HEAT CODE	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb	C.Eqv
2	LSJ4	.20	1.10	.009	.020	.21	.17	.07	.14	.04	.002	.001	.44

	PHYSICAL PROPERTIES						
ITEM #	TENSILE (PSI)	YIELD (PSI)	ELONG (2 IN)	REDUCTION OF AREA %	HARDNESS	CHARPY V-NOTCH	
2	77200	51900	30.00	59.00	157/152 BHN CVN@-50'F	98/106/110	FT LBS

ITEM #	SUPPLEMENTAL INFORMATION
2	NORMALIZED@1670'F/ 3.5HRS AIR COOL FORGED RD EN 10204-3.1B

4/11/17 PPI Q.C. F.W. XAN-87

WE CERTIFY THAT THE FITTINGS COVERED BY THIS REPORT WERE MANUFACTURED PER THE SPECIFICATIONS NOTED & THAT THE PHYSICAL & CHEMICAL PROPERTIES ARE THOSE REFLECTED IN THE RECORDS OF THE COMPANY. MERCURY FREE MFG IN THE USA

JORGE GARCIA, JR.- Q.A. MGR. 04/28/2017

Doc#: W511 Rev#:A Rev Date:11/3/11

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

E, G1, G2, G3, G4 & J

FCI FORGED COMPONENTS INC. 24/7

14527 Smith Rd.
Humble, Texas 77396
TEL: (281) 441-4088
FAX: (281) 441-8899

REPORT # 17-030309
DATE: 5/1/2017
FCI ORDER # 77823
I.A.W. ASME 2015 ED.

CUSTOMER ORDER # 1287649-JG
SOLD / SHIPPED TO: NORTH SHORE STEEL

Item	Quantity	Description
3	1	18" X 600 X 18" LG RF HB WITH NUT RELIEF

Heat Number: Z580
Material Type: SA350LF2CL1

CHEMICAL ANALYSIS

C	.168
Mn	1.180
P	.0050
S	.0030
Si	.220
Cr	.110
Mo	.020
V	.050
Cu	.110
Ni	.070
Cb(Nb)	.001
N	.0102
Sn	.006
As	.004
Sb	.001
Ti	.0024
Al	.027
B	.0004
C E	.413

PHYSICAL PROPERTIES

Yield PSI		54,000
Tensile PSI		79,200
Elongation		33.9
Reduction of Area		73.1
Hardness		154/156 HBW
CVN -50 °F	FT LBS	98/102/92
	% Shear	100/100/100
	MLE	.065/.076/.061

Heat Treatment	**NORMALIZED**
Temperature	1650 °F
Time at Temperature	1/2 HR/IN THK MIN
Cooling Media	AIR

4/11/17 PPI Q.C. F.W. XAN-88

We hereby certify that all test results and process information contained herein are correct and true as contained in the records of the company.

Prepared by: Erika Marquez

Name: Erika Marquez Title: QA Representative

Date printed: 5/1/2017 10:34:04 AM

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

FERWHY 18STD

검 사 증 명 서(A)

MILL INSPECTION CERTIFICATE

EN10204 TYPE 3.1 -1991

성적서 번호 CERTIFICATE NO. : 1C00861
방행일자 DATE OF ISSUE. : 2011-12-12
계약번호 CONTRACT(P/O) NO. : HR034288
품명 COMMODITY : H.F.W.
재등규격 SPECIFICATION : API 5L X42 PSL1/API 5LB PSL1/ASTM A53B/ASME SA53B

페이지 PAGE 1 of 1

200064747

고 객 사 CUSTOMER : HYUNDAI HYSCO USA, INC

HYUNDAI HYSCO 현대하이스코주식회사 HYUNDAI HYSCO

본사·공장 (ULSAN PLANT) : 울산광역시 북구 염포동 265번지 683-040
#265 YUMPO-DONG, BUK-KU, ULSAN,KOREA
TEL:82-52-280-014, FAX:82-52-287-8916

서울사무소 (SEOUL OFFICE) 서울시 서초구 잠원동 28-6번지 137-904
28-6, JAMWON-DONG,
SEOCHO-KU, SEOUL 137-904, KOREA
TEL:82-2-2112-9114, FAX:82-2-775-7095

관종 TYPE OF PIPE END	꼬수 DIMENSION 외경 : 두께 × 길이 (OUTDIA × THICK : LENGTH)		수량 QUAN-TITY	중량 WEIGHT	수압시험 HYDRO-STATIC TEST		제강번호 HEAT NO.	인장시험 TENSILE TEST (Gage Length : 2 INCH)				화학성분(%) CHEMICAL COMPOSITION															경도 HARD-NESS	충격시험 IMPACT TEST (℃)		도막시험 COATING TEST		비고 REM-ARK
								항복강도 YIELD STRENGTH	인장강도 TENSILE STRENGTH		연신율																				
									ㅁ7 B	ㅁ7 W																				
ㄱ1	ㄱ2	ㄷ3 ㄹ4	(PCS)	(KG)	PSI	ㅁ5		ㅁ6	Mpa/PSI		%	ㄱ8	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Ti	Nb	B	Al	CEQ ㅁ9	HV	JOULE	%	g/㎡	TI-MES	ㄱ5	
													×100			×1000		×100							×10000	×1000							
EB BE	NB	18" X 0.375" X 42.000"	2	2,685	1490	5	M33891	T	390	518	548	40		6	2	79	11	6	2	1	1	1	TR	TR	TR							
									56500	75100	79500																				
		TOTAL —	2	2,685																												

ㅁ10 HEAT TREATMENT	ㄱ11 VISUAL & DIMENSION TEST	ㅁ12 FLATTENING, BEND, GUIDED BEND TEST	ㅁ13 R-FLATTENING TEST	ㄱ14 FLARING TEST	ㅁ15 NONDESTRUCTIVE TEST (U.T)	ㄴ16 R.M.T	ㅁ17 CRUSH TEST	ㄱ18 DRIFT TEST	ㄱ19 FLANGE TEST
GOOD	GOOD	GOOD			GOOD	GOOD			

NOTE 1 : ㄱ1 Type of pipe End 관종

EB:ERW Black End	RB:SAW Black	TC:Thread Coupling
EA:ERW Annealing	RG:SAW Galvanizing	RG:Roll Grooving
EG:ERW Galvanizing	RS:SAW Spiral	VG:Victaulic Grooving
EC:ERW Black Thread	PE:Plain End	PC:Plain End + Coupled
ED:ERW Galvanizing Thread	BE:Bevel End	PB:Plain End + Bevel End
EN:ERW Galvanizing Scaffolding	TE:Thread End	BD:Ball End

ㄷ2 NB:Norminal Bore 호칭경, OD:Outside Diameter
ㅁ3 Unit 단위(M:mm, I:Inch)
ㅁ4 Unit 단위(M:Meter, F:Feet, I:Inch)
ㅁ5 Holding Time 유지시간 Sec 초
ㄱ7 B:Base Metal 모재부, W:Weld Part 용접부
ㅁ8 H:Heat(Ladle) Analysis 업인분석, P:Product Analysis 제품분석, WP:Weld Product Analysis 용접부 제품분석
ㅁ9 CEQ=C+Mn/6+(Ni+Cu)/15+(Cr+Mo+V)/5 등가탄소량
ㄱ10:Heat Treatment 열처리
ㄴ11 Visual & Dimension Test 육안 및 치수검사
ㄱ12 Flattening/Bend/Guided Bend Test 편평/밴드/굽힘시험
ㅁ13:Reverse Flattening Test 편개시험
ㄱ14 Flaring Test 확관시험
ㄱ15 Nondestructive Test 비파괴검사
ㄱ16:Residual Magnetism Test 잔류자장시험 ㅁ17:Crush Test 충만시험
ㄴ18:Drift Test 관통시험
ㅁ19:Flange Test 플랜지시험

NOTE 2 : SPEC YEAR – API 2000/ASTM 2007/ASME 2007

본 제품은 관련 규격에 합격되었음을 보증합니다.
WE HEREBY CERTIFY THAT MATERIAL DESCRIBED HEREIN HAS BEEN ACCEPTED IN ACCORDANCE WITH THE PRESCRIBED SPECIFICATION AND ORDER
- 본 검사증명서에 명기된 규격요목의 사용시 만전상 문제가 발생할 수 있으며, 검사증명서 위·변조시 사문서 위조로 법이익을 당하실 수 있습니다.

H.K. CHOI

SURVEYOR

INSPECTION MANAGER

HYS - B301 - 631 - 1 - QLT

HYUNDAI HYSCO

A4(210×297)

12/8/16 PPI Q.C. AFI-59 F.W.

SKIRT ACCESS

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

| 5640-8 | | M33891] | [LN: 3] | H0129383-1 | FERWHY18STD |

[5550-8 | s/o 5550-1 | | 1013347382] | [LN: 1] | H0101485-1 | FSVAT1.5STD |

5550-8

voestalpine Tubulars GmbH & Co KG

Alpinestrasse 17
8652 Kindberg-Aumuahl
T. +43/3865/22 15-0
F. +43/3865/2215-532
www.vatubulars.com

Legal Structure: Limited Partnership
Location: Kindberg/Austria
Company Registry Number 165400k
Commercial Court of Leoben
DPR 0592684, VAT Nr. ATU 43630406

General Partner: voestalpine Tubulars GmbH
Legal Structure: Limited Liability Company
Location: Linz, Company Registry Number 106933f
Commercial Court of Linz

HR046587MTA$1/1

Material Test Report (MTR)

FSVAT1.5STD

INSPECTION - CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

No. 92433

(gem. EN 10204)

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

Hersteller: Manufacturer: Producteur:	voestalpine Tubulars GmbH & Co KG, Austria	Auftrags-Nr.: Our works order No.: No usine:	14227 / 2
Besteller: Purchaser: Acheteur:	VOEST-ALPINE TUBULAR CORPORATION USA-77042 HOUSTON TEXAS INDUSTRIAL PIPING SPEC. INC., TULSA OK 74158-1270	Bestellnr.: Your order No.: No de la commande:	HR046587/VATC PO#307610
Pruefgegenstand: Object of tests: Eprouvette:	SEAMLESS STEEL TUBES, LINE PIPE	Zeichen des Lieferwerks: Marking of producer: Marque du fabricant:	va
Werkstoff: Material: Matières:	GRADE B / GRADE C LP-USA-01	Erschmelzungsart: Melting process: Procédé d'élaboration:	BOF fully killed, produced to fine grain practice
Anforderungen: Requirements: Exigence:	ASTM A 53 A 53 / A 53 M -ASME SA 53-2012 ASTM A106 / A 106 M - ASME SA 106-2011 (ASME Sec II Part A 1.Juli 2010) API 5 L, PSL 1 -2007 and NACE MR 0175 / ISO 15156-2009 NACE MR0103-2010 (latest edition) LINEPIPE-01.0		
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE,		
Wärmebehandlung: Heat treatment: Traitment de chaleur:	AS ROLLED		
Coupl.die stamped:			
Coupl.paint stencilling:			
Colour coding:	Fully painted: Bands:		
Tube die stamped:			
Tube paint stencilling:	va SPEC 5L-0033 "API" 09.2013 1.900" 0.145" B PSL1 SMLS TESTED 2500PSI length ft heat no A/SA 53 GRADE B S A/SA 106 GRADE B SCHED.40 PO No.: HR046587 Made in Austria		
Colour coding:	Fully painted: Bands: purple		
Label:	PO No.: HR046587 DAT Port of Houston, TX		
Remarks:	*) Grade C without marking on tubes		

5/12/15 PPI Q.C. F.W. AFB-37

Kindberg, 30.09.2013

voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
SCHNEDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du contrôle

voestalpine
ONE STEP AHEAD.

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

SKIRT VENT

voestalpine Tubulars GmbH & Co KG

5550-8

Umfang der Lieferung / Volume of delivery / Contenu de la livraison:

Versandanzeige: Dispatch advice No. Avis d'expédition:	Pos.: Pos.:	Abmessung: Dimension: Dimension:	Bundnr.: Bundle No.: Nombre Fret:	Stückzahl: Number Of: Pièces:	Länge: Length: Longueur:	Gewicht: Weight: Poids:	Los: Lot: Lot:	Schmelze: Heat: Soufflage:
	2	1,900 In x 0,145 In 2,72 lbs/ft	1-8	900	21 112.205ft	26 140.00kg		

Volume of delivery

Heat	Lot		Remark
1013347382	177538	-- 01	
1013347381	177537	-- 01	

Test results

1 Biegeversuch/Bend test: o.B./satisfactory

2 Dimensionskontrolle/ Dimensional inspection: o.B./satisfactory

3 Streuflusspruefung gem. ASTM E 570 / Flux leakage testing acc. ASTM E 570 (N 12,5 longitudinal, type and size of reference indicator used):o.B./satisfactory

4 Visuelle Inspektion/ Visual inspection: o.B./satisfactory

5 Wasserinnendruckversuch/Hydrostatic test: 2500 PSI (duration min 5.sec) o.B./satisfactory

Test remarks

5/12/15 PPI Q.C. F.W. AFB-37

Wir bestätigen, dass die gelieferten Erzeugnisse den Anforderungen der Bestellung entsprechen.
We hereby certify that the goods delivered are in compliance with the requirements of the order.

Kindberg, 30.09.2013

voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
SCHWEDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du contrôle

voestalpine
ONE STEP AHEAD.

No. 92433

SKIRT VENT

[5550-8 | s/o 5550-1 | | 1013347382] | [LN: 1] | H0101485-1 | FSVAT1.5STD |

voestalpine Tubulars GmbH & Co KG

5550-8

Tensile testing

Lot No		Test Type	Heat treatment	Temp	Specimen			Yield Strength	Tensile Strength	Elong.	Reduct. in area	Rt/Rm
				[°C]	No.	Type	Dimension [mm]	[PSI]	[PSI]	[%]	[%]	
								Requ. from 35 534	60 190	20.00		
								Requ. to				
177537	AD 01	Standard	as rolled	20	1	Strip	18.84 x 3.62	R10.50	67 877	85 427	32.00	0.79
177537	AD 01	Standard	as rolled	20	2	Strip	18.81 x 3.82	R10.50	63 671	80 786	29.40	0.79
177538	AD 01	Standard	as rolled	20	1	Strip	18.83 x 3.70	R10.50	65 557	84 121	30.90	0.78

yield strength:
Grade B : 35500 PSI
Grade C: 40000 PSI

tensile strength:
Grade B: 60200 PSI
Grade C: 70000 PSI

Hardness testing

Lot No		Test Type	Heat treatment	Specimen No.	Location	Test Method	Hardness Number from	to	Mean Hardness Number from	to	Variation
							Requ.:			99.50	
177537	AD 01	Standard	as rolled	1	Body	HRB	85.10	86.20	85.27	86.03	0.77
177538	AD 01	Standard	as rolled	1	Body	HRB	86.70	88.20	87.07	87.60	0.53

5/12/15 PPI Q.C. F.W. AFB-37

Kindberg, 30.09.2013

Page 3 of 4

No. 92433

voestalpine Tubulars GmbH & Co KG
Qualitätssicherung / Quality Department
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du contrôle

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ONE STEP AHEAD.

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

SKIRT VENT

[5550-8 | s/o 5550-1 | | 1013347382] | [LN: 1] | H0101485-1 | FSVAT1.5STD |

voestalpine Tubulars GmbH & Co KG

5550-8

Chemical test results

Heat analysis

C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
max																	
0.2300		1.0600	0.0300	0.0300	0.4000	0.4000	0.4000			0.1500	0.0800						0.4000
min																	
0.0000	0.1000	0.2900															
1013347381																	
0.1736	0.2608	0.9482	0.0141	0.0062	0.0664	0.0198	0.0191	0.0272	0.0018	0.0068	0.0016	0.0009	0.0002	0.0077	0.0447	0.0016	0.3492
1013347382																	
0.1765	0.2696	0.9653	0.0151	0.0076	0.0324	0.0197	0.0160	0.0344	0.0017	0.0147	0.0013	0.0006	0.0001	0.0048	0.0448	0.0016	0.3514

5/12/15 PPI Q.C. AFB-37 F.W.

Chemical test results

Product analysis

C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
Lot No. 177537 AD 01 1 Standard Heat No. 1013347381																	
0.1800	0.2503	0.9505	0.0149	0.0067	0.0649	0.0205	0.0181	0.0218	0.0020	0.0072	0.0040	0.0017	0.0005	0.0000	0.0401	0.0000	0.3562
Lot No. 177537 AD 01 2 Standard Heat No. 1013347381																	
0.1848	0.2513	0.9529	0.0148	0.0076	0.0649	0.0205	0.0183	0.0216	0.0021	0.0075	0.0040	0.0018	0.0005	0.0000	0.0410	0.0000	0.3615
Lot No. 177537 AD 01 3 Standard Heat No. 1013347381																	
0.1808	0.2624	0.9648	0.0149	0.0076	0.0653	0.0198	0.0190	0.0234	0.0023	0.0075	0.0045	0.0023	0.0005	0.0000	0.0432	0.0000	0.3596
Lot No. 177537 AD 01 4 Standard Heat No. 1013347381																	
0.1784	0.2586	0.9616	0.0146	0.0067	0.0649	0.0197	0.0190	0.0236	0.0022	0.0073	0.0044	0.0022	0.0005	0.0000	0.0413	0.0000	0.3566
Lot No. 177538 AD 01 1 Standard Heat No. 1013347382																	
0.1880	0.2735	0.9744	0.0153	0.0079	0.0349	0.0200	0.0171	0.0307	0.0023	0.0163	0.0045	0.0014	0.0005	0.0000	0.0438	0.0000	0.3640
Lot No. 177538 AD 01 2 Standard Heat No. 1013347382																	
0.1824	0.2672	0.9633	0.0149	0.0089	0.0342	0.0196	0.0165	0.0301	0.0022	0.0161	0.0043	0.0013	0.0004	0.0000	0.0418	0.0000	0.3563

Kindberg, 30.09.2013

Page 4 of 4

No. 92433

voestalpine Tubulars GmbH & Co KG
Qualitätssicherung / Quality Department
SCHNEDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du contrôle

voestalpine
ONE STEP AHEAD.

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

SKIRT VENT

[| 5640-8 | | | 1016386730] | [LN: 1] | H0129383-1 | FSVAT1XH |

voestalpine Tubulars GmbH & Co KG

Alpinestrasse 17
8652 Kindberg-Aumuehl
T. +43/3865/22 15-0
F. +43/3865/2215-532
www.vatubulars.com

Legal Structure: Limited Partnership
Location: Kindberg/Austria
Company Registry Number 165400k
Commercial Court of Leoben
DPR 0592684, VAT Nr. ATU 43630406

General Partner: voestalpine Tubulars GmbH
Legal Structure: Limited Liability Company
Location: Linz, Company Registry Number 109933f
Commercial Court of Linz

FSVAT1XH

MILL TEST CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

No. 122697 Rev. 0

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

Hersteller: Manufacturer: Producteur:	voestalpine Tubulars GmbH & Co KG, Austria
Besteller: Purchaser: Acheteur:	VOEST-ALPINE TUBULAR CORPORATION USA-77077 HOUSTON, TEXAS INDUSTRIAL PIPING SPECIALISTS, INC. TULSA OK 74158-1270, US
Pruefgegenstand: Object of tests: Eprouvette:	Line Pipe LP-USA-01 LINEPIPE-01.0 non upset ends (API 5 D + 5 L) - non upset UV coating
Werkstoff: Material: Matières:	GRADE B
Anforderungen: Requirements: Exigence:	Grade B acc. to ASTM A 53 / A 53M-2012 ASME SA 53-2015 Grade B acc. to ASTM A 106 / A 106M-2015, ASME SA 106-2015 Grade B acc. to API 5 L, 45.edt.-2012 (PSL1) NACE MR 0175 / ISO 15156-2015 NACE MR 0103-2015 LINEPIPE-01.0; LP-USA-01
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE,
Wärmebehandlung: Heat treatment: Traitment de chaleur:	AS ROLLED
Coupl.die stamped: Coupl.paint stencilling:	
Colour coding:	Fully painted: Bands:
Tube die stamped:	
Tube paint stencilling:	va SPEC 5L-0033 "API" 07.2016 1.315" 0.179" B PSL1 SMLS TESTED 2500 PSI Length ft Heat No. A/SA 53 GRADE B S A/SA 106 GRADE B SCHED.80 PO No.: HR068855 Made in Austria
Colour coding:	Fully painted: Bands: purple
Label:	PO No.: HR068855; DAT Port of Houston TX
Remarks:	*) SI units have been converted to US customary units

Auftrags-Nr.: 21600 / 1
Our works order No.:
No usine:

Bestellnr.: HR068855/VATC PO#
Your order No.: 605620

No de la commande:

Zeichen des Lieferwerks: va
Marking of producer:
Marque du fabricant:

Erschmelzungsart: BOF
Melting process: fully killed, produced to fine grain practice
Procédé d'élaboration:

12/8/16 PPI Q.C. F.W. AFI-61

Kindberg, 28.09.2016

voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
WEITZER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du controle

voestalpine
ONE STEP AHEAD.

No. 122697

Abnahmeprüfzeugnis wurde digital signiert und ist ohne Originalunterschrift gültig/
Inspection certificate has been signed digitally and is valid without an original signature

voestalpine Tubulars GmbH & Co KG

Umfang der Lieferung / Volume of delivery / Contenu de la livraison:

Versandanzeige: Dispatch advice No. Avis d'expédition:	Pos.: Pos.:	Abmessung: Dimension: Dimension:	Bundnr.: Bundle No.: Nombre Fret:	Stückzahl: Number Of: Pièces:	Länge: Length: Longueur:	Gewicht: Weight: Poids:	Los: Lot: Lot:	Schmelze: Heat Soufflage:
	1	1,315 in x 0,179 in; 2,17 lbs/ft SCHED.80	1-8	1028	23 469,488ft	23 077,50kg		

Volume of delivery

Heat	Lot		Remark
1016486321	208585	AD 01	
1016386730	209495	AD 01	

Test results

1 Biegeversuch/Bend test: bestanden/passed

2 Dimensionskontrolle/ Dimensional Inspection: bestanden/passed

3 Streuflusspruefung gem. ASTM E 570 / Flux leakage testing acc. ASTM E 570 (N 12,5 longitudinal, type and size of reference indicator used): bestanden/passed

4 Visuelle Inspektion/ Visual Inspection: bestanden/passed

5 Wasserinnendruckversuch/Hydrostatic test: bestanden/passed, Mindestpruefdruck/min test pressure: 2500 PSI, min.Haltezeit/min duration: 5 sec

Test remarks

Wir bestätigen, dass die gelieferten Erzeugnisse den Anforderungen der Bestellung entsprechen.
We hereby certify that the goods delivered are in compliance with the requirements of the order.

12/8/16 PPI Q.C. F,W, AFI-61

Kindberg, 28.09.2016

No. 122697

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voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
WEITZER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du controle

voestalpine
ONE STEP AHEAD.

[| 5640-8 | | | 1016386730] | [LN: 1] | H0129383-1 | FSVAT1XH |

voestalpine Tubulars GmbH & Co KG

ensile testing

Lot No	Test Type	Heat treatment	Loc.	Temp [°F]	No.	Type	Specimen Dimension[inch]	Yield Strength [PSI]	Tensile Strength [PSI]	Elong. [%]	Gage length [inch]	Reduct. in area [%]	Rt/Rm
							Requ. from	35 534	60 190	30.00			
							Requ. to						
208585	AD01	Standard	as rolled	Rear	20	1	Full Sectior 33.73 x 4.41	Rt0.50 44 381	67 152	45.60	2		0.66
208585	AD01	Standard	as rolled	Rear	20	2	Full Sectior 33.72 x 4.61	Rt0.50 42 641	64 686	42.10	2		0.66
208585	AD01	Standard	as rolled	Rear	20	3	Full Sectior 33.70 x 4.70	Rt0.50 43 801	64 106	47.10	2		0.68
209495	AD01	Standard	as rolled	Rear	20	1	Full Sectior 33.40 x 4.55	Rt0.50 46 847	67 732	45.40	2		0.69
209495	AD01	Standard	as rolled	Rear	20	2	Full Sectior 33.40 x 4.55	Rt0.50 46 122	67 442	44.10	2		0.68

Hardness testing

Lot No	Test Type	Heat treatment	Specimen Loc.	No.	Location	Test Method	Hardness Number from	to	Mean Hardness Number from	to	Variation
						Requ.:				99.50	
208585	AD01	Standard	as rolled	Rear	1	Body HRB	76.50	77.20	76.80	77.00	0.20
Quadrant	1_Outer	2_Outer	3_Outer	AVG_Outer	1_Mid	2_Mid	3_Mid	AVG_Mid	1_Inner	2_Inner	3_Inner	AVG_Inner	AVG_Variation
1	76.80	77.20	76.90	76.97	76.90	76.50	77.00	76.80	77.00	76.80	77.20	77.00	0.20
209495	AD01	Standard	as rolled	Rear	1	Body HRB	77.50	78.90	77.80	78.37	0.57
Quadrant	1_Outer	2_Outer	3_Outer	AVG_Outer	1_Mid	2_Mid	3_Mid	AVG_Mid	1_Inner	2_Inner	3_Inner	AVG_Inner	AVG_Variation
1	77.90	78.00	77.50	77.80	78.30	78.90	77.90	78.37	78.50	78.40	77.80	78.23	0.67

PPI
Q.C.
F,W,

12/8/16

AFI-61

Kindberg, 28.09.2016

No. 122697

Abnahmeprüfzeugnis wurde digital signiert und ist ohne Originalunterschrift gültig/
Inspection certificate has been signed digitally and is valid without an original signature

voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
WEITZER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du controle

voestalpine
ONE STEP AHEAD

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

INLET DIV. PIPE

[| 5640-8 | | | 1016386730] | [LN: 1] | H0129383-1 | FSVAT1XH |

voestalpine Tubulars GmbH & Co KG

Chemical test results

Heat analysis

	C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
min. Requ.	0.0000	0.1000	0.2900															
max. Requ.	0.2300		1.0600	0.0300	0.0300	0.4000	0.4000	0.4000			0.1500	0.0800						0.4000
1016386730	0.1451	0.2149	0.7135	0.0096	0.0056	0.0162	0.0148	0.0153	0.0313	0.0011	0.0016	0.0013	0.0004	0.0001	0.0055	0.0000	0.0024	0.2698
1016486321	0.1487	0.1993	0.6943	0.0127	0.0070	0.0143	0.0170	0.0164	0.0232	0.0014	0.0028	0.0010	0.0005	0.0002	0.0046	0.0000	0.0016	0.2703

Chemical test results

Product analysis

	C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
Lot No. 208585 AD 01 1 Standard Heat No. 1016486321	0.1707	0.1979	0.6803	0.0138	0.0084	0.0153	0.0190	0.0193	0.0192	0.0020	0.0026	0.0030	0.0015	0.0002	0.0050	0.0009	0.0000	0.2909
Lot No. 208585 AD 01 2 Standard Heat No. 1016486321	0.1625	0.1970	0.6798	0.0134	0.0087	0.0153	0.0191	0.0195	0.0190	0.0020	0.0030	0.0029	0.0014	0.0002	0.0047	0.0010	0.0000	0.2826
Lot No. 208585 AD 01 3 Standard Heat No. 1016486321	0.1574	0.1995	0.6852	0.0136	0.0096	0.0155	0.0191	0.0201	0.0195	0.0021	0.0032	0.0031	0.0017	0.0002	0.0045	0.0013	0.0000	0.2786
Lot No. 208585 AD 01 4 Standard Heat No. 1016486321	0.1773	0.2008	0.6892	0.0138	0.0086	0.0155	0.0191	0.0201	0.0193	0.0022	0.0031	0.0031	0.0017	0.0002	0.0076	0.0012	0.0000	0.2991
Lot No. 208585 AD 01 5 Standard Heat No. 1016486321	0.1619	0.1983	0.6804	0.0131	0.0074	0.0154	0.0190	0.0201	0.0193	0.0020	0.0031	0.0031	0.0014	0.0002	0.0052	0.0013	0.0000	0.2722
Lot No. 208585 AD 01 6 Standard Heat No. 1016486321	0.1566	0.1973	0.6831	0.0136	0.0093	0.0153	0.0190	0.0194	0.0189	0.0019	0.0030	0.0029	0.0015	0.0002	0.0047	0.0011	0.0000	0.2773
Lot No. 209495 AD 01 1 Standard Heat No. 1016386730	0.1661	0.2184	0.6942	0.0094	0.0063	0.0182	0.0165	0.0175	0.0270	0.0019	0.0028	0.0037	0.0015	0.0002	0.0099	0.0010	0.0000	0.2890
Lot No. 209495 AD 01 2 Standard Heat No. 1016386730	0.1537	0.2210	0.7016	0.0110	0.0068	0.0185	0.0168	0.0187	0.0269	0.0019	0.0031	0.0038	0.0019	0.0002	0.0080	0.0012	0.0000	0.2781
Lot No. 209495 AD 01 3 Standard Heat No. 1016386730	0.1539	0.2188	0.7021	0.0103	0.0063	0.0184	0.0167	0.0182	0.0269	0.0019	0.0029	0.0038	0.0019	0.0002	0.0077	0.0012	0.0000	0.2783
Lot No. 209495 AD 01 4 Standard Heat No. 1016386730	0.1509	0.2181	0.7014	0.0106	0.0066	0.0185	0.0168	0.0186	0.0265	0.0018	0.0031	0.0037	0.0019	0.0002	0.0076	0.0012	0.0000	0.2752

12/8/16 PPI Q.C. F,W, AFI-61

Kindberg, 28.09.2016

No. 122697

Abnahmeprüfzeugnis wurde digital signiert und ist ohne Originalunterschrift gültig/
Inspection certificate has been signed digitally and is valid without an original signature

voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
WEITZER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du controle

voestalpine
ONE STEP AHEAD.

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

INLET DIV. PIPE

NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800-827-8872

AAA FLAME CUT STEEL, INC.
THK 1/4" GR: A-36 MOD
HT & SL A3R1772-03
PLATE # 2308

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
B032740	00000000503272	N-121202-004	11719 4		L419952-1	05/23/2013 19:40

Grade

Order Description:
A36, 0.2500 IN x 96.000 IN x 240.000 IN YAK-21 PPI
Quality Plan Description: Q.C.
A36MODMN20C: ASTM A36-05/A36M/ASME SA36-00 MOD MN .20 MAX C F.W.

Customer:
12/8/16

Shipped Item	Heat/Slab Number	Certified By	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Cb	V	Al	Ti	N2	B	Ca	Sn	CEV
3E2079C	A3R1772-01 ***	A3R1772	0.18	0.85	0.011	0.003	0.05	0.26	0.08	0.07	0.026	0.000	0.001	0.033	0.001	0.007	0.0001	0.0018	0.009	0.37
3E2079D	A3R1772-01 ***	A3R1772	0.18	0.85	0.011	0.003	0.05	0.26	0.08	0.07	0.026	0.000	0.001	0.033	0.001	0.007	0.0001	0.0018	0.009	0.37
3E2081C	A3R1772-03 ***	A3R1772	0.18	0.85	0.011	0.003	0.05	0.26	0.08	0.07	0.026	0.000	0.001	0.033	0.001	0.007	0.0001	0.0018	0.009	0.37
3E2081D	A3R1772-03 ***	A3R1772	0.18	0.85	0.011	0.003	0.05	0.26	0.08	0.07	0.026	0.000	0.001	0.033	0.001	0.007	0.0001	0.0018	0.009	0.37
3E2083C	B3R6682-01 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2083D	B3R6682-01 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2085C	B3R6682-03 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2085D	B3R6682-03 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2086C	B3R6682-02 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2086D	B3R6682-02 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2087C	B3R6682-04 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2087D	B3R6682-04 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2088C	B3R6682-05 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2088D	B3R6682-05 ***	B3R6682	0.19	0.87	0.012	0.005	0.04	0.25	0.07	0.07	0.020	0.000	0.002	0.036	0.001	0.006	0.0000	0.0022	0.008	0.37
3E2089C	A3R1773-02 ***	A3R1773	0.19	0.84	0.014	0.005	0.06	0.26	0.08	0.08	0.025	0.000	0.001	0.037	0.001	0.008	0.0001	0.0018	0.008	0.37
3E2089D	A3R1773-02 ***	A3R1773	0.19	0.84	0.014	0.005	0.06	0.26	0.08	0.08	0.025	0.000	0.001	0.037	0.001	0.008	0.0001	0.0018	0.008	0.37
3E2090C	A3R1773-01 ***	A3R1773	0.19	0.84	0.014	0.005	0.06	0.26	0.08	0.08	0.025	0.000	0.001	0.037	0.001	0.008	0.0001	0.0018	0.008	0.37
3E2090D	A3R1773-01 ***	A3R1773	0.19	0.84	0.014	0.005	0.06	0.26	0.08	0.08	0.025	0.000	0.001	0.037	0.001	0.008	0.0001	0.0018	0.008	0.37
3E2092C	A3R1773-03 ***	A3R1773	0.19	0.84	0.014	0.005	0.06	0.26	0.08	0.08	0.025	0.000	0.001	0.037	0.001	0.008	0.0001	0.0018	0.008	0.37
3E2092D	A3R1773-03 ***	A3R1773	0.19	0.84	0.014	0.005	0.06	0.26	0.08	0.08	0.025	0.000	0.001	0.037	0.001	0.008	0.0001	0.0018	0.008	0.37
3E2093C	B3R6683-02 ***	B3R6683	0.19	0.87	0.012	0.004	0.06	0.30	0.08	0.07	0.031	0.000	0.002	0.035	0.001	0.008	0.0001	0.0020	0.009	0.38

Mercury has not come in contact with this product during the manufacturing process not has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

"***" indicates Heats melted and Manufactured in the U.S.A.

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

GROUNDING LUG

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800-827-8872

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
B032740	00000000503272	N-121202-004	11719 4		L419952-1	05/23/2013 19:40

Grade

Order Description:
A36, 0.2500 IN x 96.000 IN x 240.000 IN
Quality Plan Description:
A36MODMN20C: ASTM A36-05/A36M/ASME SA36-00 MOD MN .20 MAX C

Customer:

YAK-21 PPI Q.C. F.W. 12/8/16

Shipped Item	Heat/Slab Number	Certified By	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Cb	V	Al	Ti	N2	B	Ca	Sn	CEV
3E2093D	B3R6683-02 ***	B3R6683	0.19	0.87	0.012	0.004	0.06	0.30	0.08	0.07	0.031	0.000	0.002	0.035	0.001	0.008	0.0001	0.0020	0.009	0.38

Mercury has not come in contact with this product during the manufacturing process not has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

*** Indicates Heats melted and Manufactured in the U.S.A.

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

GROUNDING LUG

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800-827-8872

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
B032740	00000000503272	N-121202-004	11719 4		L419952-1	05/23/2013 19:40

Grade

Customer:

Order Description:
A36, 0.2500 IN x 96.000 IN x 240.000 IN
Quality Plan Description:
A36MODMN20C: ASTM A36-05/A36M/ASME SA36-00 MOD MN .20 MAX C

YAK-21 PPI 12/8/16 Q.C. F.W.

Shipped Item	Certified By	Heat/Slab Number	Yield ksi	Tensile ksi	Y/T %	ELONGATION % 2"	ELONGATION % 8"	Bend OK?	Hard HB	Charpy Impacts (ft-lbs) Size mm	1	2	3	Avg	Shear % 1	2	3	Avg	Test Temp
3E2079C	S3E2082FTT	A3R1772-01 ***	51.2	70.5	72.6	28.0													
3E2079C	S3E2084FTT	A3R1772-01 ***	47.6	70.4	67.6	28.9													
3E2079C	S3E2082MTT	A3R1772-01 ***	50.3	67.4	74.6	27.7													
3E2079C	S3E2084MTT	A3R1772-01 ***	49.5	67.1	73.8	25.6													
3E2079D	S3E2082FTT	A3R1772-01 ***	51.2	70.5	72.6	28.0													
3E2079D	S3E2084FTT	A3R1772-01 ***	47.6	70.4	67.6	28.9													
3E2079D	S3E2082MTT	A3R1772-01 ***	50.3	67.4	74.6	27.7													
3E2079D	S3E2084MTT	A3R1772-01 ***	49.5	67.1	73.8	25.6													
3E2081C	S3E2082FTT	A3R1772-03 ***	51.2	70.5	72.6	28.0													
3E2081C	S3E2084FTT	A3R1772-03 ***	47.6	70.4	67.6	28.9													
3E2081C	S3E2082MTT	A3R1772-03 ***	50.3	67.4	74.6	27.7													
3E2081C	S3E2084MTT	A3R1772-03 ***	49.5	67.1	73.8	25.6													
3E2081D	S3E2082FTT	A3R1772-03 ***	51.2	70.5	72.6	28.0													
3E2081D	S3E2084FTT	A3R1772-03 ***	47.6	70.4	67.6	28.9													
3E2081D	S3E2082MTT	A3R1772-03 ***	50.3	67.4	74.6	27.7													
3E2081D	S3E2084MTT	A3R1772-03 ***	49.5	67.1	73.8	25.6													
3E2083C	S3E2083FTT	B3R6682-01 ***	52.5	75.1	69.9	31.5	20.5												
3E2083C	S3E2083MTT	B3R6682-01 ***	51.3	69.8	73.5	30.9													
3E2083D	S3E2083FTT	B3R6682-01 ***	52.5	75.1	69.9	31.5	20.5												
3E2083D	S3E2083MTT	B3R6682-01 ***	51.3	69.8	73.5	30.9													
3E2085C	S3E2085FTT	B3R6682-03 ***	57.3	75.0	76.4	28.5													

Mercury has not come in contact with this product during the manufacturing process not has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

"***" indicates Heats melted and Manufactured in the U.S.A.

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

GROUNDING LUG

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800-827-8872

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
B032740	00000000503272	N-121202-004	11719 4		L419952-1	05/23/2013 19:40

Grade

Customer:

Order Description:
A36, 0.2500 IN x 96.000 IN x 240.000 IN

Quality Plan Description:
A36MODMN20C: ASTM A36-05/A36M/ASME SA36-00 MOD MN .20 MAX C

PPI
Q.C.
F.W.

VAK-21 12/8/16

Shipped Item	Certified By	Heat/Slab Number	Yield ksi	Tensile ksi	Y/T %	ELONGATION % 2"	ELONGATION % 8"	Bend OK?	Hard HB	Charpy Impacts (ft-lbs) Size mm	1	2	3	Avg	Shear % 1	2	3	Avg	Test Temp
3E2085C	S3E2085MTT	B3R6682-03 ***	51.3	69.3	74.0	30.9													
3E2085D	S3E2085FTT	B3R6682-03 ***	57.3	75.0	76.4	28.5													
3E2085D	S3E2085MTT	B3R6682-03 ***	51.3	69.3	74.0	30.9													
3E2086C	S3E2083FTT	B3R6682-02 ***	52.5	75.1	69.9	31.5	20.5												
3E2086C	S3E2085FTT	B3R6682-02 ***	57.3	75.0	76.4	28.5													
3E2086C	S3E2083MTT	B3R6682-02 ***	51.3	69.8	73.5	30.9													
3E2086C	S3E2085MTT	B3R6682-02 ***	51.3	69.3	74.0	30.9													
3E2086D	S3E2083FTT	B3R6682-02 ***	52.5	75.1	69.9	31.5	20.5												
3E2086D	S3E2085FTT	B3R6682-02 ***	57.3	75.0	76.4	28.5													
3E2086D	S3E2083MTT	B3R6682-02 ***	51.3	69.8	73.5	30.9													
3E2086D	S3E2085MTT	B3R6682-02 ***	51.3	69.3	74.0	30.9													
3E2087C	S3E2083FTT	B3R6682-04 ***	52.5	75.1	69.9	31.5	20.5												
3E2087C	S3E2085FTT	B3R6682-04 ***	57.3	75.0	76.4	28.5													
3E2087C	S3E2083MTT	B3R6682-04 ***	51.3	69.8	73.5	30.9													
3E2087C	S3E2085MTT	B3R6682-04 ***	51.3	69.3	74.0	30.9													
3E2087D	S3E2083FTT	B3R6682-04 ***	52.5	75.1	69.9	31.5	20.5												
3E2087D	S3E2085FTT	B3R6682-04 ***	57.3	75.0	76.4	28.5													
3E2087D	S3E2083MTT	B3R6682-04 ***	51.3	69.8	73.5	30.9													
3E2087D	S3E2085MTT	B3R6682-04 ***	51.3	69.3	74.0	30.9													
3E2088C	S3E2083FTT	B3R6682-05 ***	52.5	75.1	69.9	31.5	20.5												
3E2088C	S3E2085FTT	B3R6682-05 ***	57.3	75.0	76.4	28.5													

Mercury has not come in contact with this product during the manufacturing process not has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed, fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

"***" indicates Heats melted and Manufactured in the U.S.A.

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

GROUNDING LUG

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800-827-8872

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
B032740	00000000503272	N-121202-004	11719 4		L419952-1	05/23/2013 19:40
Grade				Customer:		

Order Description:
A36, 0.2500 IN x 96.000 IN x 240.000 IN
Quality Plan Description:
A36MODMN2OC: ASTM A36-05/A36M/ASME SA36-00 MOD MN .20 MAX C

YAK-21 PPI Q.C. F.W. 12/8/16

Shipped Item	Certified By	Heat/Slab Number	Yield ksi	Tensile ksi	Y/T %	ELONGATION % 2"	ELONGATION % 8"	Bend OK?	Hard HB	Charpy Impacts (ft-lbs) Size mm	1	2	3	Avg	Shear % 1	2	3	Avg	Test Temp
3E2088C	S3E2083MTT	B3R6682-05 ***	51.3	69.8	73.5	30.9													
3E2088C	S3E2085MTT	B3R6682-05 ***	51.3	69.3	74.0	30.9													
3E2088D	S3E2083FTT	B3R6682-05 ***	52.5	75.1	69.9	31.5	20.5												
3E2088D	S3E2085FTT	B3R6682-05 ***	57.3	75.0	76.4	28.5													
3E2088D	S3E2083MTT	B3R6682-05 ***	51.3	69.8	73.5	30.9													
3E2088D	S3E2085MTT	B3R6682-05 ***	51.3	69.3	74.0	30.9													
3E2089C	S3E2089FTT	A3R1773-02 ***	55.1	73.7	74.8	30.4													
3E2089C	S3E2089MTT	A3R1773-02 ***	52.5	72.2	72.7	28.1													
3E2089D	S3E2089FTT	A3R1773-02 ***	55.1	73.7	74.8	30.4													
3E2089D	S3E2089MTT	A3R1773-02 ***	52.5	72.2	72.7	28.1													
3E2090C	S3E2090FTT	A3R1773-01 ***	60.4	80.0	75.5	31.2													
3E2090C	S3E2090MTT	A3R1773-01 ***	51.2	70.2	72.9	29.3													
3E2090D	S3E2090FTT	A3R1773-01 ***	60.4	80.0	75.5	31.2													
3E2090D	S3E2090MTT	A3R1773-01 ***	51.2	70.2	72.9	29.3													
3E2092C	S3E2089FTT	A3R1773-03 ***	55.1	73.7	74.8	30.4													
3E2092C	S3E2090FTT	A3R1773-03 ***	60.4	80.0	75.5	31.2													
3E2092C	S3E2089MTT	A3R1773-03 ***	52.5	72.2	72.7	28.1													
3E2092C	S3E2090MTT	A3R1773-03 ***	51.2	70.2	72.9	29.3													
3E2092D	S3E2089FTT	A3R1773-03 ***	55.1	73.7	74.8	30.4													
3E2092D	S3E2090FTT	A3R1773-03 ***	60.4	80.0	75.5	31.2													
3E2092D	S3E2090MTT	A3R1773-03 ***	52.5	72.2	72.7	28.1													

Mercury has not come in contact with this product during the manufacturing process not has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

"***" indicates Heats melted and Manufactured in the U.S.A.

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

GROUNDING LUG

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800-827-8872

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
B032740	00000000503272	N-121202-004	11719 4		L419952-1	05/23/2013 19:40

Grade

Order Description:
A36, 0.2500 IN x 96.000 IN x 240.000 IN
Quality Plan Description:
A36MODMN20C: ASTM A36-05/A36M/ASME SA36-00 MOD MN .20 MAX C

Customer:

YAK-21 PPI Q.C. F.W. 12/8/16

Shipped Item	Certified By	Heat/Slab Number	Yield ksi	Tensile ksi	Y/T %	ELONGATION % 2"	ELONGATION % 8"	Bend OK?	Hard HB	Charpy Impacts (ft-lbs) Size mm	1	2	3	Avg	Shear % 1	2	3	Avg	Test Temp
3E2092D	S3E2090MTT	A3R1773-03 ***	51.2	70.2	72.9	29.3													
3E2093C	S3E2094FTT	B3R6683-02 ***	53.5	76.9	69.6	30.3													
3E2093C	S3E2095FTT	B3R6683-02 ***	57.3	76.8	74.6	31.7													
3E2093C	S3E2094MTT	B3R6683-02 ***	51.4	71.7	71.7	28.3													
3E2093C	S3E2095MTT	B3R6683-02 ***	52.6	72.0	73.1	27.4													
3E2093D	S3E2094FTT	B3R6683-02 ***	53.5	76.9	69.6	30.3													
3E2093D	S3E2095FTT	B3R6683-02 ***	57.3	76.8	74.6	31.7													
3E2093D	S3E2094MTT	B3R6683-02 ***	51.4	71.7	71.7	28.3													
3E2093D	S3E2095MTT	B3R6683-02 ***	52.6	72.0	73.1	27.4													

Items: 22 PCS: 309 Weight: 504763 LBS

Mercury has not come in contact with this product during the manufacturing process not has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

"***" indicates Heats melted and Manufactured in the U.S.A.

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

GROUNDING LUG

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

SSAB

Test Certificate

Form TC1: Revision 2: Date 23 Apr 2014

12400 Highway 43 North, Axis, Alabama 36505, US

Customer:
KLOECKNER METALS CORPORATION
500 COLONIAL CENTER PARKWAY
SUITE 500
ROSWELL
GA 30076

Customer P.O.No.: DFW-6919530 | **Mill Order No.** 41-429789-11 | **Shipping Manifest:** AT204989

Product Description: ASTM A516-70(10)/ASME SA516-70(13)
0.20% MAX C; AS-ROLLED, TENSILE COUPON
NORMALIZED 1650F+/-25,.5HR/INCH,.5HR MIN

Ship Date: 12 May 15 | **Cert No:** 081506800
Cert Date: 12 May 15 | (Page 1 of 1)

Size: 1.250 X 96.00 X 480.0 (IN)

Tested Pieces:				Tensiles:					Hardness	Charpy Impact Tests							
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in 8in	Tst Dir		Abs. Energy(FTLB) 1 2 3 Avg	% Shear 1 2 3 Avg	Tst Tmp	Tst Dir	Tst Siz (mm)	BDWTT Tmp %Shr
E5E005	C47	1.251 (DISCRT)	L	48	74		24	T							
E5E005	C47*	1.251 (DISCRT)	L	46	73		25	T							

Chemical Analysis

Heat Id	C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	ORGN
E5E005	.19	1.08	.009	.004	.23	.027	.027	.29	.14	.14	.04	.000	.003	.008	.0005	USA

KILLED STEEL
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE
RESULTS OF TESTS PERFORMED ON NORMALIZED TEST COUPONS ARE LABELED ABOVE WITH *
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
PRODUCTS SHIPPED:
E5E005 C47 PCES: 1, LBS: 16335

5/31/17 PPI Q.C. F.W. HBZ-77

Cust Part #:

WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH, AND MEETS THE REQUIREMENTS OF, THE APPROPRIATE SPECIFICATION

Justin Ward
SENIOR METALLURGIST - PRODUCT

02-03-2017 01:56 Load - 2719879 BL - 7776443
Extreme Plate Processing Heat - E5E005
Cust. PO - 1349 Order-Line - 14543624 / 1
blr466

LIFTING LUG

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

6/3/2015 6:20 PM FROM: Fax Server TO: +18665981572 P. 5

NUCOR
NUCOR CORPORATION
NUCOR STEEL TEXAS

Mill Certification

6/3/2015

MTR #: 0000103107
8812 Hwy 79 W
Jewett, TX 75846
(903) 626-4461
Fax: (903) 626-6290

Sold To: KLOECKNER METALS CORP
500 COLONIAL CENTER PARKWAY
SUITE 500
ROSWELL, GA 30076-0000
(678) 259-8817
Fax: (678) 259-8894

Ship To: KLOECKNER METALS
14200 ALMEDA RD
HOUSTON, TX 77053
(713) 433-7211

Customer P.O.	6933311	Sales Order	219534.6
Product Group	Merchant Bar Quality	Part Number	5337520024004W0
Grade	A36/A529GR50/CSA44W/50W	Lot #	JW1510108401
Size	3/8x2" Flat	Heat #	JW15101084
Product	3/8x2" Flat 20' A36/A529-50/44W/50W	B.L. Number	J1-706384
Description	A36/A529-50/44W/50W	Load Number	J1-310134
Customer Spec.		Customer Part #	MB382FLTA360240

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed above and that it satisfies those requirements.

Roll Date: 4/23/2015 Melt Date: 4/20/2015 Qty Shipped LBS: 5,206 Qty Shipped Pcs: 102

ASTM A36/A36M-12, A709/709M-13 GR36, ASME SA36-10 Ed '11 Ad.
ASME SA36-2010 EDITION-2011 ADDENDA
ASTM A709/A709M-13 GR 36 [250]

C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb
0.13%	0.84%	0.011%	0.027%	0.20%	0.29%	0.15%	0.19%	0.040%	0.0340%	0.001%

Yield 1: 54,600psi Tensile 1: 73,300psi Elongation: 24% in 8"(% in 203.3mm)
Yield 2: 55,600psi Tensile 2: 73,300psi Elongation 25% in 8"(% in 203.3mm)

Specification Comments: MEETS THE REQUIREMENTS OF: ASTM A36/A36M-08, A529/A529-05 GR50(345), A709/A709M-10 GR36(250); CSA G40.21-04 GR44W(300W)&GR50W(350W); AASHTO M270/270M-10 GR36(270); ASME SA36/SA36M-10 MEETS REPORTING REQUIREMENTS OF EN10204 SEC 3.1

8/3/15 PPI
YAL-5 Q.C.
F.W.

Comments: E-mail: websales@nstexas.com

1. All manufacturing processes of the steel, including melting, have been performed in the U.S.A.
2. Mercury in any form has not been used in the production or testing of this product.
3. Welding or weld repair was not performed on this material.
4. This material conforms to the specifications described on this document and may not be reproduced, except in full, without written approval of Nucor Corporation.
5. Results reported for ASTM E45 (Inclusion content) and ASTM E381 (Macro-etch) are provided as interpretation of ASTM procedures.

Bhargava R Vantari
Division Metallurgist

AS IS

ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

US HWY 12 Burns Harbor, Indiana

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.	PAGE
803-02754	02-13-16	CSS-CHGO-BNSF BVRY 062065	2

SOLD TO
AMERICAN ALLOY STEEL INC
PO BOX 40469
HOUSTON TX 77240-0469

SHIPPED TO
AMERICAN ALLOY STEEL INC
BNSF TR# 7226 MILE 66.4 LN SEG 492
6230 N HOUSTON ROSSLYN RD
HOUSTON TX 77091-3410

NOTE	SERIAL NUMBER	PAT NO.	HEAT NUMBER	NO. PCS.	SIZE AND QUANTITY THICKNESS	WIDTH OR DIA.	LENGTH	WEIGHT	YIELD POINT	TENSILE STRENGTH	AF FRAC. ELONG.	RED.
					INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN	% %

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX, ASTM A516-06 GR 65 PVQ, ASTM A516-06 GR 60 PVQ, ASME SA516 GR 70 PVQ 2013 EDITION, ASME SA516 GR PVQ 2013 EDITION, ASME SA516 GR 60 PVQ 2013 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NO 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL --- TEST CERTS AR PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3 NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

CO# 106950 GH 354-4932E

→ B045362	812S34840	2	.625	120	480	20420	48300	74300	8	25
							51900	73500	8	29

(M55)MFST REF#:6

B045363	812S34840	2	.625	120	480	20420	48300	74200	8	25
							52500	73800	8	31

(M55)MFST REF#:6

Q-QUENCH TEMPERATURE T-TEMPER TEMPERATURE N-NORMALIZE TEMPERATURE

SERIAL NUMBER	PAT NO.	HEAT NUMBER	HARD SKN	BEND	THICKNESS INCHES	TYPE	SIZE	DIR	TEST TEMP F	CHARPY IMPACT ENERGY FT LBS 1 2 3	SHEAR(%) 1 2 3	LAT. EXP MILS 1 2 3

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
JR 3/4/2016

HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	EQUIAXD GRAIN SIZE
812S34840	.17	1.07	.012	.005	.335	.261	.21	.04	.008	.003	.002	.033	.0002		.003	.004	.004

5/31/17 PPI Q.C. F.W. HBZ-76

I certify that the above results are a true and correct copy of actual results contained in records maintained by ArcelorMittal Burns Harbor and are in full compliance with the requirements of the specification cited above. This test report cannot be altered and must be transmitted intact with any subsequent third party test reports, if required.

D. W. ELWOOD PER WNK

SUPV. QUALITY ASSURANCE

BHPLTRPT.TIF

AMERICAN ALLOY PLATE # 812S34840

INLET DIVERTER

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS, TX 77429

ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

US HWY 12 Burns Harbor, Indiana

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.		PAGE
803-13212	11-04-15	CSS-CHGO-BNSF	CSS 019049	6

SOLD TO
AMERICAN ALLOY STEEL INC
PO BOX 40469
HOUSTON TX 77240-0469

SHIP TO
AMERICAN ALLOY STEEL INC
BNSF TR# 7226 MILE 66.4 LN SEG 492
6230 N HOUSTON ROSSLYN RD
HOUSTON TX 77091-3410

NOTE	SERIAL NUMBER	PAT NO.	HEAT NUMBER	NO. PCS.	SIZE AND QUANTITY: THICKNESS	WIDTH OR DIA.	LENGTH	WEIGHT	YIELD POINT	TENSILE STRENGTH	AF FRAC. ELONG.	RED.
					INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN	% %

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX, ASTM A516-06 GR 65 PVQ, ASTM A516-06 GR 60 PVQ, ASME SA516 GR 70 PVQ 2013 EDITION, ASME SA516 GR PVQ 2013 EDITION, ASME SA516 GR 60 PVQ 2013 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NO 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL --- TEST CERTS AR PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3
N ACCORD
WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1
DURES
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

CO# 106119 GH 354-4859F

A057805	821P00650	1	.875	96	480	11435	48100	73500	8	23		
							50000	72600	8	29		
(M55)MFST REF#:7												
→ A057807	821P00650	2	.875	96	480	22870	47900	74500	8	29		
							50200	71000	8	29		
(M55)MFST REF#:7												
A057808	821P00650	1	.875	96	480	11435	54000	78400	8	29		
							50500	73400	8	28		
(M55)MFST REF#:7												

Q-QUENCH TEMPERATURE T-TEMPER TEMPERATURE N-NORMALIZE TEMPERATURE

SERIAL NUMBER	PAT NO.	HEAT NUMBER	HARD BHN	BEND	THICKNESS INCHES	TYPE	SIZE	DIR	TEST TEMP °F	CHARPY IMPACT: ENERGY FT LBS 1	2	3	SHEAR(%) 1	2	3	LAT. EXP MILS 1	2	3

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
[signature] 11/23/2015

HEAT NUMBER	CHEMICAL ANALYSIS: C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MOLARD GRAIN SIZE
821P00650	.18	1.07	.012	.004	.323	.015	.01	.12	.078	.004	.002	.033	.0002		.002	.004	.003
	CE .40		PCM .26														

5/31/17 PPI Q.C. F.W. HBZ-74

I certify that the above results are a true and correct copy of actual results contained in records maintained by ArcelorMittal Burns Harbor and are in full compliance with the requirements of the specification cited above. This test report cannot be altered and must be transmitted intact with any subsequent third party test reports, if required.

D. W. ELWOOD PER WNK
SUPV. QUALITY ASSURANCE

AMERICAN ALLOY PLATE # 21006LS

BHPLTRPT.TIF

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

BASEPLATE

SSAB

Test Certificate

Form TC1: Revision 2: Date 23 Apr 2014

13609 Industrial Road, Houston, TX 77015, US

Customer:
SAMUEL SPECIALTY METALS
5022 ASHLEY COURT

HOUSTON
TX 77041

Customer P.O. No.: 016S-7248246 | Mill Order No.: 41-486172-03 | Shipping Manifest : HT108155

Product Description: ASTM A516-70(10/15)/ASME SA516-70(15)
0.43% MAX CEV (IIW); AS-ROLLED, TENSILE
COUPON NORMALIZED 1650F+/-25F/1HR/"

Ship Date: 17 Jan 17
Cert Date: 17 Jan 17

Cert No: 031191770
(Page 1 of 1)

Size: 0.375 X 96.00 X 240.0 (IN)

Tested Pieces				Tensiles						Charpy Impact Tests								
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in	Elong % 8in	Tst Dir	Hardness	Abs. Energy(FTLB) 1 2 3 Avg	% Shear 1 2 3 Avg	Tst Tmp	Tst Dir	Tst Siz (mm)	BDWTT Tmp %Shr
E6K162	A10	0.372 (DISCRT)	L	54	76			25	T							
E6K162	A10*	0.372 (DISCRT)	L	50	73			26	T							

Heat Id	Chemical Analysis C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	IIW	ORGN
E6K162	.19	1.00	.015	.001	.24	.024	.023	.23	.12	.14	.04	.001	.004	.008	.0001	.42	USA

KILLED STEEL
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE
RESULTS OF TESTS PERFORMED ON NORMALIZED TEST COUPONS ARE LABELED ABOVE WITH *
CEV (IIW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
PRODUCTS SHIPPED:
E6K162 A10 PCES: 1, LBS: 2450

Samuel, Son & Co. (U.S.) Inc.
Houston, Texas
This is a TRUE COPY
of the original MTR

5/31/17 PPI Q.C. F.W. HBZ-75

4/27/92

(U) Cust Part # : 1344107

WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH, AND MEETS THE REQUIREMENTS OF, THE APPROPRIATE SPECIFICATION

Justin Ward
SENIOR METALLURGIST - PRODUCT

NUCOR
NUCOR CORPORATION
NUCOR STEEL TEXAS

Mill Certification
11/6/2014

MTR #: 0000063978
8812 Hwy 79 W
Jewett, TX 75846
(903) 626-4461
Fax: (903) 626-6290

Sold To: KLOECKNER METALS CORP
500 COLONIAL CENTER PARKWAY
SUITE 500
ROSWELL, GA 30076-0000
(678) 259-8817
Fax: (678) 259-8894

Ship To: KLOECKNER METALS
3837 SINGLETON BLVD
DALLAS, TX 75212
(214) 630-6959

Customer P.O.	6861815	Sales Order	209927.7
Product Group	Merchant Bar Quality	Part Number	3000050024004W0
Grade	A36/A529GR50/CSA44W/50W	Lot #	JW1410576901
Size	1/2" (.5000) Round	Heat #	JW14105769
Product	1/2" (.5000) Round 20' A36/A529-50/44W/50W	B.L. Number	J1-687279
Description	A36/A529-50/44W/50W	Load Number	J1-290957
Customer Spec		Customer Part #	MB1/2RNDA360240

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed above and that it satisfies those requirements.

Roll Date: 7/14/2014 Melt Date: 7/9/2014 Qty Shipped LBS: 5,010 Qty Shipped Pcs: 375

ASTM A36/A36M-12, A709/709M-13 GR36, ASME SA36-10 Ed '11 Ad.
ASME SA36-2010 EDITION-2011 ADDENDA
ASTM A709/A709M-13 GR 36 [250]

C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb
0.15%	0.86%	0.013%	0.028%	0.22%	0.25%	0.16%	0.17%	0.050%	0.0188%	0.000%

Yield 1: 62,200psi Tensile 1: 76,500psi Elongation: 23% in 8"(% in 203.3mm)
Yield 2: 61,100psi Tensile 2: 77,200psi Elongation 23% In 8"(% in 203.3mm)

Specification Comments: MEETS THE REQUIREMENTS OF: ASTM A36/A36M-08, A529/A529-05 GR50(345), A709/A709M-10 GR36(250); CSA G40.21-04 GR44W(300W)&GR50W(350W); AASHTO M270/270M-10 GR36(270); ASME SA36/SA36M-10 MEETS REPORTING REQUIREMENTS OF EN10204 SEC 3.1

Comments: E-mail: websales@nstexas.com

1. All manufacturing processes of the steel, including melting, have been performed in the U.S.A.
2. Mercury in any form has not been used in the production or testing of this product.
3. Welding or weld repair was not performed on this material.
4. This material conforms to the specifications described on this document and may not be reproduced, except in full, without written approval of Nucor Corporation.
5. Results reported for ASTM E45 (Inclusion content) and ASTM E381 (Macro-etch) are provided as interpretation of ASTM procedures.

Q/C
FW
3/21/15
YAK-125
PPI
Q.C.
F.W.

Bhargava R Vantari
Division Metallurgist

METALFAR PRODOTTI INDUSTRIALI SPA A01
23861 CESANA BRIANZA (LC) - ITALY
VIA G. PARINI, 28
PHONE + 39 031 655441 - FAX +39 031 655149
quality.mff@farmas.com

COMPANY WITH MANAGEMENT SYSTEM CERTIFIED BY DNV
= ISO 9001 =
= ISO 14001 =

INSPECTION CERTIFICATE EN 10204:2004 / 3.1 A01

Nr A01 2014-C_MFF-08170 Data / Dated 29.11.2014 A02

ITEX PIPING PRODUCTS LLC A05
13411 WEST ROAD
77041 HOUSTON, TEXAS US

Ordine / PO	I-245434/NS
Item	112
DDT / Delivery note	2014-3E301-0004972
Packing List	2014-3E401-0004431
Fattura / Invoice	2014-3E401-0004431
Ns. rif. / Our ref.	2014-3E201-0002513-0111

A07 A04

Dest. ITEX c/o NORTH SHORE STEEL-FFV A06
12945 MARKET STREET
77015 HOUSTON, TEXAS US

Cod. colata / Heat Code B07	Nr. colata / Heat Nr B02	Quantità / Quantity B03	Descrizione / Description B01 - B02 - B11
	91436	15,00	BLIND 600 RF 18" LF2CL1

Mat. in acc. a / Mat. in acc. to B09 ASTM/ASME A 350/SA 350 M - 14 ASME CODE SECT. II, PART A, ED. 2013
ASTM A350 LF2 CL1
NACE MR-0175/2009 ISO 15156
NACE MR-0103/2012
Q.A.S.IN ACCORD.WITH PRESS.EQUIPM.DIRECT.97/23/EC(PED) ANNEX I,PARAGRAPH 4.3
CERT.4687-2014-CE-ITA-ACCREDIA

Ann. mat. / Mat. remarks B20 FULLY KILLED STEEL AND FINE GRAIN PRACTICED

Elementi / Elements C71 - C92	C	Si	Mn	S	P	Cr	Ni	Mo	Ti	Cu	V	Nb	N
LADLE ANALYSIS	0,190	0,200	0,990	0,001	0,008	0,110	0,070	0,020	0,002	0,070	0,003	0,001	0,000
	Al								CE LF	CE SF	F1	F2	PREN
LADLE ANALYSIS	0,029								0,391	0,355	0,273	0,130	--

CE LF=C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15 CE SF=C+Mn/6) F1=Cu+Ni+Cr+Mo+V F2=Cr+Mo

Provetta / Test specimen		Forma / Shape C10	°C C05	Snervamento>0,2% / Yield Strength>0,2% C11	Snervamento>1,0% / Yield Strength>1,0%	Rottura / Tensile C12	Allungamento / Elongation C13	Contrazione / Reduction of area C15
Sez/Sect mm2	L. mm	1=O - 2=□		MPa	MPa	MPa	%	%
126,60	50,80	1	20	310,0	--	505,0	30,0	61,0

DUREZZA / HARDNESS C27		RESILIENZA / IMPACT TEST					
HBW	Tipo/Type C40	Provetta / Test Specimen	°C C03	1-Joule C42	2-Joule C42	3-Joule C42	Media/Average C43
152,0 - 154,0	KV	10x10 mm	-46	68	74	70	70,7

Tratt. Term. / Heat treatment C70	NORMALIZED AT 930° C - COOLED IN STILL AIR	ELECTRIC FURNACE
Dim in acc. a / Dim. acc. to B14	ASME/ANSI B16.5 -2013	
Finitura / Roughness	125/250 MICROINCH AARH	

Marcatura in acc. / Marking in acc. to B05					
	MSS SP25 Ed. 2013	Vis. & Dim.	SATISFACTORY	Origine / Origin of Steel	EUROPEAN UNION

Note / Notes
100% MANUFACTURED IN ITALY
MANUFACTURING IN ACCORDANCE WITH ORDER AND SPECIFICATION

4/11/17 PPI Q.C. F.W. XAN-89

UFFICIO CONTROLLO QUALITA' / QUALITY CONTROL DEPARTMENT A08	ENTE UFFICIALE DI COLLAUDO / INSPECTION AUTHORITY Z03	MARCHIO PRODUZIONE / MANUFACTURER'S SYMBOL A09
S.Frigerio		MFF

UOP RUSSELL – P.O. # 4500754097 – S/O # 5654-1 – V-402, COLD SEPARATOR – PROFESSIONAL PROJECTS, INC. 18115 TELGE RD CYPRESS TX, 77429

H BLIND FLANGE

Professional Projects Inc.

18115 Telge Rd. Cypress, TX 77429

5654-1 Databook

List of Contents

Item: V-402, COLD SEPARATOR

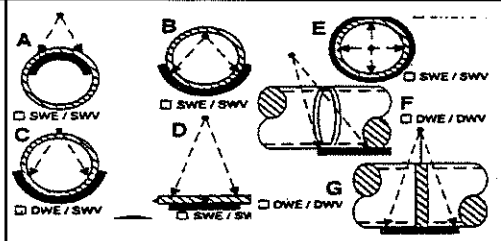
Non-Destructive Testing (NDT)

American Piping Inspection

Radiography Report

API Proj. No:		Client:	PROFESSIONAL PROJECTS INC.	Date:	4/15/2017	PAGE 1	of 1
Client job# / SO#	5654-1	Project Name:		Project Location:	HOUSTON, TX		
AFE #		PO #		Governing Spec.:		Accept. Standard:	ASME Sect. VIII
API Proc. No:	RT-2 SWE Internal exposure	Radiation Source:	Co-60	Source Strength:	68 Ci	KV: N/A	MA: N/A
Material:	Carbon Steel	Reinforcement (")	.125	Focal Spot Size (")	☐ .05 ☑ .16 ☐ Diag:	Film (Plate) Load:	☑ Single ☐ Double
Screens:	Front: .005"	Back: .005"	Film Count 12		Film Size	7"X 17"	

Weld #	View / Location Markers	Pipe Size / Diameter	Pipe / Plate Thickness	Technique	Film / Plate Type D3/D4/D5/D7,50,80,100,GP,HR,X	IQI / Pentrameter	WELDER ID	Accept (/)	Reject (X)	Porosity / Cluster Porosity	Slag or Inclusion	Crack	Incomplete Fusion	Inadequate Penetration	External Undercut	Internal Undercut	Burn Thru	Internal Concavity	High-Low / Mismatch	Film Artifact	Remarks / Comments / Line #
L1	1-2		2.5"	D	100	C		/													
	2-3		2.5"	D	100	C		/													
	3-4		2.5"	D	100	C		/													
	4-5		2.5"	D	100	C		/													
	5-6		2.5"	D	100	C		/													
	6-7		2.5"	D	100	C		/													
	7-8		2.5"	D	100	C		/													
	8-9		2.5"	D	100	C		/													
	9-10		2.5"	D	100	C		/													
	10-11		2.5"	D	100	C		/													
	11-12		2.5"	D	100	C		/													
	12-		2.5"	D	100	C		/													



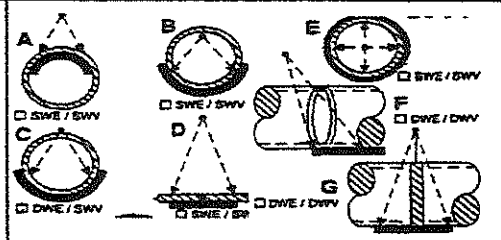
# OF WELDS RADIOGRAPHED	2	TRAVEL MILES R/T	TRAVEL HOURLY	TIME WORKED		TOTAL HOURS WORKED	RADIOGRAPHY PRODUCES TWO DIMENSIONAL IMAGES ONLY. THE DEPTH OF AND DEFECTS REPORTED ARE OF GOOD FAITH OPINIONS ONLY.
# OF RADIOGRAPHIC PERSONNEL	3				TO	SEE FIELD REPORT	
Level II Radiographer:	JOSEPH HOLMES			CLIENT:	Robert Cammack 4-17-17		

American Piping Inspection

Radiography Report

API Proj. No:		Client: PPI		Date: 7/15/17	PAGE 1 of		
Client job# / SO#	5654	Project Name:	78"x2.5" Roundseam	Project Location:	Cypress, TX		
AFE #		PO #		Governing Spec.:		Accept. Standard:	Sec VIII Div 2
API Proc. No:	RT 1 Spot Panoramic	Radiation Source:	IR 192	Source Strength:	52 Ci	KV: N/A	MA: N/A
Material:		Reinforcement (")	.125	Focal Spot Size (")	☐ .05 ☒ .16 ☐ Diag:	Film (Plate) Load:	☒ Single ☐ Double
Screens:	Front: .005"	Back: .005"	Film Count	22	F100	Film Size	17"x 17"

Weld #	View / Location Markers	Pipe Size / Diameter	Pipe / Plate Thickness	Technique	Film / Plate type D3/D4/D5/D7,50,80,100,GP,HR,X	IQI / Pentrameter	WELDER ID	Accept (/)	Reject (X)	Porosity / Cluster Porosity	Slag or Inclusion	Crack	Incomplete Fusion	Inadequate Penetration	External Undercut	Internal Undercut	Burn Thru	Internal Concavity	High-Low / Mismatch	Film Artifact	Remarks / Comments / Line #
C-1	1-2	~~78~~	2.5"	E	F100	C		/													
	2-3	78"						/													
	3-4							/													
	4-5							/													
	5-6							/													
	6-7							/													
	7-8							/													
	8-9							/													
	9-10							/													
	10-11							/													
	11-12							/													
	12-13							/													
	13-14							/													
	14-15							/													
	15-16							/													
	16-17							/													
	17-18							/													
	18-19							/													
	19-20							/													
	20-21							/													



# OF WELDS RADIOGRAPHED		TRAVEL MILES R/T	TRAVEL HOURLY	TIME WORKED			TOTAL HOURS WORKED	RADIOGRAPHY PRODUCES TWO DIMENSIONAL IMAGES ONLY. THE DEPTH OF AND DEFECTS REPORTED ARE OF GOOD FAITH OPINIONS ONLY.
# OF RADIOGRAPHIC PERSONNEL					TO		SEE FIELD REPORT	

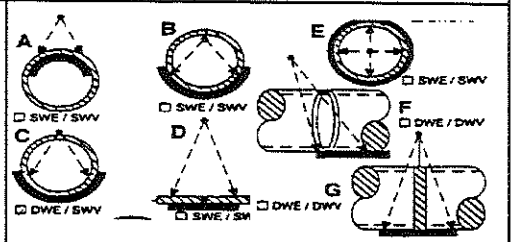
Level II Radiographer:	Austin Wood	CLIENT:	Robert Cammack 7-17-17

American Piping Inspection

Radiography Report

API Proj. No:		Client:	PPI	Date:	7/15/17	PAGE 2	of
Client job# / SO#	5654	Project Name:	78" x 2.5" Round Seam	Project Location:	Cypress, TX		
AFE #		PO #		Governing Spec.:		Accept. Standard:	Sec VIII

Weld #	View / Location Markers	Pipe Size / Diameter	Pipe / Plate Thickness	Technique	Film / Plate type D3/D4/D5/D7,50,80,100,GP,HR,X	IQI / Pentrameter	WELDER ID	Accept (/)	Reject (X)	Porosity / Cluster Porosity	Slag or Inclusion	Crack	Incompiete Fusion	Inadequate Penetration	External Undercut	Internal Undercut	Burn Thru	Internal Concavity	High-Low / Mismatch	Film Artifact	Remarks / Comments / Line #
C-1	21-22	78"	2.5"	G	F100	C		/													
1	22-1	1	1	1	1	1		/													



Robert Cammack

7-17-17

American Piping Inspection

Radiography Report

API Proj. No.	Client: PPI	Date: 7-29-17	Page 1 of 2
Client job# / SO# 5654/5654-1	Project Name: 78"X2.5"	Project Location: Cypress, TX	
AFE #	PO #	Governing Spec.: Sec VIII	Accept. Standard: Sec VIII Div. 1
API Proc. No.: API Rev 1	Radiation Source: Co60	Source Strength: 63 Ci	KV: N/A MA: N/A
Material: C/S	Reinforcement (in.): .125	Focal Spot Size (in.): ☐ .05 ☒ .16 ☐ Diag:	Film (Plate) Load: ☒ Single ☐ Double
Screens: Front: .005"	Back: .005"	Film Count 22 7"x17" F100	Film Size 7"x17"

Weld #	View / Location Markers	Pipe Size	Pipe/Plate Thickness (inche	Technique	Film / Plate type D3/D4/D5/D7,50,80,100,GP,HR,X	IQI/ Pentrameter	WELDER ID	Accept (/)	Reject (X)	Porosity / Cluster porosity	Slag or Inclusion	Crack	Incomplete Fusion	Inadequate Penetration	External Undercut	Internal Undercut	Burn Thru	Internal Concavity	High-Low/ Mismatch	Film Artifact	Remarks / Comments / Line #
W-C2	1-2	78"	2.5"	E	F100	E		/													
	2-3							/													
	3-4							/													
	4-5							/													
	5-6							/													
	6-7							/													
	7-8							/													
	8-9							/													
	9-10							/													
	10-11							/													
	11-12							/													
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	15-16							/													
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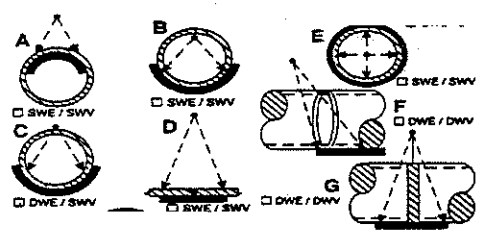
	18-19							/													
	19-20							/													
	20-21							/													



NO. OF WELDS RADIOGRAPHED	NUMBER OF RADIOGRAPHIC PERSONNEL		RADIOGRAPHY PRODUCES TWO DIMENSIONAL IMAGES ONLY, DEPTH OF DEFECTS REPORTED ARE GOOD FAITH OPINIONS ONLY.
1		3	

Level II Radiographer: [signature] II

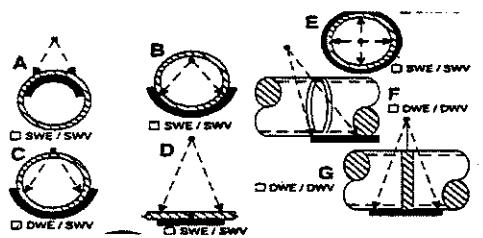
CLIENT: Robert Crammack 7-31-17

American Piping Inspection

Radiography Report

API Proj. No.:	Client: PPI	Date: 7/29/17	Page 2 of 2
Client Job# 5654 / 5654-1	Project Name: 18" X 2.5"	Project Location: Cypress, TX	
AFE#	PO #	Governing Spec.:	Accept. Standard: Sec VIII Div 1

We Id No.	View / Location Markers	PIPE SIZE	Pipe/Plate Thickness (in.)	Technique	Film Type (D3/D4/D5/D7,50,80,100)	IQI/ Pentrameter	WELDER ID	Accept (/)	Reject (X)	Porosity	Slag or Inclusion	Crack	Incomplete Fusion	Inadequate Penetration	External Undercut	Internal Undercut	Burn Thru	Internal Concavity	High-Low/ Mismatch	Film Artifact	Remarks/Comments
W-C2	21-22	18"	2.5"	E	F100	C		/													
1	22-1	1	1	1	1	1		/													



Robert Cammack
7-31-17

PROFESSIONAL PROJECTS, INC.

MAGNETIC PARTICLE TEST REPORT

JOB #:	5654	PROCEDURE:	QC-MT
S/O #:	5654-1	REVISION:	16
PART DESCRIPTION	Item V-402	ADDENDUM:	N/A
EQUIPMENT	AC Yoke	REVISION:	N/A
MAKE/MODEL	Parker B300 Contour Probe	CODE:	ASME Section VIII Div 1
SERIAL NUMBER	15140	BLACKLIGHT INTENSITY:	N/A
CAL. DUE DATE	Prior to use	BATH CONCENTRATION:	N/A
PARTICLE MANUFACTURER	Circle Safe 850A	LONGITUDINAL AMPS:	N/A
COLOR	Red	CIRCUMFERENTIAL AMPS:	N/A
BATCH #:	14413	THICKNESS: 2.5	
BLACK LIGHT SERIAL #:	N/A	LIGHTING: Streamlight 161135	
UV RADIOMETER SERIAL #:	N/A		

METHOD: [X] WET [ ] DRY [X] CONTINIOUS [ ] RESIDUAL [X] VISIBLE [ ] CONTRAST [ ] FLUORESCENT

	COMPONENT ID	WELD ID/ LOCATION	ACCEPT	DATE	INSPECTOR
	MT All sit on couplets D1,D2,E,F1,F2,G1,~G4,J frist pass of weld		x	7/19/2017	OR/RC
	MT temporary attachments , arc strikes, davit arm pocket,		x	8/10/2017	OR/RC
	MT lift and tail lugs		x	8/10/2017	OR/RC
	Note After PWHT				
	MT temporary attachments		x	8/15/2017	OR/RC
	MT All sit on couplets D1,D2,E,F1,F2,G1,G2,G3,G4, and J		x	8/15/2017	OR/RC

Owen Rodriguez B — INSPECTOR — 8/15/17 — DATE — WITNESS — DATE

Robert Cammack — APPROVED — 8-15-17 — DATE — WITNESS — DATE

TGR INDUSTRIAL SERVICES

- Welding Specifications
- Welding Procedures
- Welder Qualifications
- Non Destructive Testing
- API-AWS-ASME-ANSI

TGR INDUSTRIAL SERVICES
2815 Lilac * Pasadena, Texas 77503
Phone 281-487-8800 * Fax 281-998-0295

ULTRASONIC INSPECTION REPORT

Customer/Client PPI PROFESSIONAL PROJECTS Project 5654
Date June 14, 2017 Location CYPRESS TX P.O. 5654.1
Instrument EPOCH Model 600

UTT Longitudinal Frequency 5 MHz Size .5" Type Britek

Angle 0 Shear Freq. 5 MHz Size .5" Type Britek Couplant Water/GTX Gel
Calibration IIW 97-5503 Reference Reflector .5" Procedure TGR AWS-UT-01 Code AWS Section/Rev. 0
AMP 80%
Screen Size 6"Surface Condition CLEANED AND PREP Cable Type/Length 5'/Micro dot

Remarks LAMINATION SCAN WAS CARRIED OUT ON AREAS LISTED BELOW

Weld Identification or Location 5654/5654-1	Angle	A Defect Level (db)	B Ref. Level (db)	C Defect Level (db)	Sound Path (ui)	Surface Dist. To Weld Ctr. Line	'X' Dist. (in.)	'Y' Dist. (in.)	Depth From 'A' Face (in.)	Length of Flaw (in.)		Matl. Thick (in.)	Accept	Reject
D1	0	N/A	54.2									.875"	X	
D2	0	N/A	54.2									.875"	X	
E	0	N/A	54.2									.875"	X	
F1	0	N/A	54.2									.875"	X	
F2	0	N/A	54.2									.875"	X	
G1	0	N/A	54.2									.875"	X	
G2	0	N/A	54.2									.875"	X	
G3	0	N/A	54.2									.875"	X	
G4	0	N/A	54.2									.875"	X	
J	0	N/A	54.2									.875"	X	

Eric Fontenot

Technician(s) Eric Fontenot NDT Level II Date 6/14/17 Hours .857

Client Signature Robert Cannon Mileage 108 Travel Time 1hr Level III Approval _____ NO. 61417-F

6-14-17

By signing this report the client representative is certifying the hours, work and mileage to be approved for payment by the client.

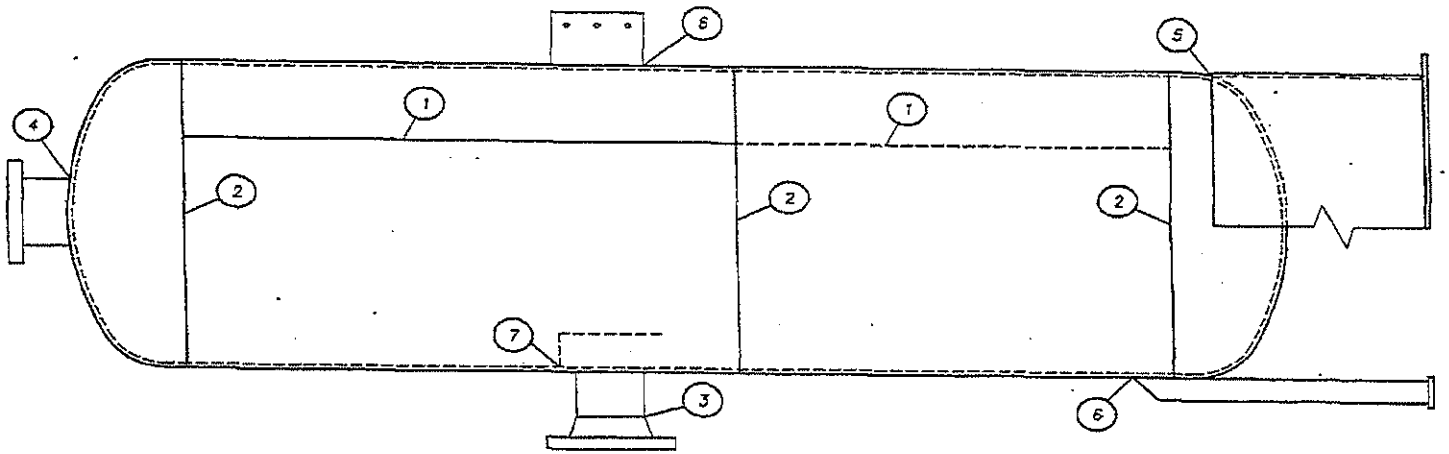
Professional Projects Inc.
18115 Telge Rd. Cypress, TX 77429

5654-1 Databook

List of Contents

Item: V-402, COLD SEPARATOR

Welding



WELD MAP

PWHT:	IMPACT TEST:	BASE METAL & THICKNESS
Required	Required	SA-516-70N / 3.25"

NO.	WELDMENT	WPS/PQR	NOTES
1	CAT A LONG SEAMS	151dcp/151-1dcp	
2	CAT B ROUND SEAMS	151dcp/151-1dcp	
3	CAT C FLANGE/PIPE/FORGING	149dcp/149-1dcp	
4	CAT D NOZZLE TO SHELL/HEAD	149dcp/149-1dcp	
5	SKIRT TO HEAD	151dcp/151-1dcp	
6	EXTERNAL ATTACHMENTS	149dcp/149-1dcp	
7	INTERNAL ATTACHMENTS	149dcp/149-1dcp	

PPI Professional Projects, Inc.

P.O. BOX 618 (118115 TELGE RD.) CYPRESS, TEXAS 77429

TITLE: 78" ID x 12'-0" s/s
ITEM: V-402
Cold Separator

CUSTOMER: UOP RUSSEL

CUSTOMER P.O. NO: 4500754097

PPI NO: 5654 | DATE: 5/3/2017

DRAWING NO: S/O 5654-1

FLUOR
DOC. NO. A7DJ
RECD: 02-DEC-2015
A7DJ-FAR-4-0207-00004-3A
EQUIP/TAG NUMBER
126-1103 126-1202
126-1203 126-1204
126-1205 126-1206
126-1212 27-1213-02
27-1228-04

FLUOR.
A – PROCEED
Authorization to proceed does not relieve Contractor/Supplier of its responsibility or liability under the Contract and or Purchase Order.
By Mario Ragma on Nov 27, 2015

"ALSO FOR SOUR SERVICE FABRICATION"

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)
(See QW-201.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name: Professional Projects, Inc. By: Seth B. Westbrook
Welding Procedure Specification No. 149 DCP Date 3/07/13 Supporting PQR No.(s) 149-1DCP
Revision No. 2 Date 5/28/2013
Welding Process(es): GMAW / FCAW Type(s) Semi-Automatic
(Automatic, Manual, Machine, or Semi-Auto)

JOINTS (QW-402) Details
Joint Design: All Types: Groove & Fillet
Backing (Yes) FCAW (No) GMAW
Backing Material (Type): Base / Weld Metal
(Refer to both backing and retainers.)
Metal Nonmetallic: Nonfusing Metal
Other: . No permanent backing bars, rings, straps, etc. shall be used.

SEE PRODUCTION DRAWINGS

PROFESSIONAL PROJECTS
DEC 02 2015
RECEIVED

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welding. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfgr. sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

ROOT GAP 0" MIN. - 3/16" MAX.

BASE METALS (QW-403)
P-No. 1 Group No. ** 1 & 2 to P-No. 1 Group No. ** 1 & 2
OR
Specification type and grade: SA-516-GR.70 Normalized
to Specification type and grade: SA-516-GR.70 Normalized
OR
Chem. Analysis and Mech. Prop.:
to Chem. Analysis and Mech. Prop.:

Thickness Range:
Base Metal: Groove .1875"** - 8.00" * Fillet All
Pipe Dia. Range: Groove All Fillet All
Other:

FILLER METALS (QW-404)	GMAW	FCAW	
Spec. No. (SFA)	5.18	5.20	
AWS No. (Class)	ER70S-2	E71T-1MJH4 (1.60% Mn Max.)	
F-No.	6	6	
A-No.	1	1	
Size of Filler Metals	.035" (Bare)	.045" (Flux Cored)	
Deposited Weld Metal Thickness Range:	.126"	1.625"	
Groove	.1375" Max.	8.00" Max.	
Fillet	All	All	
Electrode-Flux (Class)	----	----	
Flux Trade Name	----	ESAB Dual Shield II 70T-12H4	
Consumable Insert	----	----	
Other	No Supplementary Filler Metal or Powdered Filler Metal Shall Be Used.		

Each base metal-filler metal combination should be recorded individually.

** WHEN IMPACT TESTING IS REQUIRED BASE MATERIAL TO BE P1 GROUP 2 AND MINIMUM THICKNESS QUALIFIED IS .625" with a maximun thickness of 8.00"
** WPS maybe used with base metal normalized conditions.
** WPS maybe used for Sour Service and all other welds that maybe exposed to enviroments that may cause stress, corrosion and cracking

LEGEND
** WHEN IMPACTS ARE REQUIRED
*** WITHOUT IMPACTS

QW-482 (Back)

WPS No. 149 DCP Rev. 2

POSITIONS (QW-405)	
Position(s) of Groove	** 1G (Flat) / *** All Positions
Welding Progression:	Up: **XX Down: ----
Position(s) of Fillet	** 1F, 2F / *** All Positions
PREHEAT (QW-406)	
Preheat Temp. Min.	* 175°F < 1"; 200°F > 1"
Interpass Temp. Max.	300° F
Preheat Maintenance	None
(Continuous or special heating where applicable should be recorded)	
POSTWELD HEAT TREATMENT (QW-407)	
Temperature Range	* 1150° F ± 25° F
Time Range	1 Hour per inch of thickness/1hr minimum
Maximum hold time 1.75 hrs	
GAS (QW-408)	
Shielding Gas(es)	Argon / CO^2
Percent Composition (mixture)	75% Argon
	25% CO^2
Flow Rate	30-40 CFH
Gas Backing	None
Trailing Shielding Gas Composition	None

ELECTRICAL CHARACTERISTICS (QW-409)

Current AC or DC: Direct Polarity: Reverse

Amps (Range) * Volts (Range) **

(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

*	**
GMAW	GMAW
120-190	18-20
FCAW	FCAW
130-265	22-29

Tungsten Electrode Size and Type: - (Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW: GMAW - Short Circuiting / FCAW - Spray Transfer (Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range: GMAW - 120-140 IPM / FCAW - 150-520 IPM

TECHNIQUE (QW-410)

String or Weave Bead: String

Orifice or Gas Cup Size: GMAW: 1/2" / FCAW: 3/4"

Initial and Interpass Cleaning (Brushing, Grinding, etc.): Grind in bevel and 1" each side of joint. Grind, wire brush and scaling hammer between layers of weld metal. Surfaces shall be clean and free of paint, oil, dirt, scale, oxides and other detrimental material.

Method of Back Gouging: Carbon-Arc and grind to sound metal to completely remove GMAW Root Pass.

Oscillation: None

Contact Tube to Work Distance: 3/8" - 1.0"

Multiple or Single Pass (per side): Multiple

Multiple or Single Electrodes: Single

Travel Speed (Range): GMAW: 6-10 IPM / FCAW: 12-14 IPM

Peening: Is not allowed. A scaling hammer (jitterbug) is not considered peening.

Other: No pass greater than 1/4" allowed
Where required back weld using FCAW process.

Weld Layers	Process	Filler Metal Class	Filler Metal Diameter	Current Type Polarity	Current Amp. Range	Volt Range	IPM Travel Speed Range	Other (E.G., Remarks, Comments, Hot Wire Addition, Technique Torch Angle, etc.)
Root	GMAW	ER70S-2	.035"	DC-Rev.	120-190	18-20	6-10	max 22,800 j/in
2nd Completion	FCAW	E71T-1MJH4	.045"	DC-Rev.	130-265	22-29	12-14	max 32,935 j/in

* FOR SOUR SERVICE MINIMUM PREHEAT TO BE 200° F & PWHT WILL BE AT 1175° F ± 25° F

Professional Projects, Inc.

18115 Tolge Road, Cypress, TX 77429

ASME - Procedure Qualification Record (PQR) - QW-483

WeldOffice WPS

PQR record number	149-1 DCP	Revision 0	WPS record number	149 DCP	Revision 0
Date	4/25/2013		Company name	Professional Projects, Inc.	
			Welding standard	ASME Section IX	

BASE METALS (QW-403)

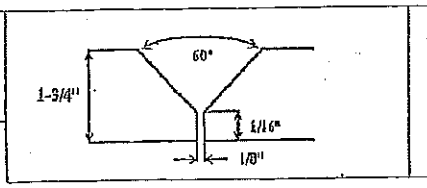
	Product form	Specification (type or grade)	P no.	Grp no.	Size	Sch.	Thick. (in.)	Dia. (in.)
Welded to:	Plate	SA-516 (70) N	1	2	-	-	1.760	-
	Plate	SA-516 (70) N	1	2	-	-	1.750	-
and tested. Notes	With PWHT, With Impacts, With hardness							

POST WELD HEAT TREATMENT (QW-407)

Temperature	(°F)	1150	Time	(hrs)	1.75	Type	Stress relief
Heating rate	(°F/hr)	228	Method		Furnace		
Cooling rate	(°F/hr)	256	Method		Furnace		
Notes	Controlled heating and cooling from 600°F.						

JOINTS (QW-402)

Joint design		Single-V-groove
Backing:		Yes; weld metal
Retainers		None
Groove angle	(deg.)	60
Root opening	(in.)	1/8
Root face	(in.)	1/16



WELDING PROCESSES

Welding process		GMAW	FCAW
Type		Semi-automatic	Semi-automatic

FILLER METALS (QW-404)

SFA specification		5.18	5.20
AWS classification		ER70S-2	E71T-12M-JH4
Filler metal F-number		6	6
Weld metal A-number		1	11
Filler metal nominal composition		solid wire	flux cored
Filler metal trade name		not recorded	not recorded
Filler metal size	(in.)	.035	.045
Deposited thickness	(in.)	.125	1.625
Maximum pass thickness	(in.)	.125	.125
Weld deposit chemistry		carbon steel	carbon steel
Supplemental filler metal		none	none
Supplemental filler metal vol.	(in³)	none	none

POSITION (QW-405)

Position	1G	1G
Weld progression	-	-

PREHEAT (QW-406)

Preheat temperature	(°F)	200	200
Maximum interpass temperature	(°F)	300	300

GAS (QW-408)

Shielding gas:	Type		75% Argon, 25% CO2	75% Argon, 25% CO2
	Flow rate	(cfh)	40	40
Trailing gas:	Type		None	None
	Flow rate	(cfh)	-	-
Backing gas:	Type		None	None
	Flow rate	(cfh)	-	-

ELECTRICAL (QW-409)

Filler metal size	(in.)	.035	.045
Amperes		182	227
Volts		23	25
Travel speed	(in./min)	10	16
Maximum heat input	(kJ/in.)	25.1[1]	23.835
Current/polarity		DCEP (reverse polarity)	DCEP (reverse polarity)
Wire feed speed	(in./min)	280	360
Arc transfer mode		Short-circuiting	Spray

TECHNIQUE (QW-410)

String or weave		Stringer	Stringer
Orifice/gas cup size		3/4	3/4
C.T.W.D.	(in.)	3/4	3/4
Multi/single pass per side		Single pass	Multiple passes
Peening		Not used	Not used
Initial/interpass cleaning		Brushing and Grinding	Brushing and Grinding
Back gouging method		Grinding	None

Professional Projects, Inc.

10115 Telge Road, Cypress, TX 77429

ASME - Procedure Qualification Record (PQR) - Test results (PWHT)

WeldOffice WPS

PQR record number	149-1 DCP	Revision 0	WPS record number	149 DCP	Revision 0
Date	4/25/2013		Company name	Professional Projects, Inc.	
			Welding standard	ASME Section IX	

TENSILE TESTS (QW-150) — Reduced section

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
T-1	.748	.631	0.6216	49100	79000	Ductile-BM
T-2	.749	.601	0.5999	44800	75000	Ductile-BM
T-3	.746	.621	0.6141	48500	79000	Ductile-BM
T-4	.743	.605	0.5931	45700	78500	Ductile-BM

Comments

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
4 transverse side bends per QW-161.1 and QW-462.2	QW-163	Acceptable	spec-ASME IX - QW-451.1

Comments

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	Impact values (% Shear)	Impact values (Mils)	Drop weight break
	Weld Metal	V-notch	0.394 x 0.394	-50	33-40-47	30-40-40	29-42-41	
	Weld Metal 1/4 T	V-notch	0.394 x 0.394	-50	46-37-66	20-30-50	17-31-58	
	HAZ	V-notch	0.394 x 0.394	-50	76-50-69	40-30-40	20-50-70	

Comments

HARDNESS TEST

Type (Scale)	Distance from surface	BA-518 (70) R	HAZ	Weld	HAZ	BA-518 (70) N
Vickers (HV) 10Kg	1/16" from surface	140	167-193	220-199-185	183-173	160
Vickers (HV) 10Kg	Mid wall		192	211	187	
Vickers (HV) 10Kg	1/16" above surface	165	184-188	221-215	203-190	180

Comments

OTHER TESTS

Type of test	Acceptance criteria	Result	Comments
Weld Metal Chemistry		Acceptable	see page 3

Comments

CERTIFICATION

Welder's name	ID Number	Stamp number		
			Mechanical testing by	Dynamic Laboratories, Inc.
			Laboratory test number	MT13-282
			Test file number	
			Tests conducted by	Jesus Vazquez

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

Dynamic Laboratories, Inc.		Professional Projects, Inc.	
Name	Signature	Name	Signature
Randy Maxey		SETH B. WESTBROOK	
Date		Date	
4/25/2013		4/26/2013	

PQR record number	149-1 PQR	Revision 0	WPS record number	149 PQR	Revision 0
Date	4/25/2013		Company name	Professional Projects, Inc.	
			Welding standard	ASME Section IX	

C	Mn	Si	S	P	Cr	Ni	Mo	V	Al	Cu	Ti	Zr	Nb	B
.05	1.26	.72	.001	.02	.03	.04	.01	.01	.02	.14	.03	.005	.01	.0007

"ALSO FOR SOUR SERVICE FABRICATION"

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

(See QW-201.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name: Professional Projects, Inc. By: Seth B. Westbrook

Welding Procedure Specification No. 151 DCP Date 3/07/13 Supporting PQR No.(s) 151-1 DCP

Revision No. 1 Date 5/28/2013

Welding Process(es): GMAW / FCAW / SAW Type(s) Semi-Automatic / Machine

(Automatic, Manual, Machine, or Semi-Auto)

JOINTS (QW-402)	Details
Joint Design: All Types: Groove & Fillet	SEE PRODUCTION DRAWINGS
Backing (Yes) FCAW, SAW (No) GMAW	
Backing Material (Type) Base / Weld Metal (Refer to both backing and retainers.)	
Metal Nonmetallic Nonfusing Metal Other . No permanent backing bars, rings, straps, etc. shall be used.	
Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welding. Where applicable, the root spacing and the details of weld groove may be specified.	
(At the option of the Mfgr. sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)	ROOT GAP 0" MIN. - 3/16" MAX.

PROFESSIONALPROJECTS

DEC 02 2015

RECEIVED

BASE METALS (QW-403)					
P-No. 1	Group No. ** 1 & 2	to P-No. 1	Group No. ** 1 & 2		
OR					
Specification type and grade	SA-516-GR.70 Normalized				
to Specification type and grade	SA-516-GR.70 Normalized				
OR					
Chem. Analysis and Mech. Prop.					
to Chem. Analysis and Mech. Prop.					
Thickness Range:					
Base Metal: Groove	.1875"** - 8.00" *	Fillet	All		
Pipe Dia. Range: Groove	All	Fillet	All		
Other:					

FILLER METALS (QW-404)	GMAW	FCAW	SAW
Spec. No. (SFA)	5.18	5.20	5.17
AWS No. (Class)	ER70S-2	E71T-1MJH4 (1.60% Mn)	EH14K
F-No.	6	6	6
A-No.	1	1	1
Size of Filler Metals	.035" (Bare)	.045"(FLUX CORED)	3/32", 1/8"
Deposited Weld Metal Thickness Range:	.125"	.250"	1.375"
Groove	.1375" Max.	.500" Max.	8.00" Max.
Fillet	All	All	All
Electrode-Flux (Class)	----	----	ESAB Spool Arc 71
Flux Trade Name	----	Dual Shield II 70T-12H4	ESAB OK Flux 10.62
Consumable Insert	----	----	----
Other	No Supplementary Filler Metal or Powdered Filler Metal Shall Be Used.		

Each base metal-filler metal combination should be recorded individually. SAW: No Recrushed Slag Used.

** WHEN IMPACT TESTING IS REQUIRED BASE MATERIAL TO BE P1 GROUP 2 AND MINIMUM THICKNESS QUALIFIED IS .625"

** base metal is in the normalized condition

FLUOR.

A – PROCEED

Authorization to proceed does not relieve Contractor/Supplier of its responsibility or liability under the Contract and or Purchase Order.

By Mario Ragma on Nov 27, 2015

FLUOR

DOC. NO. A7DJ

REC'D: 02-DEC-2015

A7DJ-FAR-4-0207-00003-3A

EQUIP/TAG NUMBER

126-1103

126-1203

126-1202

126-1204

126-1205

126-1212

27-1226-04

126-1206

27-1213-02

** WHEN IMPACTS ARE REQUIRED
*** WITHOUT IMPACTS

QW-482 (Back)

WPS No. 151 DCP Rev. 1

POSITIONS (QW-405) **1G (Flat)
Position(s) of Groove: *** SAW 1G ; GMAW / FCAW All Positions
Welding Progression: Up: FCAWGMAW Down: ---
Position(s) of Fillet: ** 1F, 2F / *** SAW 1F, 2F
GMAW / FCAW All Positions

PREHEAT (QW-406)
Preheat Temp. Min. *175°F < 1" / 200° > 1"
Interpass Temp. Max. 350°
Preheat Maintenance None
(Continuous or special heating where applicable should be recorded)

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range 1175°F +- 25 degrees
Time Range 1.75 hr min(1 hr min per in for sour service 1hr min less than 1" thick)

GAS (QW-408) GMAW / FCAW Processes Only
Shielding Gas(es) ARGON / CO^2
Percent Composition (mixture) 75% Aron 25% CO^2
Flow Rate 30-40 CFH
Gas Backing None
Trailing Shielding Gas Composition None

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC Direct Polarity Reverse
Amps (Range) * Volts (Range) **
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

	*	**
GMAW	115-125	18-20
FCAW	130-265	22-29
SAW	400-700	28-35

Tungsten Electrode Size and Type ------------------------
(Pure Tungsten, 2% Thoriated, etc.)
Mode of Metal Transfer fro GMAW GMAW - Short Circuiting / FCAW - Spray Transfer
(Spray arc, short circuiting arc, etc.)
Electrode Wire feed speed range GMAW - 120-140 IPM / FCAW - 150-520 IPM / SAW - 60-80 IPM

TECHNIQUE (QW-410)
String or Weave Bead String
Orifice or Gas Cup Size GMAW - 1/2" / FCAW - 3/4" / SAW - 3/4"
Initial and Interpass Cleaning (Brushing, Grinding, etc.) Grind in bevel and 1/2" each side of joint. Grind, wire brush and scaling hammer between layers of weld metal. Surfaces shall be clean and free of paint, oil, scale and other detrimental materials
Method of Back Gouging Carbon-Arc to remove GMAW Root Pass completely and grind to sound metal.
Oscillation None
Contact Tube to Work Distance GMAW & FCAW 3/8" - 1" / SAW 1" - 1-1/2"
Multiple or Single Pass (per side) Multiple
Multiple or Single Electrides Single
Travel Speed (Range) GMAW: 6-9 IPM / FCAW: 12-14 IPM / SAW: 16-20 IPM
Peening Is not allowed. A scaling hammer (jitterbug) is not considered peening.
Other No pass greater than 3/8" allowed
Where required back weld using FCAW process.

Weld Layers	Process	Filler Metal Class	Filler Metal Diameter	Current Type Polarity	Current Amp. Range	Volt Range	IPM Travel Speed Range	Other (E.G., Remarks, Comments, Hot Wire Addition, Technique Torch Angle, etc.)
ROOT	GMAW	ER70S-2	.035"	DC-REV.	120-130	20-22	6-9	max 19,066 J/in
Hot Pass	FCAW	E71T-1MJH4	.045"	DC-REV.	130-265	22-29	12-14	max 32,935 J/in
3rd	SAW	EM14K	1/8"	DC-REV.	400-700	28-39	16-20	max 81,900 J/in
Completion 1 Side	SAW	EM14K	3/32"	DC-REV.	400-600	28-39	14-18	max 78,000 J/in
Backweld	FCAW	E71T-1MJH4	.045"	DC-REV.	130-265	22-29	12-14	max 32,935 J/in

* FOR SOUR SERVICE MINIMUM PREHEAT TO BE 200 °F

Professional Projects, Inc.

18115 Telge Road, Cypress, TX 77429

ASME - Procedure Qualification Record (PQR) - QW-483

WeldOffice WPS

PQR record number	161-1 DCP	Revision 0	WPS record number	161 DCP	Revision 0
Date	4/26/2013		Company name	Professional Projects, Inc.	
			Welding standard	ASME Section IX	

BASE METALS (QW-403)

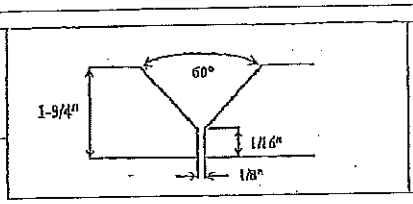
	Product form	Specification (type or grade)	P no.	Grp no.	Size	Sch.	Thick. (in.)	Dia. (in.)
Welded to:	Plate	SA-516 (70) N	1	2	-	-	1.750	-
	Plate	SA-516 (70) N	1	2	-	-	1.750	-
and tested	With PWHT; With impacts; With hardness							
Notes								

POST WELD HEAT TREATMENT (QW-407)

Temperature	(°F)	1150	Time	(hrs)	1.75	Type	Stressrelief
Heating rate	(°F/hr)	229	Method		Furnace		
Cooling rate	(°F/hr)	288	Method		Furnace		
Notes		Controlled heating and cooling from 600°F.					

JOINTS (QW-402)

Joint design		Single-V-groove
Backing:		Yes; weld metal
Retainers		None
Groove angle	(deg.)	60
Root opening	(in.)	1/8
Root face	(in.)	1/16



WELDING PROCESSES

Welding process	GMAW	FCAW	SAW
Type	Semi-automatic	Semi-automatic	Automatic

FILLER METALS (QW-404)

SFA specification		5.18	5.20	5.17
AWS classification		ER70S-2	E71T-12M-JH4	EM14K
Filler metal F-number		6	6	6
Weld metal A-number		1	11	1
Filler metal nominal composition		solid wire	flux cored	solid wire
Filler metal trade name		not recorded	not recorded	ESAB Spool Arc 71
Filler metal size	(in.)	.035	.045	1/8
Deposited thickness	(in.)	.125	.250	1.375
Maximum pass thickness	(in.)	.125	.125	.250
Weld deposit chemistry		carbon steel	carbon steel	carbon steel
Flux AWS specification		-	-	5.17
Flux AWS classification		-	-	F7A8
Flux nominal composition		-	-	bonded flux
Flux trade name		-	-	ESAB OK Flux 10.62
Flux type		-	-	Neutral flux
Flux from recrushed slag		-	-	fle
Supplemental filler metal		none	none	none
Supplemental filler metal vol.	(in³)	none	none	none

POSITION (QW-405)

Position	1G	1G	1G
Weld progression	-	-	-

PREHEAT (QW-406)

Preheat temperature	(°F)	200	200	200
Maximum interpass temperature	(°F)	350	350	350

GAS (QW-408)

Shielding gas:	Type	75% Argon, 25% CO2	75% Argon, 25% CO2	-
	Flow rate (cfh)	40	40	-
Trailing gas:	Type	None	None	-
	Flow rate (cfh)	-	-	-
Backing gas:	Type	None	None	-
	Flow rate (cfh)	-	-	-

ELECTRICAL (QW-409)

Filler metal size	(in.)	.035	.045	1/8
Amperes		162	227	550
Volts		23	28	29
Travel speed	(in./min)	16	16	13
Maximum heat input	(kJ/in.)	25,116	23,635	73,516
Current/polarity		DCEP (reverse polarity)	DCEP (reverse polarity)	DCEP (reverse polarity)
Wire feed type		-	-	Cold wire
Wire feed speed	(in./min)	250	350	57
Arc transfer mode		Short-circuiting	Spray	-

TECHNIQUE (QW-410)

String or weave		Stringer	Stringer	Stringer
Orifice/gas cup size		3/4	3/4	-
Contact tip to work distance	(in.)	3/4	3/4	1.5
Oscillation		-	-	None
Multi/single electrode		-	-	Single electrode
Electrode angle	(deg.)	-	-	90
Multi/single pass per side		Single pass	Multiple passes	Multiple passes
Multiple or single layer		-	-	Multiple layer
Peening		Not used	Not used	Not used
Initial/interpass cleaning		Brushing and Grinding	Brushing and Grinding	Brushing and Grinding
Back gouging method		Grinding	None	None

Professional Projects, Inc.

10115 Telge Road, Cypress, TX 77429

ASME - Procedure Qualification Record (PQR) - Test results (PWHT)

WeldOffice WPS

PQR record number	151-1 DCP	Revision 0	WPS record number	151 DCP	Revision 0
Date	4/26/2013		Company name	Professional Projects, Inc.	
			Welding standard	ASME Section IX	

TENSILE TESTS (QW-150)

Reduced section

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
T-1A	.753	.621	0.6152	49600	80590	Ductile-BM
T-1B	.754	.780	0.6002	46100	77000	Ductile-BM
T-2A	.754	.807	0.6085	46800	80000	Ductile-BM
T-2B	.753	.803	0.6659	46800	77000	Ductile-BM

Comments

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
4 transverse side bends per QW-451.1 and QW-462.2	QW-163	Acceptable	see - ASME IX - QW-451.1

Comments

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	(% Shear)	(Mils)	Drop weight break
	Weld Metal	V-notch	0.394 x 0.394	-50	100-84-108	60-40-70	83-71-90	
	Weld Metal 1/4 T	V-notch	0.394 x 0.394	-50	88-105-78	75-75-60	80-91-65	
	HAZ	V-notch	0.394 x 0.394	-50	69-73-20	40-30-10	63-68-20	

Comments

HARDNESS TEST

Type (Scale)	Distance from surface	SA-516 (70) N	HAZ	Weld	HAZ	SA-516 (70) N
Vickers (HV) 10Kg	1/16" from surface	161	170-176	199-220-203	193-208	148
Vickers (HV) 10Kg	Mid wall		178	174	174	
Vickers (HV) 10Kg	1/16" above surface	152	174-187	237-240	199-195	164

Comments

OTHER TESTS

Type of test	Acceptance criteria	Result	Comments
Weld Metal Chemistry		Acceptable	see page 3

Comments

CERTIFICATION

Welder's name	ID Number	Stamp number		
			Mechanical testing by	Dynamic Laboratories, Inc.
			Laboratory test number	54713-263
			Test file number	
			Tests conducted by	Jesus Vazquez

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

Dynamic Laboratories, Inc.		Professional Projects, Inc.	
Name	Signature	Name	Signature
Randy Maxey		SETH B. DESTEFANO	
Date		Date	
4/26/2013		4/27/2013	

PQR record number	151-1 DCP	Revision 0	WPS record number	151 DCP	Revision 0
Date	4/18/2013		Company name	Professional Projects, Inc.	
			Welding standard	ASME Section IX	

C	Mn	Si	S	P	Cr	Ni	Mo	V	Al	Cu	Ti	Zr	Nb	B
.01	1.26	.70	.002	.01	.03	.04	.01	.01	.02	.14	.03	.005	.01	.00063

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Eduardo Martinez Navejar Clock No.: _____ Stamp No.: Dot.T

Using WPS No.: 149 DCP Rev.: 2 Date: 5/28/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification	Qualification Ranges
Process	GMAW / FCAW	GMAW / FCAW
Process Type	Semi-Auto	Semi-Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With	Without / With
Material Spec. (QW-403)	P1 to P1	P1 to P1
Thickness	----------	.1875" - 8.00"
Groove	----------	All
Fillet		
Diameter	All	2 7/8" OD & Over
Groove	All	All
Fillet		
Filler Metal (QW-404)	5.18 / 5.20	5.18 / 5.20
Spec. No.	ER70S-2/E71T-1MJH4	ER70S-2/E71T-1MJH4
Class	6 / 6	6 / 6
F-No.	GMAW= .125"	GMAW= .1375" Max.
Deposited Weld Metal Thickness	FCAW= 1.625"	FCAW= 8.00" Max.
Groove _____ Fillet _____	1G (Flat)	1G (Flat)
Position (QW-405)	Uphill/Downhill	Uphill/Downhill
Weld Progression (QW-410)	75% Argon / 25% CO^2	75% Argon / 25% CO^2
Gas Type (QW-408)		
Gas Backing: N/A		
Electrical Characteristics (QW-409)	DC	DC
Current	Reverse	Reverse
Polarity		

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results: _____

Fillet Weld Test Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen) _____

Length and Per Cent of Defects _____ inches _____ %

Marco Test-Fusion _____

Apperance-Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

Other: **Visual Examination - Satisfactory**

Test Conducted by: Professional Projects, Inc. Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

By: _____

Date: 6/24/2012

CERTIFIED COPY

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Eduardo Martinez Navejar Clock No.: _____ Stamp No.: Dot.T

Using WPS No.: 151DCP Rev.: 1 Date: 5/28/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification		Qualification Ranges
Process	GMAW / FCAW / SAW		GMAW / FCAW / SAW
Process Type	Semi-Auto / Auto		Semi-Auto / Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With / With	With /	Without / With / With
Material Spec. (QW-403)	P1 to P1		P1 to P1
Thickness	.750"		.1875" - 1.50"
Groove	- - - - - - - - - -		All
Fillet			
Diameter	- - - - - - - - - -		2-7/8" & Over
Groove	- - - - - - - - - -		All
Fillet			
Filler Metal (QW-404)	5.18 / 5.20 / 5.17		5.18 / 5.20 / 5.17
Spec. No.	ER70S-2 / E71T-1 / EM13K		ER70S-2 / E71T-1 / EM13K
Class	6 / 6 / 6		6 / 6 / 6
F-No.	GMAW= .125"		GMAW= .1375" Max.
Deposited Weld Metal Thickness	FCAW= .3125"		FCAW= .625 Max.
Groove _____ Fillet _____	SAW= .4375"		SAW= .875" Max
Position (QW-405)	1G		1G
Weld Progression (QW-410)	Uphill/Downhill/Downhill		Downhill
Gas Typ (QW-408)	75% Argon / 25% CO^2		75% Argon / 25% CO^2
Gas Backing: N/A			
Electrical Characteristics (QW-409)			
Current	DC		DC
Poliarity	Reverse		Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results: _____

Fillet Weld Terst Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen) _____

Length and Per Cent of Defects _____ inches _____ %

Marco Test-Fusion _____

Apperance-Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

Visual Examination - Satisfactory

Test Conducted by: Professional Projects, Inc. Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

By: _____

Date: 6/20/2012

CERTIFIED BY CCM

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

* No Consumable Inserts

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Francisco Morales Clock No.: _____ Stamp No.: E

Using WPS No.: 149 DCP Rev.: 2 Date: 5/28/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification	Qualification Ranges
Process	GMAW / FCAW	GMAW / FCAW
Process Type	Semi-Auto	Semi-Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With	Without / With
Material Spec. (QW-403)	P1 to P1	P1 to P1
Thickness		
Groove	----------	.1875" - 8.00"
Fillet	----------	All
Diameter		
Groove	All	2 7/8" OD & Over
Fillet	All	All
Filler Metal (QW-404)		
Spec. No.	5.18 / 5.20	5.18 / 5.20
Class	ER70S-2/E71T-1MJH4	ER70S-2/E71T-1MJH4
F-No.	6 / 6	6 / 6
Deposited Weld Metal Thickness	GMAW= .125"	GMAW= .1375" Max.
Groove _____ Fillet _____	FCAW= 1.625"	FCAW= 8.00" Max.
Position (QW-405)	1G (Flat)	1G (Flat)
Weld Progression (QW-410)	Uphill/Downhill	Uphill/Downhill
Gas Type (QW-408)	75% Argon / 25% CO^2	75% Argon / 25% CO^2
Gas Backing: N/A		
Electrical Characteristics (QW-409)		
Current	DC	DC
Polarity	Reverse	Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results: _____

Fillet Weld Test Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen) _____

Length and Per Cent of Defects _____ inches _____ %

Marco Test-Fusion _____

Apperance-Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

Other: **Visual Examination - Satisfactory**

Test Conducted by: Professional Projects, Inc. Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

Date: 3/13/2017 **By:** _____

CERTIFIED QCM

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Francisco Morales | Clock No. | Stamp No.: E

Using WPS No.: 151DCP | Rev.: 1 | Date: 5/28/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification		Qualification Ranges
Process	GMAW / FCAW / SAW		GMAW / FCAW / SAW
Process Type	Semi-Auto / Auto		Semi-Auto / Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With / With	With /	Without / With / With
Material Spec. (QW-403)	P1 to P1		P1 to P1
Thickness			
Groove	.750"		.1875" - 1.50"
Fillet	- - - - - - - - - -		All
Diameter			
Groove	- - - - - - - - - -		2-7/8" & Over
Fillet	- - - - - - - - - -		All
Filler Metal (QW-404)			
Spec. No.	5.18 / 5.20 / 5.17		5.18 / 5.20 / 5.17
Class	ER70S-2 / E71T-1 / EM13K		ER70S-2 / E71T-1 / EM13K
F-No.	6 / 6 / 6		6 / 6 / 6
Deposited Weld Metal Thickness	GMAW= .125"		GMAW= .1375" Max.
Groove _____ Fillet _____	FCAW= .3125"		FCAW= .625 Max.
	SAW= .4375"		SAW= .875" Max
Position (QW-405)	1G		1G
Weld Progression (QW-410)	Uphill/Downhill/Downhill		Downhill
Gas Typ (QW-408)	75% Argon / 25% CO^2		75% Argon / 25% CO^2
Gas Backing: N/A			
Electrical Characteristics (QW-409)			
Current	DC		DC
Poliarity	Reverse		Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results: _____

Fillet Weld Terst Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen) _____

Length and Per Cent of Defects _____ inches _____ %

Marco Test-Fusion _____

Apperance-Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

Visual Examination - Satisfactory

Test Conducted by: Professional Projects, Inc. | Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

Date: 5/25/2016 **By:** _____

CERTIFIED PPI QC

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

* No Consumable Inserts

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Emmanuel Cruz Clock No.: _____ Stamp No.: I

Using WPS No.: 149 DCP Rev.: 2 Date: 5/28/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification	Qualification Ranges
Process	GMAW / FCAW	GMAW / FCAW
Process Type	Semi-Auto	Semi-Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With	Without / With
Material Spec. (QW-403)	P1 to P1	P1 to P1
Thickness		
Groove	----------	.1875" - 8.00"
Fillet	----------	All
Diameter		
Groove	All	2 7/8" OD & Over
Fillet	All	All
Filler Metal (QW-404)		
Spec. No.	5.18 / 5.20	5.18 / 5.20
Class	ER70S-2/E71T-1MJH4	ER70S-2/E71T-1MJH4
F-No.	6 / 6	6 / 6
Deposited Weld Metal Thickness	GMAW= .125"	GMAW= .1375" Max.
Groove _____ Fillet _____	FCAW= 1.625"	FCAW= 8.00" Max.
Position (QW-405)	1G (Flat)	1G (Flat)
Weld Progression (QW-410)	Uphill/Downhill	Uphill/Downhill
Gas Type (QW-408)	75% Argon / 25% CO^2	75% Argon / 25% CO^2
Gas Backing: N/A		
Electrical Characteristics (QW-409)		
Current	DC	DC
Polarity	Reverse	Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results: _____

Fillet Weld Test Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen) _____

Length and Per Cent of Defects _____ inches _____ %

Marco Test-Fusion _____

Apperance-Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

Other: **Visual Examination - Satisfactory**

Test Conducted by: Professional Projects, Inc. Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

By: _____

Date: 6/23/2013

CERTIFIED PROJECTS

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Emmanuel Cruz | Clock No. | Stamp No.: I

Using WPS No.: 151DCP | Rev.: 1 | Date: 5/28/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification		Qualification Ranges
Process	GMAW / FCAW / SAW		GMAW / FCAW / SAW
Process Type	Semi-Auto / Auto		Semi-Auto / Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With / With	With /	Without / With / With
Material Spec. (QW-403)	P1 to P1		P1 to P1
Thickness			
Groove	.750"		.1875" - 1.50"
Fillet	- - - - - - - - - -		All
Diameter			
Groove	- - - - - - - - - -		2-7/8" & Over
Fillet	- - - - - - - - - -		All
Filler Metal (QW-404)			
Spec. No.	5.18 / 5.20 / 5.17		5.18 / 5.20 / 5.17
Class	ER70S-2 / E71T-1 / EM13K		ER70S-2 / E71T-1 / EM13K
F-No.	6 / 6 / 6		6 / 6 / 6
Deposited Weld Metal Thickness	GMAW= .125"		GMAW= .1375" Max.
Groove _____ Fillet _____	FCAW= .3125"		FCAW= .625 Max.
	SAW= .4375"		SAW= .875" Max
Position (QW-405)	1G		1G
Weld Progression (QW-410)	Uphill/Downhill/Downhill		Downhill
Gas Typ (QW-408)	75% Argon / 25% CO^2		75% Argon / 25% CO^2
Gas Backing: N/A			
Electrical Characteristics (QW-409)			
Current	DC		DC
Poliarity	Reverse		Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results:

Fillet Weld Terst Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen)

Length and Per Cent of Defects _____ inches _____ %

Marco Test-Fusion

Apperance-Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

Visual Examination - Satisfactory

Test Conducted by: Professional Projects, Inc. | Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

Date: 7/3/2016 **By:**

CERTIFIED PPI CWI

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

* No Consumable Inserts

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Roberto Alverez | Clock No. | Stamp No.: K

Using WPS No.: 149 DCP | Rev.: 2 | Date: 5/28/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification	Qualification Ranges
Process	GMAW / FCAW	GMAW / FCAW
Process Type	Semi-Auto	Semi-Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With	Without / With
Material Spec. (QW-403)	P1 to P1	P1 to P1
Thickness		
Groove	----------	.1875" - 8.00"
Fillet	----------	All
Diameter		
Groove	All	2 7/8" OD & Over
Fillet	All	All
Filler Metal (QW-404)		
Spec. No.	5.18 / 5.20	5.18 / 5.20
Class	ER70S-2/E71T-1MJH4	ER70S-2/E71T-1MJH4
F-No.	6 / 6	6 / 6
Deposited Weld Metal Thickness	GMAW= .125"	GMAW= .1375" Max.
Groove ____ Fillet ____	FCAW= 1.625"	FCAW= 8.00" Max.
Position (QW-405)	1G (Flat)	1G (Flat)
Weld Progression (QW-410)	Uphill/Downhill	Uphill/Downhill
Gas Type (QW-408)	75% Argon / 25% CO^2	75% Argon / 25% CO^2
Gas Backing: N/A		
Electrical Characteristics (QW-409)		
Current	DC	DC
Polarity	Reverse	Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results:

Fillet Weld Test Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen)

Length and Per Cent of Defects ____ inches ____ %

Marco Test-Fusion

Apperance-Fillet Size (leg) ____ in. X ____ in. Convexity ____ in. or Concavity ____ in.

Other: **Visual Examination - Satisfactory**

Test Conducted by: Professional Projects, Inc. | Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

Date: 3/13/2017 **By:**

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Roberto Alvarez | Clock No. | Stamp No.: K

Using WPS No.: 151DCP | Rev.: 2 | Date: 2/12/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification		Qualification Ranges
Process	GMAW / FCAW / SAW		GMAW / FCAW / SAW
Process Type	Semi-Auto / Auto		Semi-Auto / Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With / With	With /	Without / With / With
Material Spec. (QW-403)	P1 to P1		P1 to P1
Thickness			
Groove	.750"		.1875" - 1.50"
Fillet	- - - - - - - - - -		All
Diameter			
Groove	- - - - - - - - - -		2-7/8" & Over
Fillet	- - - - - - - - - -		All
Filler Metal (QW-404)			
Spec. No.	5.18 / 5.20 / 5.17		5.18 / 5.20 / 5.17
Class	ER70S-2 / E71T-1 / EM13K		ER70S-2 / E71T-1 / EM13K
F-No.	6 / 6 / 6		6 / 6 / 6
Deposited Weld Metal Thickness	GMAW= .125"		GMAW= .1375" Max.
Groove _____ Fillet _____	FCAW= .3125"		FCAW= .625 Max.
	SAW= .4375"		SAW= .875" Max
Position (QW-405)	1G		1G
Weld Progression (QW-410)	Uphill/Downhill/Downhill		Downhill
Gas Typ (QW-408)	75% Argon / 25% CO^2		75% Argon / 25% CO^2
Gas Backing: N/A			
Electrical Characteristics (QW-409)			
Current	DC		DC
Poliarity	Reverse		Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results: _____

Fillet Weld Terst Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen) _____

Length and Per Cent of Defects _____ inches _____ %

Marco Test-Fusion _____

Apperance-Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

Visual Examination - Satisfactory

Test Conducted by: Professional Projects, Inc. | Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

Date: 2/12/2013 **By:** _____

CERTIFIED PPI

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

* No Consumable Inserts

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Gerardo Perez | Clock No. | Stamp No.: Q

Using WPS No.: 149 DCP | Rev.: 2 | Date: 5/28/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification	Qualification Ranges
Process	GMAW / FCAW	GMAW / FCAW
Process Type	Semi-Auto	Semi-Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With	Without / With
Material Spec. (QW-403)	P1 to P1	P1 to P1
Thickness		
Groove	----------	.1875" - 8.00"
Fillet	----------	All
Diameter		
Groove	All	2 7/8" OD & Over
Fillet	All	All
Filler Metal (QW-404)		
Spec. No.	5.18 / 5.20	5.18 / 5.20
Class	ER70S-2/E71T-1MJH4	ER70S-2/E71T-1MJH4
F-No.	6 / 6	6 / 6
Deposited Weld Metal Thickness	GMAW= .125"	GMAW= .1375" Max.
Groove ____ Fillet ____	FCAW= 1.625"	FCAW= 8.00" Max.
Position (QW-405)	1G (Flat)	1G (Flat)
Weld Progression (QW-410)	Uphill/Downhill	Uphill/Downhill
Gas Type (QW-408)	75% Argon / 25% CO^2	75% Argon / 25% CO^2
Gas Backing: N/A		
Electrical Characteristics (QW-409)		
Current	DC	DC
Polarity	Reverse	Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory
Side Bend per QW462.2	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results:

Fillet Weld Test Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen)

Length and Per Cent of Defects ____ inches ____ %

Marco Test-Fusion

Apperance-Fillet Size (leg) ____ in. X ____ in. Convexity ____ in. or Concavity ____ in.

Other: **Visual Examination - Satisfactory**

Test Conducted by: Professional Projects, Inc. | Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

Date: 5/29/2013 **By:**

CERTIFIED

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

QW-484 SUGGESTED FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TEST (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name: Gerardo Perez | Clock No. | Stamp No.: Q

Using WPS No.: 151DCP | Rev.: 1 | Date: 2/12/2013

the above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification		Qualification Ranges
Process	GMAW / FCAW / SAW		GMAW / FCAW / SAW
Process Type	Semi-Auto / Auto		Semi-Auto / Auto
Backing [metal, weld metal, flux, etc. (QW-402)]	Without / With / With	With /	Without / With / With
Material Spec. (QW-403)	P1 to P1		P1 to P1
Thickness			
Groove	.750"		.1875" - 1.50"
Fillet	- - - - - - - - - -		All
Diameter			
Groove	- - - - - - - - - -		2-7/8" & Over
Fillet	- - - - - - - - - -		All
Filler Metal (QW-404)			
Spec. No.	5.18 / 5.20 / 5.17		5.18 / 5.20 / 5.17
Class	ER70S-2 / E71T-1 / EM13K		ER70S-2 / E71T-1 / EM13K
F-No.	6 / 6 / 6		6 / 6 / 6
Deposited Weld Metal Thickness	GMAW= .125"		GMAW= .1375" Max.
Groove _____ Fillet _____	FCAW= .3125"		FCAW= .625 Max.
	SAW= .4375"		SAW= .875" Max
Position (QW-405)	1G		1G
Weld Progression (QW-410)	Uphill/Downhill/Downhill		Downhill
Gas Typ (QW-408)	75% Argon / 25% CO^2		75% Argon / 25% CO^2
Gas Backing: N/A			
Electrical Characteristics (QW-409)			
Current	DC		DC
Poliarity	Reverse		Reverse

Guided Bend Test Results QW462.2(a), QW462.3(a), QW462.3(b)

Type and Figure No.	Results
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory
Side Bends per QW462.2(a)	Satisfactory

Radiographic Test Results (QW304 & QW305)

For alternative qualification of groove welds by radiography

Radiographic Results:

Fillet Weld Terst Results [See QW462.4(a), QW462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen)

Length and Per Cent of Defects _____ inches _____ %

Marco Test-Fusion

Apperance-Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

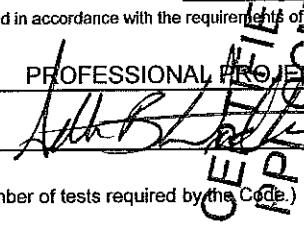
Visual Examination - Satisfactory

Test Conducted by: Professional Projects, Inc. | Laboratory-Test No.: None

We certify that the statement 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.

Organization: PROFESSIONAL PROJECTS, INC.

Date: 2/12/2013 **By:**



(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

* No Consumable Inserts

Professional Projects Inc.
18115 Telge Rd. Cypress, TX 77429

5654-1 Databook

List of Contents

Item: V-402, COLD SEPARATOR

Pressure Testing

MIDNIGHT
1
2
3
4
5
6 AM
7
8
9
10
11
NOON
1
2
3
4
5
6 PM
7
8
9
10
11
4500
4000
3500
3000
2500
2000
1500
1000
500
8-17-17
Graphic Controls
5654th
Hydro 1430
39
PI 38
R 37
Recorder
DATE
BR B 0-5000-8
START
PRINTED IN USA

Rentals  Available

JOHNNY'S GAUGE & METER REPAIRS
(713) 695-1038 • 718 DUNWOODY
HOUSTON, TEXAS 77076-1914

CALIBRATION CERTIFICATE

CUSTOMER Professional Projects, Inc.
P.O. Box 618
Cypress, Texas 77410

DATE CALIBRATED 2-01-2017
OUR INVOICE NO. 4898
CUSTOMER'S P. O. NO. _____

INDICATED RANGE 0-3,000# ACCURACY ± 0.5 % SERIAL NO. PPI-38

TYPE OF INSTRUMENT CALIBRATED 4½" McDaniel Pressure Gauge

TYPE OF STANDARD USED TO CALIBRATE Crosby Deadweight Tester
S/N-39037

ALL STANDARDS DIRECTLY TRACEABLE TO
NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO. 2.6/172409 & 6.6/139577

ROOM TEMPERATURE AT TEST 74° F

DATE OF CALIBRATION DUE 2-01-2018

INSPECTOR Fred Sull

Rentals  Available

JOHNNY'S GAUGE & METER REPAIRS
(713) 695-1038 • 718 DUNWOODY
HOUSTON, TEXAS 77076-1914

CALIBRATION CERTIFICATE

CUSTOMER Professional Projects, Inc.
P.O. Box 618
Cypress, Texas 77410

DATE CALIBRATED 4-27-2017
OUR INVOICE NO. 5193
CUSTOMER'S P. O. NO. _____

INDICATED RANGE 0-3,000# ACCURACY ± 0.5 % SERIAL NO. PPI-39

TYPE OF INSTRUMENT CALIBRATED 4½" McDaniel Pressure Gauge

TYPE OF STANDARD USED TO CALIBRATE Crosby Deadweight Tester
S/N-39037

ALL STANDARDS DIRECTLY TRACEABLE TO
NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO. 2.6/172409 & 6.6/139577

ROOM TEMPERATURE AT TEST 74° F

DATE OF CALIBRATION DUE 4-27-2018

INSPECTOR Fred Snell

Rentals  Available

JOHNNY'S GAUGE & METER REPAIRS
(713) 695-1038 • 718 DUNWOODY
HOUSTON, TEXAS 77076-1914

CALIBRATION CERTIFICATE

CUSTOMER Professional Projects, Inc.
P.O. Box 618
Cypress, Texas 77410

DATE CALIBRATED 4-27-2017
OUR INVOICE NO. 5193
CUSTOMER'S P. O. NO. _____

INDICATED RANGE 0-5,000# ACCURACY ± 1.0 % SERIAL NO. R-37

TYPE OF INSTRUMENT CALIBRATED 8" Heco Pressure Recorder

TYPE OF STANDARD USED TO CALIBRATE Crosby Deadweight Tester
S/N-39037

ALL STANDARDS DIRECTLY TRACEABLE TO
NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO. 2.6/172409 & 6.6/139577

ROOM TEMPERATURE AT TEST 74° F

DATE OF CALIBRATION DUE 4-27-2018

INSPECTOR Fred Snell

Professional Projects Inc.

18115 Telge Rd. Cypress, TX 77429

5654-1 Databook

List of Contents

Item: V-402, COLD SEPARATOR

Miscellaneous Certificates/ Reports


NB 3170
CERTIFIED BY
PPI PROFESSIONAL PROJECTS INC.
CYPRESS TEXAS
U
W
RT-1
HT
1100
-50
2017
PSI AT 150 °F
PSI AT - °F
°F AT 1100 PSI
MFGR. SER. NO. 5654-1
SA-516-70N
SA-516-70N
2.2262"
2.5"
.0625"
1430
40,667 LBS
ITEM: V-402, COLD SEPARATOR
P.O.:4500754097

#3

W H LABORATORIES 8450 Rayson • Houston, Texas 77080 • 713/895-7504 • FAX 713/895-8906

Company: Tex-Fab, Inc.

Date: 03-15-2017

Lab Report #: 17-0314-16

Attention: Jay Johnson

P.O. #:

TEMPERATURE MEASURING DEVICE CALIBRATION IN ACCORDANCE WITH WHL WORK INSTRUCTION CAL-103

The chart recorder included in this report has been calibrated in accordance with ASTM and traceable to NIST using an Analogic Digi Cal II potentiometer S/N 7977, calibration due 04-27-2017.

Model and/or Make: 0-2000°F Honeywell

Serial, Identification # or Set #: 0848Y879399200001 #3

Date Calibrated: 03-15-2017 Next Due Date: 03-15-2018

Standard Temperature Reading °F	Instrument Reading °F		Deviation °F		After Calibration °F		Deviation °F	
	Chart	LED	Chart	LED	Chart	LED	Chart	LED
200	200	200	0	0	200	200	0	0
400	400	399	0	-1	400	399	0	-1
600	600	598	0	-2	600	598	0	-2
800	800	799	0	-1	800	799	0	-1
1000	1000	1000	0	0	1000	1000	0	0
1200	1200	1198	0	-2	1200	1198	0	-2
1400	1400	1400	0	0	1400	1400	0	0
1600	1600	1602	0	+2	1600	1602	0	+2
1800	1800	1800	0	0	1800	1800	0	0
2000	2000	1999	0	-1	2000	1999	0	-1

Comments: Satisfactory. Accurate to within ± 1% of full scale.

Date: 03-15-2017

Approved by: Howard E. Heinsohn

Howard E. Heinsohn

(1) VESSEL
2½" THK X 78" ID X 17'10" OAL
TAG 5654

TEX-FAB, INC.

CHART # 227
S/O # 17-781
DATE 8-15-17
CUST PPI
PO # 17-781

DESCRIPTION

CH01 794.7 °F CH02 799.9 °F CH03 804.0 °F CH04 9999 CH05 9999 °F
16:51 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 870.2 °F CH02 875.1 °F CH03 879.0 °F CH04 9999 °F CH05 9999 °F
16:21 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 969.3 °F CH02 976.4 °F CH03 9?3.9 °F CH04 9999 °F CH05 9999 °F
15:51 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 1062 °F CH02 1065 °F CH03 1056 °F CH04 9999 °F CH05 9999 °F

L 15:30:00 14 AUG 17 GROUP A 2.00inch/h #01

15:21 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 1137 °F CH02 1143 °F CH03 1144 °F CH04 9999 °F CH05 9999 °F
14:51 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 1144 °F CH02 1140 °F CH03 1141 °F CH04 9999 °F CH05 9999 °F
14:21 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 1144 °F CH02 1144 °F CH03 1144 °F CH04 9999 °F CH05 9999 °F
13:51 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 1139 °F CH02 1139 °F CH03 1145 °F CH04 9999 °F CH05 9999 °F
13:21 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 1141 °F CH02 1149 °F CH03 1149 °F CH04 9999 °F CH05 9999 °F
12:51 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 1070 °F CH02 1073 °F CH03 1069 °F CH04 9999 °F CH05 9999 °F
12:21 14AUG17

L 12:15:00 14 AUG 17 GROUP A 2.00inch/h #01

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 1004 °F CH02 1000. °F CH03 996.8 °F CH04 9999 °F CH05 9999 °F
11:51 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 940.2 °F CH02 954.2 °F CH03 950.9 °F CH04 9999 °F CH05 9999 °F
11:21 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 852.9 °F CH02 870.8 °F CH03 882.0 °F CH04 9999 °F CH05 9999 °F
10:51 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 752.2 °F CH02 748.0 °F CH03 777.2 °F CH04 9999 °F CH05 9999 °F
10:21 14AUG17

PPI S/O 17781
P/O 5654 #1
TAG 5654 #1
Recorder #3
Samuel

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 627.0 °F CH02 580.? °F CH03 554.1 °F CH04 9999 °F CH05 9999 °F
09:51 14AUG17

CH11 9999 °F CH12 9999 °F
CH06 9999 °F CH07 9999 °F CH08 9999 °F CH09 9999 °F CH10 9999 °F
CH01 321.2 °F CH02 376.6 °F CH03 332.9 °F CH04 9999 °F CH05 9999 °F
09:21 14AUG17

CY-FAIR COATINGS, INC.

P.O. Box 1440
Tomball, TX 77377-1440

Phone: (281) 351-7427
Fax: (281) 378-4378

Paint Report

Cy-Fair Job Number: 17262

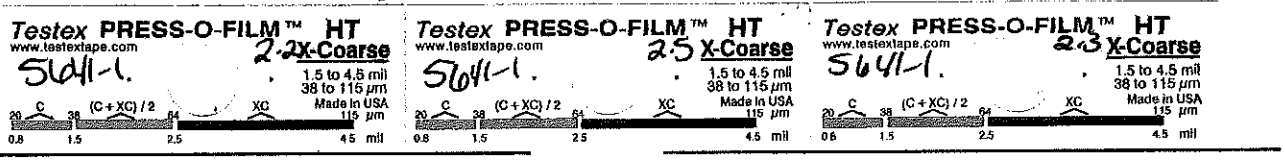
Equipment Description: PPI S/O 5654-1 **Item:** V-402, COLD SEPARATOR

P.O.# 5654-9 **Area:** All External Surfaces

Surface Preparation: **Spec.** SSPC-SP- 6 **Surface Condition** Mill Scale

Date	Time	Temp. (f)	Rel. Humidity	Dew Point (f)
8/21/2017	9:45AM	89	64%	75

Anchor Pattern: 2.2 to 2.5 **Measured by:** Press-O-Film



Coating Application: No moisture on surface and a minimum of 5 deg. F above dew point per Cy-Fair Coatings Procedure, Inc. C-001 Rev. 4.

AT	RH	DP	ST	Date	Type	Manufacturer and product	Batch / Lot number	DFT	Measured by
91	55%	73	93	8/21/2017	FAST CURE EPOXY	SHERWIN WILLIAMS MACROPOXY 646	A: XM1957MU B: XM2027VN	4.0 TO 6.0	MikroTest Elektro-Physik
Time: 14:35PM				1st					
95	46%	71	96	8/23/2017	FAST CURE EPOXY	SHERWIN WILLIAMS MACROPOXY 646	A: XM1957MU B: XM2027VN	4.0 TO 6.0	MikroTest Elektro-Physik
Time: 15:35PM				2nd					
93	48%	71	94	8/24/2017	ALPHATIC ACRYLIC POLYURETHANE	SHERWIN WILLIAMS HI- SOLIDS POLYURETHANE	A: XM0877RX B: MQ0587RK	3.0 TO 4.0	MikroTest Elektro-Physik
Time: 16:30PM				3rd					

Remarks: COLOR: STUCTURAL GRAY # 4031