UOP RUSSELL LLC
Tulsa, Oklahoma

JOB NO: J-447 DATE: 7/14/11
CLIENT: UOP Russell BY: JRG
SUBJECT: 60 MM Cryo Plant

FILTER / SEPARATOR

TAG NO: F-441
SERVICE: Inlet Filter / Coalescer
DESCRIPTION: Reverse flow coalescer to remove 99.99% of all solid particles and 99.5% of all liquid particles 0.3 microns and larger. Located upstream of Mol Sieve Beds V-442 & V-443

Basis: Nominal

	Vapor		Liquid	
Fluid	Inlet Gas		Hydrocarbon and/or Compr Lube Oil	
Flow Rate, (Lbs/Hr)	139,259		Trace Amounts	
Density, Lbs/Ft^3	3.236			
Viscosity, cP	0.0138			
Mol. Wt.	18.38			
Operating Pressure / Temperature	964.0	psia	120	°F
Design Pressure / Temperature	1100	psig	150	°F
MDMT @ Pressure	-20 @ 1100			
Clean Pressure Drop, Max.	2			
Corrosion Allowance	0.0625			
Code: ASME Section VIII w/Stamp	Yes X	No		
National Board No.	Yes X	No		
Materials of Construction	CS			
Closure Type	Quick Open X	Swing Bolt	Other	
Davited, Hinged, Other	Davited X	Hinged	Other	
Internals	▲ 1 Set of 8 Porous Media Elements - GCA1308L002V			
Dimensions	24" OD x 11' - 0" S/S			
Radiography / Stress Relieve	RT-2		Per Code	
Sandblast / Paint	SSPC SP-6		TRCo Std ENG - 36c System 3 (Note 2)	
Insulation Thickness	1"H w / EHT			

Connections		Qty	Size	Rating	Face	Type
Filter	Inlet	1	8	600	RF	FLG
	Outlet	1	8	600	RF	FLG
	PDI	2	0.5	6000		CPLG
	Vent	1	0.75	6000		CPLG
	PI	1	0.5	6000		CPLG
	LSHH	2	1	6000		CPLG
Separator	Liquid Outlet	2	1	600	RF	FLG
	LT	4	1.5	6000		CPLG
	LG	4	0.75	6000		CPLG
	LSHH	2	1	6000		CPLG
Charcoal	Dump					
	Fill					

P.O. # | Weight (Lb): 5,200
Manufacturer / Model # KMI UltiSep GU2408H08A

Notes:
1) See attached "Scope of Supply".
2) Use TRCo Painting System 3
3) Duplicate of PO 247-5
4) Wind: ASCE 7-10, V=120 MPH, Exp.C, Cat. III
5) Seismic: ASCE 7-10, Site D, I=1.25, Ss=100%, S1=40%

REVISION	3		4		5		▲ 6	
ENGINEER/DATE	TKF	10/29/12	TKF	07/11/13	JRG	08/14/13	SHP	08/19/13
ISSUED FOR	Revised		Revised		Revised		Revised	

KMI FABRICATORS, INC

410 Boyd Road
Mineral Wells, Texas 76067
Phone: 940-325-7841
Fax: 940-325-3765

165051

Quality Documentation Records & Transmittal

DATE: 02/08/2017

CUSTOMER: UOP RUSSELL LLC

CUSTOMER PO NO.: PO# 4500749401 TAG: F-441 PROJECT# J447XX

SERIAL, NO. 165051

NATIONAL BOARD, NO. 6567

TABLE OF CONTENTS

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

165051

SECTION 1

MANUFACTURER'S DATA REPORTS AND/OR MANUFACTURERS PARTIAL DATA REPORTS

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 **KMI Fabricators, Inc., 410 Boyd Road, Mineral Wells, Texas, 76067**
(Name and address of Manufacturer)

2. Manufactured for **UOP RUSSELL LLC c/o Honeywell International, PO Box 981762, El Paso, Texas, 79998 - 1762**
(Name and address of Purchaser)

3. Location of Installation **UNKNOWN**
(Name and address)

4. Type **VERTICAL** (Horizontal or vertical, tank) | **165051** (Manufacturer's serial number) | **N/A** (CRN) | **165051-V R1** (Drawing number) | **6567** (National Board number) | **2017** (Year built)

5. ASME Code, Section VIII, Division 1 **2015/ N/A** [Edition and Addenda, if applicable (date)] | **N/A** (Code Case numbers) | **N/A** (Special service per UG-120(d))

6. Shell: **SA-106-C** (Material spec. number, grade) | **0.969"** (Nominal thickness) | **0.0625"** (Corr. allow.) | **24" (OD)** (Inner diameter) | **11' 0"** [Length (overall)]

Body Flanges on Shells

No.	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Location	Bolting			
									Num & Size	Bolting Material	Washer (OD, ID, thk)	Washer Material
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

7. Seams: **TYPE S** [Long. (welded, dbl., sngl., lap, butt)] | **NONE** [R.T.(spot or full)] | **100** (Eff.,%) | **N/A** (H.T. temp) | **N/A** (Time, hr) | **TYPE 1** [Girth. (welded, dbl., sngl., lap, butt)] | **FULL** [R.T. (spot or full)] | **100** (Eff., %) | **1** (No. of courses)

8. Heads: (a) Material **SA-350-LF2 C1** (Spec. no., grade) (b) Material **SA-516-70-N** (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	0.968"	0.0625"	N/A	N/A	N/A	N/A	N/A	22.064	N/A
(b)	BOTTOM	0.75"	0.0625"	N/A	N/A	2:1	N/A	N/A	N/A	CONCAVE,

Body Flanges on Heads

	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Bolting			
									Num & Size	Bolting Material	Washer (OD, ID, thk)	Washer Material
(a)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A

9. MAWP **1100 psi** (Internal) | **N/A** (External) at max. temp. **150 °F** (Internal) | **N/A** (External)

Min. design metal temp. **-20 °F** at **1100 psi** . Hydro, pneu., or comb. test pressure **HYDRO at 1430 psi** .

Proof test **N/A** .

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	
INLET	1	8"	600# RFLWN		SA-105	1.375"	0.0625"	INTEGRAL		WELDED	SHELL
OUTLET	1	8'	600# RFLWN		SA-105	1.375"	0.0625"	INTEGRAL		WELDED	SHELL
LIQUID OUTLET (SUMP)	1	1"	600# RFLWN		SA-105	0.56"	0.0625"	INTEGRAL		WELDED	SHELL
LIQUID OUTLET (COALESCER)	1	1"	600# RFLWN		SA-105	0.56"	0.0625"	INTEGRAL		WELDED	SHELL
DRAIN (SUMP)	1	1"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		BOTTOM HEAD
DRAIN (COALESCER)	1	1"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL
LEVEL CONTROL (SUMP)	2	1 1/2"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL

Additional Nozzles - See Attached U-4...

11. Supports: Skirt **YES** (Yes or no) Lugs **N/A** (Number) Legs **N/A** (Number) Other **PLATE/SA-516-70N** (Describe) Attached **WELDED / BOTTOM HEAD** (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:

Form U2A, CLOSURE 24", NATIONAL OILWELL VARCO, TOMBALL, TEXAS
S/N ZH549
"U" STAMP 10052

(Name of part, item number, Manufacturer's name and identifying stamp)

ONE PAGE U4 SUPPLEMENTARY ATTACHED;MATERIAL IS EXEMPTED FROM IMPACT TESTING; MDMT: BASED ON USC66(a). DESIGNED TO UG-22(a)ONLY. CUSTOMER PO#4500733134 - TAG#F-441; PROJECT#J445XX; 1100 PSIG INLET FILTER/COALESCER

FORM U-1A (Back)

NB Number 6567

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 Number **15097** expires **May 3, 2018**.

Date **02/13/2017** Co. name **KMI Fabricators, Inc.** (Manufacturer) Signed _____ (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by **KMI Fabricators, Inc.** at **410 Boyd Road, Mineral Wells, Texas, 76067**

I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and employed by OneCIS Insurance Company, of Lynn, MA

have inspected the component described in this Manufacturer's Data Report on February 13, 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 02/13/2017 Signed _____ (Authorized Inspector) Commissions 12125, TX1368 [National Board (incl. endorsements)]

FORM U-4 MANUFACTURER'S DATA REPORT SUPPLEMENTARY SHEET

As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by **KMI Fabricators, Inc., 410 Boyd Road, Mineral Wells, Texas, 76067**
(Name and address of Manufacturer)

2. Manufactured for **UOP RUSSELL LLC c/o Honeywell International, PO Box 981762, El Paso, Texas, 79998 - 1762**
(Name and address of Purchaser)

3. Location of installation **UNKNOWN**
(Name and address)

4. Type **VERTICAL** (Horizontal, vertical, or sphere) **N/A** (Tank, separator, heat exch., etc.) **165051** (Manufacturer's serial number)

N/A (CRN) **165051-V R1** (Drawing number) **6567** (National Board number) **2017** (Year built)

Data Report Item Number Remarks

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	
LEVEL CONTROL (COALESCER)	2	1 1/2"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL
SIGHT GLASS (SUMP)	2	3/4"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL
SIGHT GLASS (COALESCER)	2	3/4"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL
DP	2	1/2"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL
VENT	1	3/4"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL
LSHH (SUMP)	2	1"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL
PI	1	1/2"	COUP-O-LET	SA-105		6000#	0.0625"	INTEGRAL	WELDED		SHELL
LSHH (COALESCER)	2	1"	COUP-O-LET	SA-105		6000#	0.0625'	INTEGRAL	WELDED		SHELL

Certificate of Authorization: Type **"U"** No. **15097** Expires **May 3, 2018**

Date **02/13/2017** Name **KMI Fabricators, Inc.** (Manufacturer) Signed Karen Barnes (Representative)

Date **02/13/2017** Name (Authorized Inspector) Commissions: 12125, TX1368 [National Board (incl. endorsements)]

SO No 1531971-1
PO No 10350

FORM U-2A MANUFACTURER'S PARTIAL DATA REPORT (ALTERNATE FORM)

A Part of a Pressure Vessel Fabricated by One Manufacturer for Another Manufacturer
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by NATIONAL OILWELL VARCO 10906 FM 2920 TOMBALL, TEXAS 77375
(Name and address of Manufacturer)

2. Manufactured for KMI FABRICATORS INC. 410 BOYD ROAD MINERAL WELLS, TX 76067
(Name and address of Purchaser)

3. Location of Installation UNKNOWN
(Name and address)

4. Type: (1) 24" CLOSURE (Description of vessel part (shell, two-piece head, tube bundle)) ZH549 (Mfg.'s Serial No.) N/A (CRN)

N/A (National Board Number) 1531971-1R2 (Drawing Number) NATIONAL OILWELL VARCO (Drawing prepared by:) 2017 (Year Built)

5. ASME Code, Section VIII, Div. 1 2015 EDITION (Edition and Addenda (Date)) N/A (Code Case No.) N/A (Special service per UG-120(d))

6. Shell (a) No. of course(s) 1 (b) Overall length (ft. and in.): 1-00.

Course(s)			Material	Thickness, in.		Long Joint (Cat. A)			Circum. Joint (Cat. A, B, & C)			Heat Treatment	
No.	Diameter, in	Length,ft+in	Spec./Grade or Type	Nom.	Corr.	Type	Full, Spot, None	Eff.	Type	Full, Spot, None	Eff.	Temp., F	Time
1	22.064	1-00.	SA 350 LF2 CLASS 1	0.968	0.063	S	NONE	1	S	NONE	1	N/A	N/A

Body Flanges on Shells

No.	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Location	Bolting			
									Num & Size	Bolting Material	Washer (OD, ID, Thk)	Washer Material
N/A												

7. Heads: (a) SA 350 LF2 CLASS 1 (Mat'l Spec. no., Grade or Type)(H.T. - Time and Temp.) (b) N/A (Mat'l Spec. no., Grade or Type)(H.T. - Time and Temp.)

	Location (Top, Bottom Ends)	Thickness, in.		Radius, in.		Elliptical	Conical	Hemispherical	Flat	Side to Pressure		Category A		
		Min.	Corr.	Crown	Knuckle	Ratio	Apex Angle	Radius	Diameter	Convex	Concave	Type	Full, Spot, None.	Effc.
(a)	TOP	0.791	0.063	-----	-----	2:1	-----	-----	-----		X	S	NONE	1
(b)														

Body Flanges on Heads

	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Bolting			
									Num & Size	Bolting Material	Washer (OD, ID, Thk)	Washer Material
(a)	N/A											

8. MAWP 1100 (internal) [ ] (external) PSI @ max temp.= 150 (internal) [ ] (external) °F. Min Design Metal Temp -20 °F at 1100 PSI

9. Impact test Yes - CAP, HUB, & FITTING (Indicate yes or no and the component(s) impact tested) At a test temp of -51 & -50 & -50 °F

10. Hydro., pneu., or comb. Test pressure SEE REMARKS Proof Test: N/A

11. Nozzles, inspection, and safety valve openings: UG-125(a) At PSIG

Purpose (Inlet, Outlet, Drain, etc.)	No.	Dia. or Size, in.	Flange Type	Material		Nozzle Thickness, in		Reinforcement Material	How Attached		Location (Insp. Open.)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
SEE REMARKS											
OUTLET	1	1/2" NPT	TH'D	SA 350 LF2 CL1		0.500	0.063	INHERENT	*WELDED		HEAD
PAV	1	1/2" NPT	TH'D	SA 350 LF2 CL1		N/A	N/A	INHERENT	INT THD		SHELL

12. Identification of part(s)

Name of Part	Qty.	Line No.	Mfg's. Identification No.	Mfg's. Dwg No.	CRN	National Board No.	Year
N/A							

13. Supports: Skirt ---- (Yes or No) Lugs ---- (Number) Legs ---- (Number) Others ---- (Describe) Attached ---- (Where and How)

14. Remarks: THIS TEMPERATURE APPLICABLE TO CLOSURE METAL COMPONENTS ONLY. ACTUAL SERVICE TEMPERATURE IS DETERMINED BY TEMPERATURE LIMITATIONS OF O-RING MATERIAL.
UG-120,c,2 DESIGN & CALCULATION BY NATIONAL OILWELL VARCO.
CLOSURE ASSEMBLY IS NOT HYDROSTATICALLY TESTED, PRESSURE ALERT VALVE FURNISHED.
*Fig. UW-16.1(x-2).

FORM U-2A (Back)

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of material, construction, and workmanship of this pressure vessel part conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1.

U Certificate of Authorization No. 10052 Expires: July 16, 2017

Date: 01/20/17 Name: NATIONAL OILWELL VARCO Signed: Stacey R. Dunn

(Manufacturer) (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by The Hartford Steam Boiler Inspection and Insurance Company of CONNECTICUT have inspected the pressure vessel part described in this Manufacturer's Data Report on 01-20, 2017, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel part 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 part 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: 01/20/2017 Signed: [signature] Commissions: NB 14370 A/S

(Authorized Inspector) [National Board (incl. endorsements)]

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

165051

SECTION 2

MANUFACTURING DRAWINGS AND/OR SPECIFICATIONS (if required)

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

SPECIFICATION DATA SHEET

(MECHANICAL DESIGN/FABRICATION/INSPECTION/TESTING DATA)

KMI Project No:	**Quote No.: Q160140R1**
Equip. Description:	Vertical UltiSep 24" O.D. x 11'-0" sm-sm @ 1100 psig
Model No.:	**GU2408H08A**
KMI SERIAL NO.:	165051
Quantity:	1
Tag Number:	**F-441**
Purchaser:	UOP Russell LLC
Purchaser P.O. No.:	4500749401
End User:	Unknown (Not Stated)
Project:	J447XX
Destination:	1401 RUSSELL WAREHOUSE

CUSTOMER SUPPLIED SPECIFICATIONS:

ASME Section VIII, Div 1

Notes:

1) Use TRCo Painting System 3
2) Include initial set of elements in base cost
3) Include extra set of elements and spare gasket as an added cost
4) Vendor to provide the following fabrication drawings:
   - Two (2) electronic copies "For Approval"
   - Two (2) electronic copies Certified AFC
   - Four (4) Final Hard Copies of As-Built Job Data Book Documentation and (1) CD with all documents available in electronic format
5) Vendor to submit weld procedures to UOP Russell for approval prior to start of fabrication
6) Provide two (2) carbon steel lifting lugs
7) External nozzle projections shall be per UOP Russell Standard 13j
8) Vendor shall provide zinc or cadmium plated bolts when design tempeture is 650F or less. Bolts shall be black (non-plated) for design tempetures above 650F
9) American Piping for Material
10) Spare elements for each vessel.
11) Spare O-rings for each vessel.

REVISION HISTORY

REV	DATE	BY	DESCRIPTION OF CHANGE
0	12/5/2016	MDB	PER PURCHASE ORDER
1			
2			

PROJECT: J447XX	TAG#: F-441	CUST. PO#: 4500749401

MECHANICAL DESIGN DATA/CONDITIONS			
DESIGN PRESSURE, PSIG:	1,100	**DESIGN CODE:**	ASME SEC VIII Div. 1
DESIGN TEMPERATURE, ^{O}F:	150		
CORROSION ALLOWANCE:	0.0625	**WIND:**	ASCE 7-10 (120mph, Exp. C, Cat. III)
MDMT, ^{O}F:	-20	**SEISMIC:**	ASCE 7-10 (Site D, I=1.25, Ss=100%, S1=40%)

CONNECTIONS/OPENINGS					
SERVICE	**MARK**	**QTY.**	**SIZE (NPS)**	**TYPE**	**FLG/CPLG RATING**
INLET	N1	1	8"	RF FLG	ANSI 600#
OUTLET	N2	1	8"	RF FLG	ANSI 600#
LIQUID OUTLETS	N3/4	2	1"	RF FLG	ANSI 600#
DRAINS	C1/C2	2	1"	NPT	6000#
LEVEL CONTROLS	C3/C4	4	1 1/2"	NPT	6000#
SIGHT GLASSES	C5/C6	4	3/4"	NPT	6000#
DIFFERENTIAL PRESSURE	C7	2	1/2"	NPT	6000#
VENT	C8	1	3/4"	NPT	6000#
LSHH (SUMP)	C9	2	1"	NPT	6000#
PI	C10	1	1/2"	NPT	6000#
LSHH (COALESCER)	C11	2	1"	NPT	6000#
FLANGE FINISH:					

MATERIALS		
COMPONENT	**PRESSURE PART**	**NON-PRESSURE ATTACHMENT MATERIALS**
FORGINGS	SA-105 N	LIFT LUG: 2 - KMI STANDARDS
PLATE	SA-516-70	NAME PLATE BRACKET: SA-992 Beam Material
PIPE	SA-106 B/C	
FLANGES	SA-105	
FITTINGS	SA-234 WPB	
STUDS	SA-193 B7 Cad. Plt.	
NUTS	SA-194 2H Cad. Plt.	
FLANGE GASKETS	PTFE	
RESTRICTION ON ORIGIN OF MATERIALS: Domestic, Western Europe, Etc.		
MATERIAL TEST REPORTS (MTR'S) REQUIREMENTS:		
IMPACT TESTING REQUIRED: Not Required		

MATERIALS OF CONSTRUCTION - VESSEL INTERNALS	
PENTAIR Element Support Riser	**ELEMENT Part No.: GCA1308L002V**

CLOSURE TYPE	
TYPE: YALE Fig 500 Threaded quick opening closure w/ davit	
O-RING: BUNA-N	**O-RING Part No.:** H70014

MISCELLANEOUS ATTACHMENTS	
DESCRIPTION	**MATERIAL**
NAMEPLATE:	316 SS (Standard KMI)
SKIRT / BASEPLATE:	SA-53 B ERW Welded Pipe / SA-516-70
HINGE PLATE:	Not Applicable

PROJECT: J447XX	TAG#: F-441	CUST. PO#: 4500749401

INSPECTION AND TESTING/NDE		
VISUAL EXAMINATION (VT): Per Code		
RADIOGRAPHIC TESTING (RT): RT-2 per ASME Code		
ULTRASONIC TESTING (UT): None		
MAGNETIC PARTICLE TESTING (MT): None		
LIQUID PENETRANT TESTING (PT): None		
HARDNESS TESTING (HDT): None		
PRODUCTION WELD IMPACT TESTING: None		
POST WELD HEAT TREATMENT: None		
HYDROSTATIC TEST (HYT): 1.3 X MAWP		
PHEUMATIC TEST (PNT) OF WEAR PAD: None		
WPS/PQR APPROVAL REQUIRED:	**WELD MAPS REQUIRED:** No	
NATIONAL BOARD NO.: Yes		
INSPECTION BY:	**CUSTOMER:**	

INSPECTION AND TESTING NOTES
MT: None
HARDNESS: None
HYDRO: 1.3 X MAWP
CUSTOMER:

SURFACE PREPARATION	
INTERNAL: None	**EXTERNAL:** SSPC-SP 6 Commercial Blast

EXTERNAL COATINGS REQUIREMENTS (MFR. OF COATINGS:)

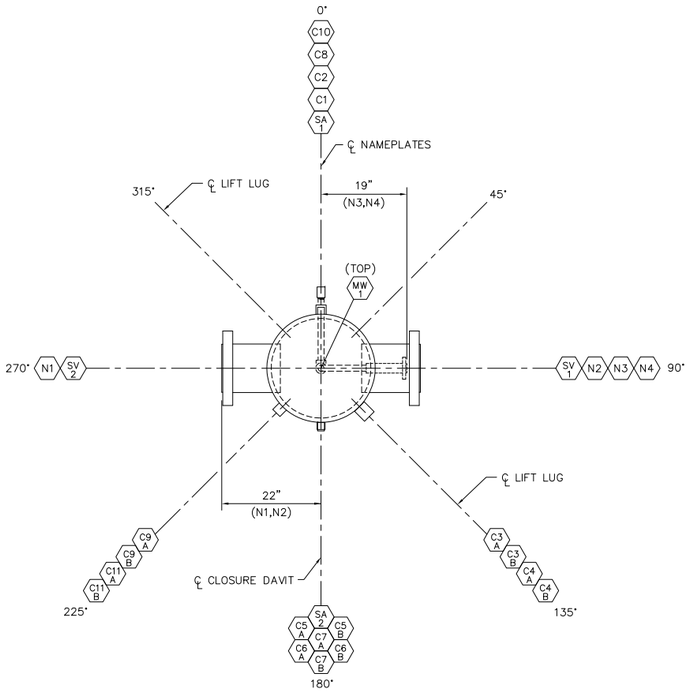
COAT	DESCRIPTION	DFT (MILS)	COLOR
PRIMER	Sherwin Williams Macropoxy 646 (B58-600)	4-6	Not Stated
INTERMEDIATE	Sherwin Williams Macropoxy 646 (B58-600)	4-6	Not Stated
TOPCOAT	Sherwin Williams Hi-Solids Polyurethan B65 Series/B60V30	3-4	*

NOTES: Total System: DFT 12-16 mils VOC's per 1000 sq. ft. = 28 lbs
* TOP COAT IS SHERWIN WILLIAMS STRUCTURAL GRAY", SW4031

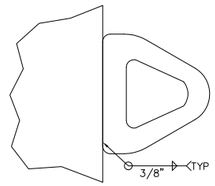
INTERNAL COATING
None

SHIPPING INFORMATION		
EST. EMPTY WT.: 5289 lbs.	**EST. TEST WT.:** 7304 lbs.	**EST. OPERATING WT.:** 5690 lbs.
FLANGE PROTECTORS:		
THREADED OPENINGS:		

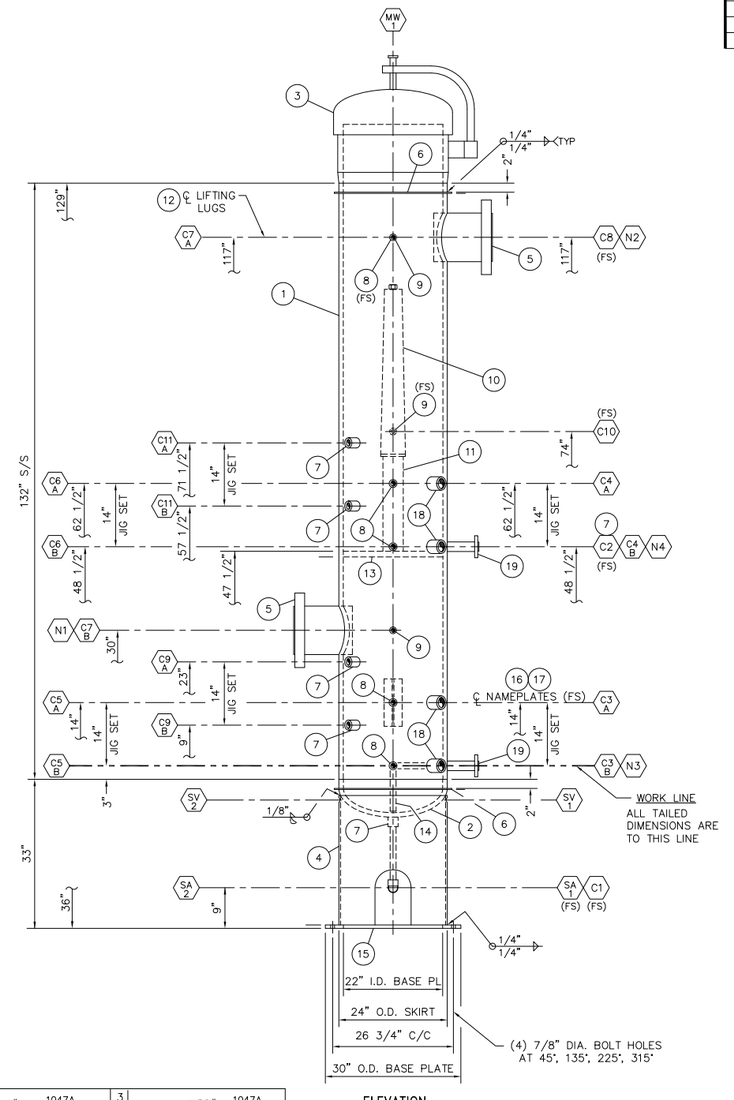
QA NOTES
NO. OF COPIES OF FINAL DATA:
NOTES:



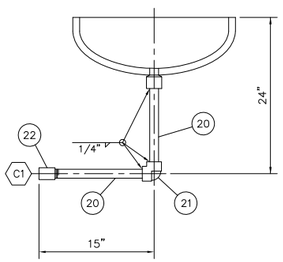
PLAN VIEW



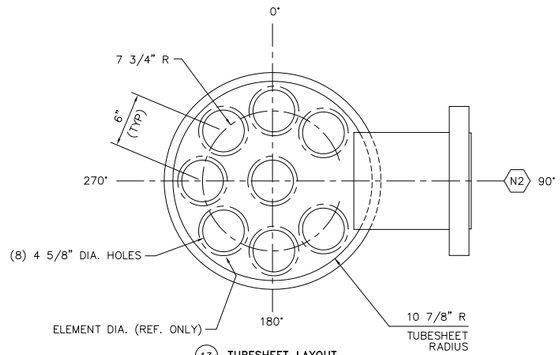
(12) LIFTING LUG DETAIL
SCALE: NONE
QTY. (2)



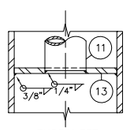
ELEVATION



C1 DRAIN DETAIL
SCALE: NONE



(13) TUBESHEET LAYOUT
SCALE: NONE

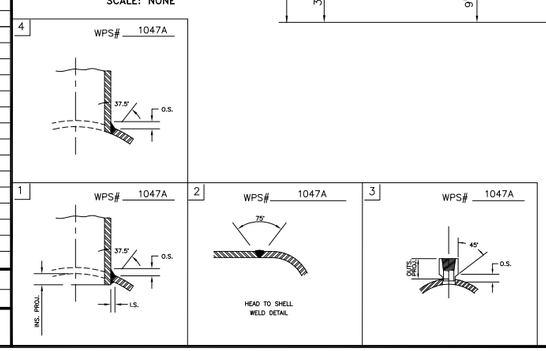


TUBESHEET
SCALE: NONE

MW1	1	24" 600# ANSI CLOSURE	VESSEL ACCESS			2		
SA1–2	2	8" DIA. HOLE x 12 1/4" LG.	SKIRT ACCESS					
SV1–2	2	1" DIA. HOLE	SKIRT VENT					
C11A–B	2	1" 6000# LONG COUP–O–LET	LSHH (COALESCER)	–	–	3	3/8"	–
C10	1	1/2" 6000# LONG COUP–O–LET	PI	–	–	3	3/8"	–
C9A–B	2	1" 6000# LONG COUP–O–LET	LSHH (SUMP)	–	–	3	3/8"	–
C8	1	3/4" 6000# LONG COUP–O–LET	VENT	–	–	3	3/8"	–
C7A–B	2	1/2" 6000# LONG COUP–O–LET	DIFFERENTIAL PRESSURE	–	–	3	3/8"	–
C6A–B	2	3/4" 6000# LONG COUP–O–LET	SIGHT GLASS (COALESCER)	–	–	3	3/8"	–
C5A–B	2	3/4" 6000# LONG COUP–O–LET	SIGHT GLASS (SUMP)	–	–	3	3/8"	–
C4A–B	2	1 1/2" 6000# LONG COUP–O–LET	LEVEL CONTROL (COALESCER)	–	–	3	3/8"	–
C3A–B	2	1 1/2" 6000# LONG COUP–O–LET	LEVEL CONTROL (SUMP)	–	–	3	3/8"	–
C2	1	1" 6000# LONG COUP–O–LET	DRAIN (COALESCER)	–	–	3	3/8"	–
C1	1	1" 6000# LONG COUP–O–LET	DRAIN (SUMP)	–	–	3	3/8"	–
N4	1	1" 600# RFLWN FLG	LIQUID OUTLET (COALESCER)	7"	TRIM FLUSH	4	3/8"	–
N3	1	1" 600# RFLWN FLG	LIQUID OUTLET (SUMP)	7"	–	1	3/8"	–
N2	1	8" 600# RFLWN FLG	OUTLET	10"	–	1	3/8"	–
N1	1	8" 600# RFLWN FLG	INLET	10"	–	1	3/8"	–

ITEM	QTY	SIZE & RATING , TYPE	DESCRIPTION	OUTS.	INS.	WELD DETAIL DWG. NO.	O.S.	I.S.
				PROJECTION			WELD SIZE	

SCHEDULE OF OPENINGS



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BILL OF MATERIALS

ITEM	QTY. REQ'D	DESCRIPTION	MATERIAL	M R
1	1	SHELL, PIPE, 24" SCH 60 (.969" NOM) SMLS x 11'–0" LG.	SA–106–C	
2	1	HEAD, 24" OD x 7/8" NOM, 2:1 ELLIP. W/ 2" S.F. (HOT FORMED)	SA–516–70–N	
3	1	CLOSURE, 24" OD 600# ANSI (YALE/HUBER FIG. 500 W/ DAVIT)	CS	
4	1	SKIRT, PIPE, 24" SCH STD x 30" LG. (TRIM TO FIT)	SA–53–B	
5	2	FLANGE, 8" 600# RFLWN x 13" LG	SA–105–N	
6	2	PLATE, INSULATION RING, 26" OD x 24 1/4" ID x 1/4" THK.	SA–516–70–N	
7	6	COUP–O–LET, LONG, 1" 6000# NPT x 3" LG.	SA–105	
8	5	COUP–O–LET, LONG, 3/4" 6000# NPT x 3" LG.	SA–105	
9	3	COUP–O–LET, LONG, 1/2" 6000# NPT x 3" LG.	SA–105	
10	8	CARTRIDGE, PART NO. GCA1308L002V (BY PENTAIR)		
11	8	RISER, PART NO. GA5536P422CS x 22" LG. (BY PENTAIR)		
12	2	LIFT LUGS, PHOENIX MODEL 2–899–MLL	A105	
13	1	PLATE, TUBESHEET, 21 3/4" OD x 1 1/4" THK. (SEE DETAIL)	SA–516–70–N	
14	1	PIPE, 1" SCH 80 (SIPHON TUBE)	SA–53–B	
15	1	PLATE, BASE, 30" OD x 22" ID x 3/4" THK.	SA–516–70–N	
16	1	NAME PLATE BRACKET, KMI STD T–BEAM x 10 1/2" LG.	SA–36	
17	2	NAME PLATES, ASME CODE (KMI & PENTAIR)	SS	
18	4	COUP–O–LET, LONG, 1 1/2" 6000# NPT x 3" LG.	SA–105	
19	2	FLANGE, 1" 600# RFLWN x 9" LG	SA–105–N	
20	1	PIPE, DRAIN, 1" SCH 160 SMLS (CUT TO FIT)	SA–106–B	
21	1	ELBOW, 1" 3000# 90° SOCKETWELD	SA–105	
22	1	COUPLING, FULL, 1" 3000# THREADED	SA–105	

SEE KMI DATA SHEETS FOR NOTES

RELEASED FOR	DATE	BY	CHK
APPROVAL	12/5/16	MDB	
FABRICATION	12/21/16	MDB	
FINAL (AS BUILT)	2/16/17	MDB	

IV. DATA PLATE INFORMATION

PENTAIR

Process Technologies
936–788–1000
www.pentairseparations.com

UltiSep ® ID No.
GU2408H08A

Replacement Element No.
GCA1308L002V

NB 6567
CERTIFIED BY
KMI FABRICATORS, INC.
410 BOYD RD.
MINERAL WELLS, TX 76067

ASME U W
1100 PSI AT 150 °F MAWP
–20 °F AT 1100 PSI MDMT
RT–2
SERIAL NO. 165051
YR. BLT. 2017
CORR. ALLOWANCE .0625"
EXT.PRESS. ☒ PSI AT ☒ °F
INLET FILTER/ COALESCER
TAG: F–441

SPECIFICATIONS

I. GENERAL

1. VESSEL TO BE CONSTRUCTED AND STAMPED PER A.S.M.E. CODE SECTION VIII, DIVISION 1. 2015
2. ADDENDA NONE
3. JOINT EFFICIENCY (SHELL) 100 %
4. JOINT EFFICIENCY (HEAD) 100 %
5. DIMENSIONAL TOLERANCES ±1/8 INCH UNLESS OTHERWISE NOTED
6. FLANGE AND ANCHOR BOLTS TO STRADDLE VESSEL CENTERLINES.

II. NON DESTRUCTIVE TESTING

1. RADIOGRAPH	RT–2 (SEE KMI DATA SHEETS)
2. ULTRASONIC	NONE
3. MAGNETIC PARTICLE	NONE
4. DYE PENETRANT	NONE
5. STRESS RELIEVE	NONE

III. DESIGN

1. DESIGN PRESS. 1100 PSIG AT 150 °F.
2. HYDROSTATIC TEST AT 1430 PSIG.
3. CORROSION ALLOWANCE 0.0625 INCHES.

KMI FABRICATORS, INC.
410 BOYD RD.
MINERAL WELLS, TX 76067
PHONE: (800) 325–7841
FAX: (940) 325–3765
EMAIL: kmi@kmifab.com
Web Site: www.kmifab.com

CUSTOMER: UOP RUSSELL LLC
P.O. NO.: 4500749401
NO. REQ'D.: ONE (1)
SERIAL NO.: 165051
EMPTY WT.: 5,289 lbs

DESCRIPTION: 24" OD x 11'–0" S/S
1100 PSIG INLET FILTER/COALESCER
TAG: F–441 JOB NO.: J447XX

NO.	DATE	BY	CHK.	DESCRIPTION
1	2/16/17	MDB		AS BUILT

REVISIONS

Drawn MDB	Date 12/5/16	Drawing Number 165051–V	Rev. 1
Checked	Scale 3/4"=1'–0"		

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

165051

SECTION 3

DESIGN CALCULATIONS

KMI Fabricators, Inc.

410 Boyd Road

Mineral Wells, Texas 76067

Phone: 940-325-7841

Revision 0

COMPRESS Pressure Vessel Design Calculations

Item:	24" Inlet Filter/Coalescer
Vessel No:	F-441
Customer:	UOP Russell LLC
P.O. No.:	4500749401
Designer:	Mark Berry
Date:	December 5, 2016

KMI Serial No. 165051
UOP Job No.: J447XX

Table of Contents

Table of Contents

Deficiencies Summary

No deficiencies found.

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)		
C1	2.25	0.4675	0.125	Yes	Yes	0.75*	N/A		N/A	N/A	0.0625	Exempt
C10	1.5	0.33	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C11A	2.25	0.4675	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C11B	2.25	0.4675	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C2	2.25	0.4675	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C3A	3	0.55	0.1432	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C3B	3	0.55	0.1433	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C4A	3	0.55	0.1432	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C4B	3	0.55	0.1432	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C5A	1.75	0.35	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C5B	1.75	0.35	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C6A	1.75	0.35	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C6B	1.75	0.35	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C7A	1.5	0.33	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C7B	1.5	0.33	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C8	1.75	0.35	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C9A	2.25	0.4675	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
C9B	2.25	0.4675	0.125	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
N1	10.75	1.375	0.3819	Yes	Yes	0.969	0.7083		N/A	N/A	0.0625	105.2
N2	10.75	1.375	0.3819	Yes	Yes	0.969	0.7083		N/A	N/A	0.0625	105.2
N3	2.12	0.56	0.1973	Yes	Yes	0.969	N/A		N/A	N/A	0.0625	Exempt
N4	2.12	0.56	0.1973	Yes	Yes	0.969	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

Nozzle Schedule

Specifications									
Nozzle mark	**Identifier**	**Size**	**Materials**		**Impact Tested**	**Normalized**	**Fine Grain**	**Flange**	**Blind**
C1	Drain (Sump)	NPS 1 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
	Nozzle Pipe (C1)	NPS 1 Sch 160	Nozzle Piping	SA-106 B Smls pipe	No	No	No	N/A	No
C10	PI	NPS 0.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C11A	LSHH (Coalescer)	NPS 1 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C11B	LSHH (Coalescer)	NPS 1 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C2	Drain (Coalescer)	NPS 1 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C3A	Level Control (Sump)	NPS 1.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C3B	Level Control (Sump)	NPS 1.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C4A	Level Control (Coalescer)	NPS 1.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C4B	Level Control (Coalescer)	NPS 1.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C5A	Sight Glass (Sump)	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C5B	Sight Glass (Sump)	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C6A	Sight Glass (Coalescer)	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C6B	Sight Glass (Coalescer)	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C7A	Differential Pressure	NPS 0.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C7B	Differential Pressure	NPS 0.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C8	Vent	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C9A	LSHH (Sump)	NPS 1 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
C9B	LSHH (Sump)	NPS 1 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
N1	Inlet	10.75 OD x 1.375	Nozzle	SA-105	No	Yes	Yes	NPS 8 Class 600 LWN A105 N	No
N2	Outlet	10.75 OD x 1.375	Nozzle	SA-105	No	Yes	Yes	NPS 8 Class 600 LWN A105 N	No
N3	Liquid Outlet (Sump)	2.12 OD x 0.56	Nozzle	SA-105	No	Yes	Yes	NPS 1 Class 600 LWN A105 N	No
N4	Liquid Outlet (Coalescer)	2.12 OD x 0.56	Nozzle	SA-105	No	Yes	Yes	NPS 1 Class 600 LWN A105 N	No

Pressure Summary

Component Summary									
Identifier	P Design (psi)	T Design (°F)	MAWP (psi)	MAP (psi)	MAEP (psi)	T_e external (°F)	MDMT (°F)	MDMT Exemption	Impact Tested
Closure	1,100	150	1,216.96	1,324.5	571.46	150	-55	Note 1	No
Straight Flange on Closure	1,100	150	1,391.86	1,502.15	614.88	150	-55	Note 2	No
Shell	1,100	150	1,343.32	1,454.23	584.35	150	-20	Note 3	No
Straight Flange on Bottom Head	1,100	150	1,390.96	1,502.15	614.88	150	-55	Note 5	No
Bottom Head	1,100	150	1,215.86	1,324.5	571.46	150	-55	Note 4	No
Drain (Sump) (C1)	1,100	150	1,312.73	1,428.58	571.46	150	-155	Note 6	No
Nozzle Pipe (C1)	1,100	150	N/I	N/I	N/I	150	N/I	N/A	No
PI (C10)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 7	No
LSHH (Coalescer) (C11A)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 8	No
LSHH (Coalescer) (C11B)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 8	No
Drain (Coalescer) (C2)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 8	No
Level Control (Sump) (C3A)	1,100	150	1,343.95	1,454.28	584.35	150	-155	Note 9	No
Level Control (Sump) (C3B)	1,100	150	1,343.44	1,454.28	584.35	150	-155	Note 9	No
Level Control (Coalescer) (C4A)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 10	No
Level Control (Coalescer) (C4B)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 10	No
Sight Glass (Sump) (C5A)	1,100	150	1,343.96	1,454.28	584.35	150	-155	Note 11	No
Sight Glass (Sump) (C5B)	1,100	150	1,343.45	1,454.28	584.35	150	-155	Note 12	No
Sight Glass (Coalescer) (C6A)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 11	No
Sight Glass (Coalescer) (C6B)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 11	No
Differential Pressure (C7A)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 7	No
Differential Pressure (C7B)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 7	No
Vent (C8)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 11	No
LSHH (Sump) (C9A)	1,100	150	1,344.2	1,454.28	584.35	150	-155	Note 8	No
LSHH (Sump) (C9B)	1,100	150	1,343.78	1,454.28	584.35	150	-155	Note 8	No
Inlet (N1)	1,100	150	1,126.98	1,244.48	584.35	150	-43.9	Note 13	No
Outlet (N2)	1,100	150	1,126.98	1,244.48	584.35	150	-43.9	Note 13	No
Liquid Outlet (Sump) (N3)	1,100	150	1,343.45	1,454.28	584.35	150	-43.8	Note 14	No
Liquid Outlet (Coalescer) (N4)	1,100	150	1,344.2	1,454.28	584.35	150	-43.9	Note 13	No

Chamber Summary	
Design MDMT	-20 °F
Rated MDMT	-20 °F @ 1,126.98 psi
MAWP hot & corroded	1,126.98 psi @ 150 °F
MAP cold & new	1,244.48 psi @ 60 °F
MAEP	571.46 psi @ 150 °F

Notes for MDMT Rating		
Note #	**Exemption**	**Details**
1.	Straight Flange governs MDMT	
2.	Material impact test exemption temperature from Fig UCS-66 Curve D = -36.87°F Fig UCS-66.1 MDMT reduction = 18.6°F, (coincident ratio = 0.8139) Rated MDMT of -55.47°F is limited to -55°F by UCS-66(b)(2)	UCS-66 governing thickness = 0.8479 in
3.	Material is impact test exempt per UG-20(f)	UCS-66 governing thickness = 0.8479 in
4.	Straight Flange governs MDMT	
5.	Material impact test exemption temperature from Fig UCS-66 Curve D = -36.87°F Fig UCS-66.1 MDMT reduction = 18.5°F, (coincident ratio = 0.8145) Rated MDMT of -55.37°F is limited to -55°F by UCS-66(b)(2)	UCS-66 governing thickness = 0.8479 in
6.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1038).	
7.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1052).	
8.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1037).	
9.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1212).	
10.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1211).	
11.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1192).	
12.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1193).	
13.	LWN rated MDMT per UCS-66(c)(4) Flange rated MDMT per UCS-66(b)(1)(b) = -43.9°F (Coincident ratio = 0.7615) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	
14.	LWN rated MDMT per UCS-66(c)(4) Flange rated MDMT per UCS-66(b)(1)(b) = -43.8°F (Coincident ratio = 0.762) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

Radiography Summary

UG-116 Radiography							
Component	**Longitudinal Seam**		**Top Circumferential Seam**		**Bottom Circumferential Seam**		**Mark**
	Category (Fig UW-3)	**Radiography / Joint Type**	**Category (Fig UW-3)**	**Radiography / Joint Type**	**Category (Fig UW-3)**	**Radiography / Joint Type**	
Closure	N/A	Seamless No RT	N/A	N/A	B	Spot UW-11(a)(5)(b) / Type 1	RT2
Shell	N/A	Seamless No RT	B	Spot UW-11(a)(5)(b) / Type 1	B	Spot UW-11(a)(5)(b) / Type 1	RT2
Bottom Head	N/A	Seamless No RT	B	Spot UW-11(a)(5)(b) / Type 1	N/A	N/A	RT2
Nozzle	**Longitudinal Seam**		**Nozzle to Vessel Circumferential Seam**		**Nozzle free end Circumferential Seam**		
Inlet (N1)	N/A	Seamless No RT	D	N/A / Type 7	C	N/A	N/A
Outlet (N2)	N/A	Seamless No RT	D	N/A / Type 7	C	N/A	N/A
Drain (Coalescer) (C2)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Level Control (Sump) (C3A)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Level Control (Sump) (C3B)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Level Control (Coalescer) (C4A)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Level Control (Coalescer) (C4B)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Sight Glass (Sump) (C5A)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Sight Glass (Sump) (C5B)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Sight Glass (Coalescer) (C6A)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Sight Glass (Coalescer) (C6B)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Differential Pressure (C7A)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Differential Pressure (C7B)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Vent (C8)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
LSHH (Sump) (C9A)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
LSHH (Sump) (C9B)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
PI (C10)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
LSHH (Coalescer) (C11A)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
LSHH (Coalescer) (C11B)	N/A	Seamless No RT	D	N/A / Type 7	N/A	N/A	N/A
Liquid Outlet (Sump) (N3)	N/A	Seamless No RT	D	N/A / Type 7	C	N/A	N/A
Liquid Outlet (Coalescer) (N4)	N/A	Seamless No RT	D	N/A / Type 7	C	N/A	N/A
Drain (Sump) (C1)	N/A	Seamless No RT	D	N/A / Type 7	B	UW-11(a)(4) exempt / Type 1	N/A
Nozzle Flange	**Longitudinal Seam**		**Flange Face**		**Nozzle to Flange Circumferential Seam**		
ASME B16.5/16.47 flange attached to Inlet (N1)	N/A	Seamless No RT	N/A	N/A / Gasketed	C	N/A	N/A
ASME B16.5/16.47 flange attached to Outlet (N2)	N/A	Seamless No RT	N/A	N/A / Gasketed	C	N/A	N/A
ASME B16.5/16.47 flange attached to Liquid Outlet (Sump) (N3)	N/A	Seamless No RT	N/A	N/A / Gasketed	C	N/A	N/A
ASME B16.5/16.47 flange attached to Liquid Outlet (Coalescer) (N4)	N/A	Seamless No RT	N/A	N/A / Gasketed	C	N/A	N/A
UG-116(e) Required Marking: **RT2**							

Weight Summary

Weight (lb) Contributed by Vessel Elements										
Component	Metal New*	Metal Corroded	Insulation	Insulation Supports	Lining	Piping + Liquid	Operating Liquid		Test Liquid	
							New	Corroded	New	Corroded
Closure	170.3	157.5	6.1	10	0	0	0	0	81.9	83.4
Shell	2,549.4	2,391.6	75	10	0	0	318.2	321.9	1,851	1,873
Bottom Head	169.5	156.7	6.1	10	0	0	82.2	83.9	82.2	83.9
Skirt	226.5	226.5	16.8	10	0	0	0	0	0	0
Base Plate	69	69	0	0	0	0	0	0	0	0
TOTAL:	**3,184.7**	**3,001.2**	**104**	**40**	**0**	**0**	**400.4**	**405.8**	**2,015.1**	**2,040.3**
*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
	New	Corroded	New	Corroded						
Closure	0	0	0	0	0	0	0	0	0	1,239
Shell	0	0	507.8	494.1	0	0	0	0	0	189
Bottom Head	0	0	4.7	3.9	0	0	0	0	0	0
Skirt	0	0	0	0	0	0	0	0	0	20
TOTAL:	**0**	**0**	**512.4**	**497.9**	**0**	**0**	**0**	**0**	**0**	**1,448**

Vessel Totals		
	New	Corroded
Operating Weight (lb)	5,690	5,497
Empty Weight (lb)	5,289	5,091
Test Weight (lb)	7,304	7,131
Capacity** (US gal)	238	241
**The vessel capacity does not include volume of nozzle, piping or other attachments.		

Vessel Lift Condition	
Vessel Lift Weight, New (lb)	5,289
Center of Gravity from Datum (in)	75.6664

Settings Summary

COMPRESS 2016 Build 7600	
ASME Section VIII Division 1, 2015 Edition	
Units	U.S. Customary
Datum Line Location	3.00" 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	1"
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 at user defined pressure	1,430 psi
Test liquid specific gravity	1.00
Maximum stress during test	90% of yield
Required Marking - UG-116	
UG-116(e) Radiography	RT2
UG-116(f) Postweld heat treatment	None
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	No
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)	Yes
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	KMI Fabricators
License	Commercial
License Key ID	31538
Support Expires	May 12, 2017

Vertical shop test based on user defined pressure

Gauge pressure at 60°F = 1,430 psi

Vertical shop test					
Identifier	**Local test pressure (psi)**	**Test liquid static head (psi)**	**Stress during test (psi)**	**Allowable test stress (psi)**	**Stress excessive?**
Closure	1,430.275	0.275	19,309	34,200	No
Straight Flange on Closure	1,430.275	0.275	18,891	34,200	No
Shell	1,435.04	5.04	19,379	36,000	No
Straight Flange on Bottom Head	1,435.112	5.112	18,955	34,200	No
Bottom Head	1,435.315	5.315	19,377	34,200	No
Differential Pressure (C7A)	1,430.724	0.724	19,552	54,000	No
Differential Pressure (C7B)	1,433.864	3.864	19,595	54,000	No
Drain (Coalescer) (C2)	1,433.205	3.205	20,081	54,000	No
Drain (Sump) (C1)	1,435.419	5.419	20,623	51,300	No
Inlet (N1)	1,433.993	3.993	23,397	54,000	No
LSHH (Coalescer) (C11A)	1,432.375	2.375	20,069	54,000	No
LSHH (Coalescer) (C11B)	1,432.88	2.88	20,076	54,000	No
LSHH (Sump) (C9A)	1,434.125	4.125	20,094	54,000	No
LSHH (Sump) (C9B)	1,434.631	4.631	20,101	54,000	No
Level Control (Coalescer) (C4A)	1,432.71	2.71	20,929	54,000	No
Level Control (Coalescer) (C4B)	1,433.215	3.215	20,936	54,000	No
Level Control (Sump) (C3A)	1,434.461	4.461	20,954	54,000	No
Level Control (Sump) (C3B)	1,434.966	4.966	20,962	54,000	No
Liquid Outlet (Coalescer) (N4)	1,433.199	3.199	18,895	54,000	No
Liquid Outlet (Sump) (N3)	1,434.95	4.95	18,918	54,000	No
Outlet (N2)	1,430.853	0.853	23,345	54,000	No
PI (C10)	1,432.276	2.276	19,573	54,000	No
Sight Glass (Coalescer) (C6A)	1,432.695	2.695	20,025	54,000	No
Sight Glass (Coalescer) (C6B)	1,433.2	3.2	20,032	54,000	No
Sight Glass (Sump) (C5A)	1,434.445	4.445	20,049	54,000	No
Sight Glass (Sump) (C5B)	1,434.951	4.951	20,056	54,000	No
Vent (C8)	1,430.727	0.727	19,997	54,000	No

(1) P_L stresses at nozzle openings have been estimated using the method described in PVP-Vol. 399, pages 77-82.
(2) $1.5*0.9*S_y$ used as the basis for the maximum local primary membrane stress at the nozzle intersection P_L.

The field test condition has not been investigated.

The test temperature of 60 °F is warmer than the minimum recommended temperature of 10 °F so the brittle fracture provision of

UG-99(h) has been met.

Thickness Summary

Component Data								
Component Identifier	**Material**	**Diameter (in)**	**Length (in)**	**Nominal t (in)**	**Design t (in)**	**Total Corrosion (in)**	**Joint E**	**Load**
Closure	SA-516 70	24 OD	6.375	0.75*	0.6871	0.0625	1.00	Internal
Straight Flange on Closure	SA-516 70	24 OD	2	0.875	0.7083	0.0625	1.00	Internal
Shell	SA-106 C Smls pipe	24 OD	132	0.969	0.7088	0.0625	1.00	Internal
Straight Flange on Bottom Head	SA-516 70	24 OD	2	0.875	0.7089	0.0625	1.00	Internal
Bottom Head	SA-516 70	24 OD	6.375	0.75*	0.6877	0.0625	1.00	Internal
Skirt	SA-53 E/B Wld pipe	24 OD	29.5	0.375	0.0273	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

Building Code: ASCE 7-10		
Elevation of base above grade		0.00 ft
Increase effective outer diameter by		0.00 ft
Wind Force Coefficient, Cf		0.7000
Risk Category (Table 1.5-1)		III
Basic Wind Speed, V		120.00 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		14.4478 ft
Minimum Diameter, b	Operating, Corroded	2.1667 ft
	Empty, Corroded	2.1667 ft
Fundamental Frequency, n_1	Operating, Corroded	14.1413 Hz
	Empty, Corroded	14.2430 Hz
	Vacuum, Corroded	14.1413 Hz
Damping coefficient, β	Operating, Corroded	0.0259
	Empty, Corroded	0.0210
	Vacuum, Corroded	0.0259

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
Vacuum, Corroded
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)**
Closure	164.9982	2.17	29.0	*	0	15	4	0.0033
Shell	32.9982	2.17	28.8	0.2118	0	284	1,695	0.003
Bottom Head (top)	29.5	2.17	29.0	*	0	291	1,779	0.0003
Skirt	0	2.17	29.0	0.09367	0	346	2,561	0.0002
*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)**
Closure	164.9982	2.17	29.4	*	0	15	4	0.0032
Shell	32.9982	2.17	29.2	0.2118	0	284	1,695	0.003
Bottom Head (top)	29.5	2.17	29.4	*	0	291	1,779	0.0003
Skirt	0	2.17	29.4	0.09367	0	346	2,561	0.0002
*Moment of Inertia I varies over the length of the component								

Wind Deflection Report: Vacuum, 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)**
Closure	164.9982	2.17	29.0	*	0	15	4	0.0033
Shell	32.9982	2.17	28.8	0.2118	0	284	1,695	0.003
Bottom Head (top)	29.5	2.17	29.0	*	0	291	1,779	0.0003
Skirt	0	2.17	29.0	0.09367	0	346	2,561	0.0002
*Moment of Inertia I varies over the length of the component								

Wind Pressure (WP) Calculations

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

$Kz = 2.01 * (Z/Zg)^{2/\alpha}$
$= 2.01 * (Z/900.00)^{0.2105}$
$qz = 0.00256 * Kz * Kzt * Kd * V^2$
$= 0.00256 * Kz * 1.0000 * 0.9500 * 120.0000^2$
$= 35.0208 * Kz$
$WP = 0.6 * qz * G * Cf$ (Minimum 16 lb/ft^2)
$= 0.6 * qz * G * 0.7000$ (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	29.73	11.30	11.30	N.A.	N.A.	11.30
Design Wind Force determined from: F = Pressure * Af , where Af is the projected area.							

Gust Factor Calculations

Operating, Corroded
Empty, Corroded
Vacuum, Corroded

Gust Factor Calculations: Operating, Corroded

Vessel is considered a rigid structure as n_1 = 14.1413 Hz ≥ 1 Hz.

$\bar{z}$ = max (0.60 * h , z_{min})
= max (0.60 * 14.4478 , 15.0000)
= 15.0000

$I_{\bar{z}}$ = c * $(33 / \bar{z})^{1/6}$
= 0.2000 * $(33 / 15.0000)^{1/6}$
= 0.2281

$L_{\bar{z}}$ = l * $(\bar{z} / 33)^{ep}$
= 500.0000 * $(15.0000 / 33)^{0.2000}$
= 427.0566

Q = Sqr(1 / (1 + 0.63 * ((b + h) / $L_{\bar{z}}$)$^{0.63}$))
= Sqr(1 / (1 + 0.63 * ((2.1667 + 14.4478) / 427.0566)$^{0.63}$))
= 0.9616

G = 0.925 * (1 + 1.7 * g_Q * $I_{\bar{z}}$ * Q) / (1 + 1.7 * g_v * $I_{\bar{z}}$)
= 0.925 * (1 + 1.7 * 3.40* 0.2281 * 0.9616) / (1 + 1.7 * 3.40 * 0.2281)
= 0.9048

Gust Factor Calculations: Empty, Corroded

Vessel is considered a rigid structure as n_1 = 14.2430 Hz ≥ 1 Hz.

$\bar{z}$ = max (0.60 * h , z_{min})
= max (0.60 * 14.4478 , 15.0000)
= 15.0000

$I_{\bar{z}}$ = c * $(33 / \bar{z})^{1/6}$
= 0.2000 * $(33 / 15.0000)^{1/6}$
= 0.2281

$L_{\bar{z}}$ = l * $(\bar{z} / 33)^{ep}$
= 500.0000 * $(15.0000 / 33)^{0.2000}$
= 427.0566

Q = Sqr(1 / (1 + 0.63 * ((b + h) / L_{z^-})$^{0.63}$))
= Sqr(1 / (1 + 0.63 * ((2.1667 + 14.4478) / 427.0566)$^{0.63}$))
= 0.9616

G = 0.925 * (1 + 1.7 * g_Q * I_{z^-} * Q) / (1 + 1.7 * g_v * I_{z^-})
= 0.925 * (1 + 1.7 * 3.40* 0.2281 * 0.9616) / (1 + 1.7 * 3.40 * 0.2281)
= 0.9048

Gust Factor Calculations: Vacuum, Corroded

Vessel is considered a rigid structure as n_1 = 14.1413 Hz ≥ 1 Hz.

$\bar{z}$ = max (0.60 * h , z_{min})
= max (0.60 * 14.4478 , 15.0000)
= 15.0000

I_{z^-} = c * (33 / $\bar{z}$)$^{1/6}$
= 0.2000 * (33 / 15.0000)$^{1/6}$
= 0.2281

L_{z^-} = l * ($\bar{z}$ / 33)^{ep}
= 500.0000 * (15.0000 / 33)$^{0.2000}$
= 427.0566

Q = Sqr(1 / (1 + 0.63 * ((b + h) / L_{z^-})$^{0.63}$))
= Sqr(1 / (1 + 0.63 * ((2.1667 + 14.4478) / 427.0566)$^{0.63}$))
= 0.9616

G = 0.925 * (1 + 1.7 * g_Q * I_{z^-} * Q) / (1 + 1.7 * g_v * I_{z^-})
= 0.925 * (1 + 1.7 * 3.40* 0.2281 * 0.9616) / (1 + 1.7 * 3.40 * 0.2281)
= 0.9048

Table Lookup Values	
α = 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]
$\bar{a}$ = 0.1538, $\bar{b}$ = 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]

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		14.4478 ft
Weight	Operating, Corroded	5,497 lb
	Empty, Corroded	5,091 lb
	Vacuum, Corroded	5,497 lb
Period of Vibration Calculation		
Fundamental Period, T	Operating, Corroded	0.071 sec (f = 14.1 Hz)
	Empty, Corroded	0.070 sec (f = 14.2 Hz)
	Vacuum, Corroded	0.071 sec (f = 14.1 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:

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)**
Closure	164.9982	29.0	*	489	320
Shell	32.9982	28.8	0.2118	1,149	10,074
Bottom Head (top)	29.5	29.0	*	1,157	10,410
Skirt	0	29.0	0.09367	1,174	13,282
*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)**
Closure	164.9982	29.4	*	466	305
Shell	32.9982	29.2	0.2118	1,069	9,580
Bottom Head (top)	29.5	29.4	*	1,073	9,893
Skirt	0	29.4	0.09367	1,087	12,552
*Moment of Inertia I varies over the length of the component					

Seismic Shear Report: Vacuum, 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)**
Closure	164.9982	29.0	*	489	320
Shell	32.9982	28.8	0.2118	1,149	10,074
Bottom Head (top)	29.5	29.0	*	1,157	10,410
Skirt	0	29.0	0.09367	1,174	13,282
*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
Vacuum, Corroded

Base Shear Calculations: Operating, Corroded

Paragraph 15.4.4: Period Determination

Fundamental Period is taken from the Rayleigh method listed previously in this report.

T = 0.0707 sec.

12.8.1: Calculation of Seismic Response Coefficient

C_s is the value computed below, bounded by C_sMin and C_sMax:
C_sMin is calculated with equation 15.4-1 and shall not be less than 0.03; in addition, if S_1 >= 0.6g, C_sMin shall not be less than eqn 15.4-2.
C_sMax calculated with 12.8-3 because (T = 0.0707) <= (T_L = 12.0000)

C_s = S_{DS} / (R / I_e) = 0.7333 / (3.0000 / 1.2500) = 0.3056
C_sMin = max (0.044 * S_{DS} * I_e , 0.03) = max (0.044 * 0.7333 * 1.2500 , 0.03) = 0.0403
C_sMax = S_{D1} / (T * (R / I_e)) = 0.4267 / (0.0707 * (3.0000 / 1.2500)) = 2.5140
C_s = 0.3056

12.8.1: Calculation of Base Shear

V = C_s * W
= 0.3056 * 5,496.9590
= 1,679.63 lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E_h

Q_E = V
E_h = 0.7 * ρ * Q_E (Only 70% of seismic load considered as per Section 2.4.1)
= 0.70 * 1.0000 * 1,679.63
= 1,175.74 lb

Base Shear Calculations: Empty, Corroded

Paragraph 15.4.4: Period Determination

Fundamental Period is taken from the Rayleigh method listed previously in this report.

T = 0.0702 sec.

12.8.1: Calculation of Seismic Response Coefficient

C_s is the value computed below, bounded by C_sMin and C_sMax:
C_sMin is calculated with equation 15.4-1 and shall not be less than 0.03; in addition, if S_1 >= 0.6g, C_sMin shall not be less than eqn 15.4-2.
C_sMax calculated with 12.8-3 because (T = 0.0702) <= (T_L = 12.0000)

C_s = S_{DS} / (R / I_e) = 0.7333 / (3.0000 / 1.2500) = 0.3056
C_sMin = max (0.044 * S_{DS} * I_e , 0.03) = max (0.044 * 0.7333 * 1.2500 , 0.03) = 0.0403
C_sMax = S_{D1} / (T * (R / I_e)) = 0.4267 / (0.0702 * (3.0000 / 1.2500)) = 2.5321
C_s = 0.3056

12.8.1: Calculation of Base Shear

$V = C_s * W$
$= 0.3056 * 5,091.1558$
$= 1,555.63$ 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)
$= 0.70 * 1.0000 * 1,555.63$
$= 1,088.94$ lb

Base Shear Calculations: Vacuum, Corroded

Paragraph 15.4.4: Period Determination

Fundamental Period is taken from the Rayleigh method listed previously in this report.

$T = 0.0707$ sec.

12.8.1: Calculation of Seismic Response Coefficient

C_s is the value computed below, bounded by C_sMin and C_sMax:
C_sMin is calculated with equation 15.4-1 and shall not be less than 0.03; in addition, if $S_1 >= 0.6g$, C_sMin shall not be less than eqn 15.4-2.
C_sMax calculated with 12.8-3 because $(T = 0.0707) <= (T_L = 12.0000)$

$C_s = S_{DS} / (R / I_e)$ $= 0.7333 / (3.0000 / 1.2500)$ $= 0.3056$
$C_s\text{Min} = \max (0.044 * S_{DS} * I_e , 0.03)$ $= \max (0.044 * 0.7333 * 1.2500 , 0.03)$ $= 0.0403$
$C_s\text{Max} = S_{D1} / (T * (R / I_e))$ $= 0.4267 / (0.0707 * (3.0000 / 1.2500))$ $= 2.5140$
$C_s = 0.3056$

12.8.1: Calculation of Base Shear

$V = C_s * W$
$= 0.3056 * 5,496.9590$
$= 1,679.63$ 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)
$= 0.70 * 1.0000 * 1,679.63$
$= 1,175.74$ lb

Shell

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-106 C Smls pipe (II-D p. 22, ln. 1)		
Pipe NPS and Schedule		NPS 24 Sch 60		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
No	No	No	No	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1,100	150	-20
External		15	150	
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Operating		0.83	23	1
Test vertical		5.04	139.625	1
Dimensions				
Outer Diameter		24"		
Length		132"		
Pipe Nominal Thickness		0.969"		
Pipe Minimum Thickness[1]		0.8479"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		2,549.4		218.44
Corroded		2,391.61		220.93
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		1	12.5	74.99
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		132	10	10
Radiography				

Longitudinal seam	Seamless No RT
Top Circumferential seam	Spot UW-11(a)(5)(b) Type 1
Bottom Circumferential seam	Spot UW-11(a)(5)(b) Type 1

[1]Pipe minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	0.7088"
Design thickness due to external pressure (t_e)	0.2257"
Design thickness due to combined loadings + corrosion	0.371"
Maximum allowable working pressure (MAWP)	1,343.32 psi
Maximum allowable pressure (MAP)	1,454.23 psi
Maximum allowable external pressure (MAEP)	584.35 psi
Rated MDMT	-20 °F

UCS-66 Material Toughness Requirements	
Governing thickness, t_g =	0.8479"
MDMT =	-20°F
Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F.	

Design thickness, (at 150 ° F) Appendix 1-1

t = $P*R_o$ / (S*E + 0.40*P) + Corrosion
= 1,100.83*12 / (20,000*1.00 + 0.40*1,100.83) + 0.0625
= 0.7088"

Maximum allowable working pressure, (at 150 ° F) Appendix 1-1

P = $S*E*t / (R_o - 0.40*t) - P_s$
= 20,000*1.00*(0.969*0.875 - 0.0625) / (12 - 0.40*(0.969*0.875 - 0.0625)) - 0.83
= 1,343.32 psi

Maximum allowable pressure, (at 60 ° F) Appendix 1-1

P = $S*E*t / (R_o - 0.40*t)$
= 20,000*1.00*(0.969*0.875) / (12 - 0.40*(0.969*0.875))
= 1,454.23 psi

External Pressure, (Corroded & at 150 ° F) UG-28(c)

L / D_o = 139.7917 / 24 = 5.8247
D_o / t = 24 / 0.1632 = 147.0606

From table G: A = 0.000116
From table CS-2: B = 1,654.4236 psi

P_a = 4*B / (3*(D_o / t))
= 4*1,654.42 / (3*(24 / 0.1632))
= 15 psi

Design thickness for external pressure P_a = 15 psi

t_a = t + Corrosion = 0.1632 + 0.0625 = 0.2257"

Maximum Allowable External Pressure, (Corroded & at 150 ° F) UG-28(c)

L / D_o = 139.7917 / 24 = 5.8247
D_o / t = 24 / (0.969*0.875 - 0.0625) = 30.5587

From table G: A = 0.001346
From table CS-2: B = 13,392.8038 psi

P_a = 4*B / (3*(D_o / t))
= 4*13,392.8 / (3*(24 / (0.969*0.875 - 0.0625)))
= 584.35 psi

External Pressure + Weight + Wind Loading Check (Bergman, ASME paper 54-A-104)

P_v = W / (2*π*R_m) + M / (π*R_m^2)
= 4,552.3 / (2*π*11.5468) + 20,341 / (π*11.5468^2)
= 111.3098 lb/in
α = P_v / (P_e*D_o)
= 111.3098 / (15*24)
= 0.3092
n = 2
m = 1.23 / (L / D_o)^2
= 1.23 / (139.7917 / 24)^2
= 0.0363
Ratio P_e = (n^2 - 1 + m + m*α) / (n^2 - 1 + m)
= (2^2 - 1 + 0.0363 + 0.0363*0.3092) / (2^2 - 1 + 0.0363)
= 1.0037
Ratio P_e * P_e ≤ MAEP
(1.0037 * 15 = 15.06) ≤ 584.35
Cylinder design thickness is satisfactory.

External Pressure + Weight + Seismic Loading Check (Bergman, ASME paper 54-A-104)

P_v = (1 + 0.14*S_{DS})*W / (2*π*R_m) + M / (π*R_m^2)
= 1.10*4,552.3 / (2*π*11.5468) + 120,886 / (π*11.5468^2)
= 357.7955 lb/in
α = P_v / (P_e*D_o)
= 357.7955 / (15*24)
= 0.9939
n = 2
m = 1.23 / (L / D_o)^2
= 1.23 / (139.7917 / 24)^2
= 0.0363

Ratio P_e = $(n^2 - 1 + m + m*\alpha) / (n^2 - 1 + m)$
= $(2^2 - 1 + 0.0363 + 0.0363*0.9939) / (2^2 - 1 + 0.0363)$
= 1.0119

Ratio P_e * P_e ≤ MAEP

(1.0119 * 15 = 15.18) ≤ 584.35

Cylinder design thickness is satisfactory.

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	17,321	150	0.0625	Wind	0.2964	0.2904
						Seismic	0.3085	0.2784
Operating, Hot & New	1,100	20,000	17,340	150	0	Wind	0.2947	0.2886
						Seismic	0.3073	0.276
Hot Shut Down, Corroded	0	20,000	17,321	150	0.0625	Wind	0.0005	0.0054
						Seismic	0.0126	0.0172
Hot Shut Down, New	0	20,000	17,340	150	0	Wind	0.0005	0.0055
						Seismic	0.0131	0.0178
Empty, Corroded	0	20,000	17,321	70	0.0625	Wind	0.0005	0.0054
						Seismic	0.0119	0.0165
Empty, New	0	20,000	17,340	70	0	Wind	0.0005	0.0055
						Seismic	0.0124	0.0172
Vacuum	-15	20,000	17,321	150	0.0625	Wind	0.0035	0.0094
						Seismic	0.0085	0.0212
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	17,321	150	0.0625	Weight	0.0035	0.0037

Bottom Head

ASME Section VIII Division 1, 2015 Edition				
Component		Ellipsoidal Head		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Attached To		Shell		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
No	Yes	Yes	No	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1,100	150	-20
External		15	150	
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Operating		1.11	30.6875	1
Test vertical		5.32	147.25	1
Dimensions				
Outer Diameter		24"		
Head Ratio		2		
Minimum Thickness		0.75"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Length L_{sf}		2"		
Nominal Thickness t_{sf}		0.875"		
Weight and Capacity				
		Weight (lb)[1]		**Capacity (US gal)[1]**
New		169.5		9.82
Corroded		156.7		10
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		1	12.5	6.11
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		132	10	10
Radiography				
Category A joints		Seamless No RT		

Head to shell seam	Spot UW-11(a)(5)(b) 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)	0.6877"
Design thickness due to external pressure (t_e)	0.1213"
Maximum allowable working pressure (MAWP)	1,215.86 psi
Maximum allowable pressure (MAP)	1,324.5 psi
Maximum allowable external pressure (MAEP)	571.46 psi
Straight Flange governs MDMT	-55°F

Factor K		
$K = (1/6)*[2 + (D / (2*h))^2]$		
Corroded	$K = (1/6)*[2 + (22.625 / (2*5.6875))^2]$	0.9927
New	$K = (1/6)*[2 + (22.5 / (2*5.625))^2]$	1

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

t = $P*D_o*K / (2*S*E + 2*P*(K - 0.1)) + Corrosion$
= $1,101.11*24*0.992694 / (2*20,000*1 + 2*1,101.11*(0.992694 - 0.1)) + 0.0625$
= 0.6876"

Maximum allowable working pressure, (Corroded at 150 ° F) Appendix 1-4(c)

P = $2*S*E*t / (K*D_o - 2*t*(K - 0.1)) - P_s$
= $2*20,000*1*0.6875 / (0.992694*24 - 2*0.6875*(0.992694 - 0.1)) - 1.11$
= 1,215.86 psi

Maximum allowable pressure, (New at 60 ° F) Appendix 1-4(c)

P = $2*S*E*t / (K*D_o - 2*t*(K - 0.1)) - P_s$
= $2*20,000*1*0.75 / (1*24 - 2*0.75*(1 - 0.1)) - 0$
= 1,324.5 psi

Design thickness for external pressure, (Corroded at 150 ° F) UG-33(d)

Equivalent outside spherical radius (R_o)
R_o = K_o*D_o
= 0.8471*24
= 20.3294 in

A = $0.125 / (R_o / t)$
= $0.125 / (20.3294 / 0.058716)$
= 0.000361

From Table B = 5,193.4527

CS-2: psi

P_a = B / (R_o / t)
= 5,193.4527 / (20.3294 / 0.0587)
= 15 psi

t = 0.0587" + Corrosion = 0.0587" + 0.0625" = 0.1212"
Check the external pressure per UG-33(a)(1) Appendix 1-4(c)

t = 1.67*P_e*D_o*K / (2*S*E + 2*1.67*P_e*(K - 0.1)) + Corrosion
= 1.67*15*24*0.992694 / (2*20,000*1 + 2*1.67*15*(0.992694 - 0.1)) + 0.0625
= 0.0774"

The head external pressure design thickness (t_e) is 0.1212".

Maximum Allowable External Pressure, (Corroded at 150 ° F) UG-33(d)

Equivalent outside spherical radius (R_o)
R_o = K_o*D_o
= 0.8471*24
= 20.3294 in

A = 0.125 / (R_o / t)
= 0.125 / (20.3294 / 0.6875)
= 0.004227

From Table CS-2: B = 16,898.18 psi

P_a = B / (R_o / t)
= 16,898.18 / (20.3294 / 0.6875)
= 571.4625 psi

Check the Maximum External Pressure, UG-33(a)(1) Appendix 1-4(c)

P = 2*S*E*t / ((K*D_o - 2*t*(K - 0.1))*1.67)
= 2*20,000*1*0.6875 / ((0.992694*24 - 2*0.6875*(0.992694 - 0.1))*1.67)
= 728.72 psi

The maximum allowable external pressure (MAEP) is 571.46 psi.

% Extreme fiber elongation - UCS-79(d)

EFE = (75*t / R_f)*(1 - R_f / R_o)
= (75*0.875 / 4.2625)*(1 - 4.2625 / ∞)
= 15.3959%

The extreme fiber elongation exceeds 5 percent and the thickness exceeds 5/8 inch;. Heat treatment per UCS-56 is required if fabricated by cold forming.

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**
No	Yes	Yes	No	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1,100	150	-20
External		15	150	
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Operating		0.9	25	1
Test vertical		5.11	141.625	1
Dimensions				
Outer Diameter		24"		
Length		2"		
Nominal Thickness		0.875"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		35.98		3.37
Corroded		33.5		3.4
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		1	12.5	0
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Seamless No RT		
Top Circumferential seam		Spot UW-11(a)(5)(b) 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)	0.7089"
Design thickness due to external pressure (t_e)	0.2257"
Design thickness due to combined loadings + corrosion	0.3737"
Maximum allowable working pressure (MAWP)	1,390.96 psi
Maximum allowable pressure (MAP)	1,502.15 psi
Maximum allowable external pressure (MAEP)	614.88 psi
Rated MDMT	-55 °F

UCS-66 Material Toughness Requirements	
Governing thickness, t_g =	0.8479"
Exemption temperature from Fig UCS-66 Curve D =	-36.87°F
t_r = 1,127.89*12 / (20,000*1 + 0.4*1,127.89) =	0.6618"
Stress ratio = t_r*E^* / (t_n - c) = 0.6618*1 / (0.875 - 0.0625) =	0.8145
Reduction in MDMT, T_R from Fig UCS-66.1 =	18.5°F
MDMT = max[MDMT - T_R, -55] = max[-36.87 - 18.5 , -55] =	-55°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Design thickness, (at 150 ° F) Appendix 1-1

t = $P*R_o$ / (S*E + 0.40*P) + Corrosion
= 1,100.9*12 / (20,000*1.00 + 0.40*1,100.9) + 0.0625
= 0.7089"

Maximum allowable working pressure, (at 150 ° F) Appendix 1-1

P = S*E*t / (R_o - 0.40*t) - P_s
= 20,000*1.00*0.8125 / (12 - 0.40*0.8125) - 0.9
= 1,390.96 psi

Maximum allowable pressure, (at 60 ° F) Appendix 1-1

P = S*E*t / (R_o - 0.40*t)
= 20,000*1.00*0.875 / (12 - 0.40*0.875)
= 1,502.15 psi

External Pressure, (Corroded & at 150 ° F) UG-28(c)

L / D_o = 139.7917 / 24 = 5.8247
D_o / t = 24 / 0.1632 = 147.0606

From table G: A = 0.000116
From table CS-2: B = 1,654.4236 psi

P_a = 4*B / (3*(D_o / t))
= 4*1,654.42 / (3*(24 / 0.1632))
= 15 psi

Design thickness for external pressure P_a = 15 psi

t_a = t + Corrosion = 0.1632 + 0.0625 = 0.2257"

Maximum Allowable External Pressure, (Corroded & at 150 ° F) UG-28(c)

L / D_o = 139.7917 / 24 = 5.8247
D_o / t = 24 / 0.8125 = 29.5385

From table G: A = 0.001428
From table CS-2: B = 13,621.9131 psi

P_a = 4*B / (3*(D_o / t))
= 4*13,621.91 / (3*(24 / 0.8125))
= 614.88 psi

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*0.875 / 11.5625)*(1 - 11.5625 / ∞)
= 3.7838%

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	17,330	150	0.0625	Wind	0.299	0.2929
						Seismic	0.3112	0.2807
Operating, Hot & New	1,100	20,000	17,348	150	0	Wind	0.2973	0.2911
						Seismic	0.3099	0.2784
Hot Shut Down, Corroded	0	20,000	17,330	150	0.0625	Wind	0.0006	0.0054
						Seismic	0.0128	0.0174
Hot Shut Down, New	0	20,000	17,348	150	0	Wind	0.0005	0.0056
						Seismic	0.0132	0.018
Empty, Corroded	0	20,000	17,330	70	0.0625	Wind	0.0006	0.0054
						Seismic	0.0121	0.0167
Empty, New	0	20,000	17,348	70	0	Wind	0.0005	0.0056
						Seismic	0.0125	0.0173
Vacuum	-15	20,000	17,330	150	0.0625	Wind	0.0035	0.0094
						Seismic	0.0087	0.0214
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	17,330	150	0.0625	Weight	0.0036	0.0037

Skirt

ASME Section VIII Division 1, 2015 Edition				
Component		Support Skirt		
Material		SA-53 E/B Wld pipe (II-D p. 14, ln. 12)		
Skirt is Attached To		Bottom Head		
Skirt Attachment Offset		3.4982" down from the top seam		
Design Temperature				
Internal		150°F		
External		150°F		
Dimensions				
Inner Diameter	**Top**	23.25"		
	Botttom	23.25"		
Length (includes base ring thickness)		29.5"		
Nominal Thickness		0.375"		
Corrosion	**Inner**	0"		
	Outer	0"		
Weight				
New		226.45 lb		
Corroded		226.45 lb		
Insulation				
		Thickness	**Density**	**Weight**
Insulation		1"	12.5	16.76 lb
		Spacing	**Individual Weight**	**Total Weight**
Insulation Supports		132"	10 lb	10 lb
Joint Efficiency				
Top		0.55		
Bottom		0.8		

Skirt design thickness, largest of the following + corrosion = 0.0273 in

The governing condition is due to seismic, tensile stress at the top, operating & new.

The skirt thickness of 0.3281 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	bottom	150	17,176.47	87.66	0.0019
		Compressive			17,176.47	381.59	0.0083
	operating, new	Tensile	bottom	150	17,176.47	82.61	0.0018
		Compressive			17,176.47	388.62	0.0085
	empty, corroded	Tensile	bottom	60	17,176.47	98.6	0.0022
		Compressive			17,176.47	367.01	0.008
	empty, new	Tensile	bottom	60	17,176.47	93.4	0.002
		Compressive			17,176.47	374.23	0.0082
	test, new	Tensile	bottom	60	17,176.47	-152.1	0.0033
		Compressive				263.27	0.0057
	vacuum, corroded	Tensile	bottom	150	17,176.47	87.66	0.0019
		Compressive			17,176.47	381.59	0.0083
Seismic	operating, corroded	Tensile	top	150	17,176.47	1,213.78	0.0265
		Compressive	bottom		17,176.47	1,184.25	0.0259
	operating, new	Tensile	top	150	17,176.47	1,248.96	0.0273
		Compressive	bottom		17,176.47	1,222.06	0.0267
	empty, corroded	Tensile	top	60	17,176.47	1,158.33	0.0253
		Compressive	bottom		17,176.47	1,114.88	0.0243
	empty, new	Tensile	top	60	17,176.47	1,194.7	0.0261
		Compressive	bottom		17,176.47	1,153.86	0.0252
	vacuum, corroded	Tensile	top	150	17,176.47	1,213.78	0.0265
		Compressive	bottom		17,176.47	1,184.25	0.0259

Loading due to seismic, operating & new

Tensile side

Required thickness, tensile stress at base:

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

$= -(0.6 - 0.14*0.7333)*5{,}610.54 / (\pi*23.625*17{,}176*0.8) + 48*13{,}695.8 / (\pi*23.625^2*17{,}176*0.8)$

$= 0.0245$ in

Required thickness, tensile stress at the top:

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

$= -(0.6 - 0.14*0.7333)*5{,}347.33 / (\pi*23.625*17{,}176*0.55) + 48*10{,}719 / (\pi*23.625^2*17{,}176*0.55)$

$= 0.0273$ in

Compressive side

Required thickness, compressive stress at base:

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

$= (1 + 0.14*0.7333)*5{,}610.54 / (\pi*23.625*17{,}176*1) + 48*13{,}695.8 / (\pi*23.625^2*17{,}176*1)$

$= 0.0267$ in

Required thickness, compressive stress at the top:

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

$= (1 + 0.14*0.7333)*5{,}347.33 / (\pi*23.625*17{,}176*1) + 48*10{,}719 / (\pi*23.625^2*17{,}176*1)$

$= 0.0217$ in

Base Plate

Inputs	
Base configuration	single base plate without gussets
Base plate material	SA-36
Base plate allowable stress, S_p	16,600 psi
Foundation compressive strength	1,658 psi
Concrete ultimate 28-day strength	3,000 psi
Bolt circle, BC	26.75"
Base plate inner diameter, D_i	22"
Base plate outer diameter, D_o	30"
Base plate thickness, t_b	0.75"
Anchor Bolts	
Material	CS
Allowable stress, S_b	20,000 psi
Bolt size and type	0.75" series 8 threaded
Number of bolts, N	4
Corrosion allowance (applied to root radius)	0"
Anchor bolt clearance	0.125"
Bolt root area (corroded), A_b	0.3 in^2
Diameter of anchor bolt holes, d_b	0.875"
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	346.4	2,560.7	5,487	0.0163	0.2325	33.23
Wind	operating, new	346.4	2,562.2	5,679.5	0.0149	0.2346	33.83
Wind	empty, corroded	346.4	2,560.7	5,081.2	0.0193	0.2281	31.98
Wind	empty, new	346.4	2,562.2	5,279.1	0.0179	0.2303	32.6
Wind	test, new	47.2	50.2	7,294.6	0	0.1926	22.81
Wind	vacuum, corroded	346.4	2,560.7	5,487	0.0163	0.2325	33.23
Seismic	operating, corroded	1,173.6	13,282.3	5,487	0.2638	0.5992	220.77
Seismic	operating, new	1,214.8	13,695.8	5,679.5	0.2719	0.6087	227.8
Seismic	empty, corroded	1,086.8	12,552.3	5,081.2	0.25	0.5815	207.88
Seismic	empty, new	1,129.1	12,978.9	5,279.1	0.2583	0.5915	215.13
Seismic	vacuum, corroded	1,173.6	13,282.3	5,487	0.2638	0.5992	220.77

Anchor bolt load (governing)

$P = -(0.6 - 0.14*S_{DS})*W / N + 48 * M / (N*BC)$
$= -(0.6 - 0.14*0.7333)*5,679.54 / 4 + 48 * 13,695.8 / (4*26.75)$
$= 5,437.77\ lb_f$

Required area per bolt = P / S_b = 0.2719 in^2

The area provided (0.302 in^2) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, governing)

Base plate width, t_c:	4	in
Average base plate diameter, d:	26	in
Base plate elastic modulus, E_s:	29.0E+06	psi
Base plate yield stress, S_y:	36,000	psi

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

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

$t_s = (N*A_b) / (\pi*d)$
$= (4*0.302) / (\pi*26)$
$= 0.0148$ in

From table 12.4 for k = 0.148496:

$K_1 = 2.7759,\ K_2 = 1.0434$
$L_1 = 9.141,\quad L_2 = 16.9793,\ L_3 = 3.0733$

Total tensile force on bolting

$T = (12*M - (0.6 - 0.14*S_{DS})*W *(L_1 + L_3)) / (L_2 + L_3)$

= (12*13,695.8 - (0.6 - 0.14*0.7333)*5,679.54 *(9.141 + 3.0733)) / (16.9793 + 3.0733)
= 6,475.44 lb_f

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

$f_s = T / (t_s * (d / 2) * K_1)$
= 6,475.44 / (0.0148 * (26 / 2) * 2.7759)
= 12,133 psi

Total compressive load on foundation

$C_c = T + (1 + 0.14*S_{DS})*W + \text{Bolt Preload}$
= 6,475.44 + (1 + 0.14*0.7333)*5,679.54 + 0
= 12,738.08 lb_f

Foundation bearing stress

$f_c = C_c / (((t_c - t_s) + n*t_s)*(d / 2)*K_2)$
= 12,738.08 / (((4 - 0.0148) + 9.2889*0.0148)*(26 / 2)*1.0434)
= 228 psi

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

$k = 1 / (1 + f_s / (n*f_c))$
= 1 / (1 + 12,133 / (9.2889*228))
= 0.148496

Base plate required thickness (governing)

$t_r = (3*f_c*L^2 / S_p)^{0.5}$
= $(3*228*3^2 / 16{,}600)^{0.5}$
= 0.6087 in

The base plate thickness is satisfactory.

Inlet (N1)

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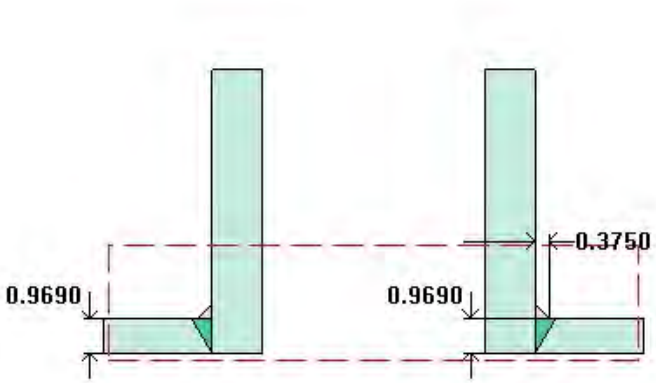
Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	Shell
Orientation	270°
Nozzle center line offset to datum line	30"
End of nozzle to shell center	22"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23) (normalized)
Inside diameter, new	8"
Nominal wall thickness	1.375"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	7.56"
Projection available outside vessel to flange face, Lf	10"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.969"

ASME B16.5-2013 Flange	
Description	NPS 8 Class 600 LWN A105 N
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	No
Rated MDMT	-43.9°F
Liquid static head	0 psi
Consider External Loads on Flange MAWP Rating	No
MAWP rating	1,420 psi @ 150°F
MAP rating	1,480 psi @ 60°F
Hydrotest rating	2,225 psi @ 60°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Flexitallic Spiral Wound CG 304 S.S.
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -43.9°F (Coincident ratio = 0.7615) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements	
LWN rated MDMT per UCS-66(c)(4) =	-43.9°F
Material is exempt from impact testing at the Design MDMT of -20°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}
5.247	5.5216	1.1343	4.2467	--	--	0.1406	0.3819	1.375

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

WRC 107												
Load Case	**P (psi)**	**P_r (lb_f)**	**M_c (lb_f-in)**	**V_c (lb_f)**	**M_L (lb_f-in)**	**V_L (lb_f)**	**M_t (lb_f-in)**	**Max Comb Stress (psi)**	**Allow Comb Stress (psi)**	**Max Local Primary Stress (psi)**	**Allow Local Primary Stress (psi)**	**Over stressed**
Load case 1	1,100	2,400	49,740	2,970	74,640	2,970	119,280	**23,956**	**60,000**	**21,483**	**30,000**	No
Load case 1 (Hot Shut Down)	0	2,400	49,740	2,970	74,640	2,970	119,280	-10,078	60,000	-2,897	30,000	No

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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}**
0.663	10.2114	5.0554	5.0154	--	--	0.1406	0.125	1.375

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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

Outlet (N2)

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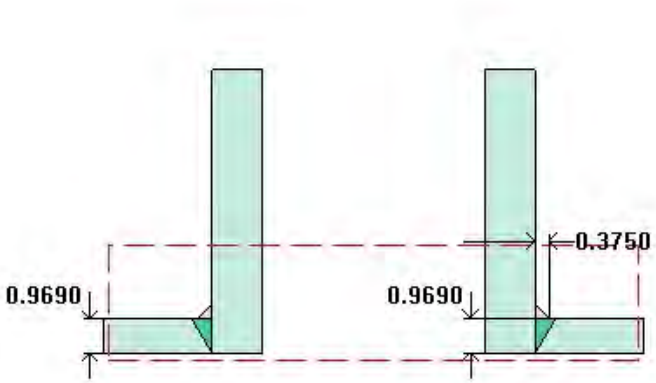
Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	Shell
Orientation	90°
Nozzle center line offset to datum line	117"
End of nozzle to shell center	22"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23) (normalized)
Inside diameter, new	8"
Nominal wall thickness	1.375"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	7.56"
Projection available outside vessel to flange face, Lf	10"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.969"

ASME B16.5-2013 Flange	
Description	NPS 8 Class 600 LWN A105 N
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	No
Rated MDMT	-43.9°F
Liquid static head	0 psi
Consider External Loads on Flange MAWP Rating	No
MAWP rating	1,420 psi @ 150°F
MAP rating	1,480 psi @ 60°F
Hydrotest rating	2,225 psi @ 60°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Flexitallic Spiral Wound CG 304 S.S.
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -43.9°F (Coincident ratio = 0.7615) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements	
LWN rated MDMT per UCS-66(c)(4) =	-43.9°F
Material is exempt from impact testing at the Design MDMT of -20°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}
5.247	5.5216	1.1343	4.2467	--	--	0.1406	0.3819	1.375

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

WRC 107												
Load Case	**P (psi)**	**P_r (lb_f)**	**M_c (lb_f-in)**	**V_c (lb_f)**	**M_L (lb_f-in)**	**V_L (lb_f)**	**M_t (lb_f-in)**	**Max Comb Stress (psi)**	**Allow Comb Stress (psi)**	**Max Local Primary Stress (psi)**	**Allow Local Primary Stress (psi)**	**Over stressed**
Load case 1	1,100	2,400	49,740	2,970	74,640	2,970	119,280	**23,956**	**60,000**	**21,483**	**30,000**	No
Load case 1 (Hot Shut Down)	0	2,400	49,740	2,970	74,640	2,970	119,280	-10,078	60,000	-2,897	30,000	No

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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}**
0.663	10.2114	5.0554	5.0154	--	--	0.1406	0.125	1.375

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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 (Sump) (N3)

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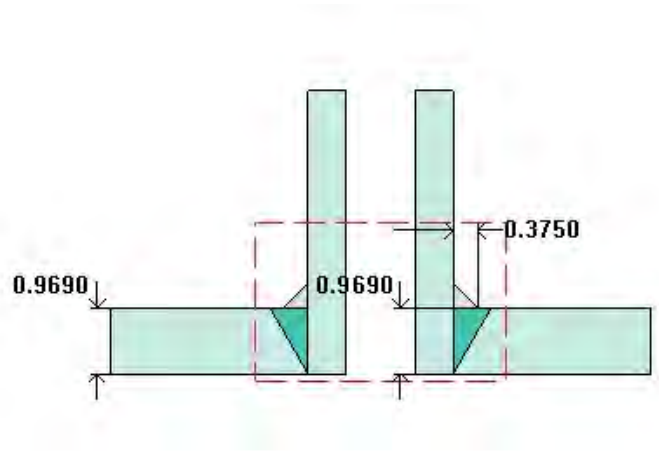
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	90°
Nozzle center line offset to datum line	0"
End of nozzle to shell center	19"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23) (normalized)
Inside diameter, new	1"
Nominal wall thickness	0.56"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	6.06"
Projection available outside vessel to flange face, Lf	7"
Local vessel minimum thickness	0.8479"
Liquid static head included	0.74 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.969"

ASME B16.5-2013 Flange	
Description	NPS 1 Class 600 LWN A105 N
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	No
Rated MDMT	-43.8°F
Liquid static head	0.72 psi
MAWP rating	1,420 psi @ 150°F
MAP rating	1,480 psi @ 60°F
Hydrotest rating	2,225 psi @ 60°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Flexitallic Spiral Wound CG 304 S.S.
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -43.8°F (Coincident ratio = 0.762) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements	
LWN rated MDMT per UCS-66(c)(4) =	-43.8°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.74 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)							0.1973	0.56

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)

Reinforcement Calculations for External Pressure

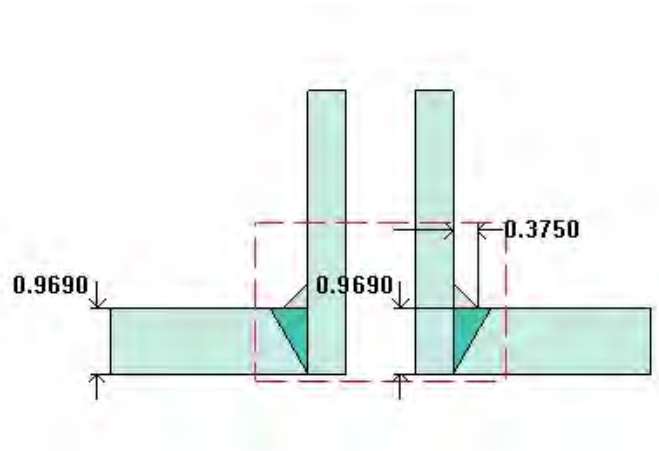
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	**A available**	**A_1**	**A_2**	**A_3**	**A_5**	**A welds**	**t_{req}**	**t_{min}**
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.56

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Liquid Outlet (Coalescer) (N4)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	90°
Nozzle center line offset to datum line	48.5"
End of nozzle to shell center	19"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23) (normalized)
Inside diameter, new	1"
Nominal wall thickness	0.56"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	6.06"
Projection available outside vessel to flange face, Lf	7"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.969"

ASME B16.5-2013 Flange	
Description	NPS 1 Class 600 LWN A105 N
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	No
Rated MDMT	-43.9°F
Liquid static head	0 psi
MAWP rating	1,420 psi @ 150°F
MAP rating	1,480 psi @ 60°F
Hydrotest rating	2,225 psi @ 60°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Flexitallic Spiral Wound CG 304 S.S.
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -43.9°F (Coincident ratio = 0.7615) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements	
LWN rated MDMT per UCS-66(c)(4) =	-43.9°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)							0.1973	0.56

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)

Reinforcement Calculations for External Pressure

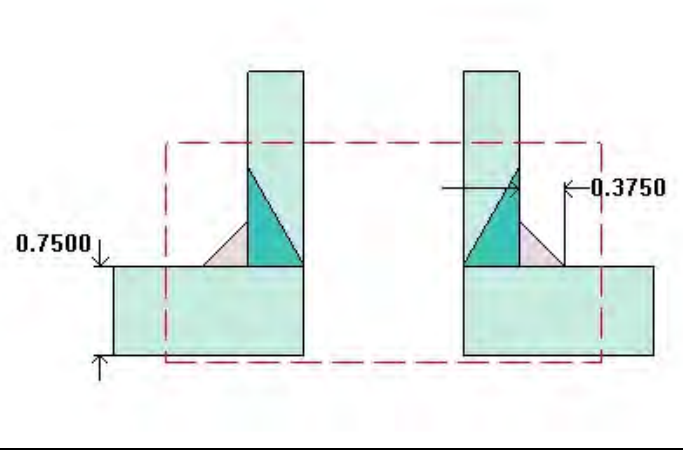
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	**A available**	**A_1**	**A_2**	**A_3**	**A_5**	**A welds**	**t_{req}**	**t_{min}**
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.56

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Drain (Sump) (C1)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Bottom Head
Orientation	0°
End of nozzle to datum line	-13.5"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2.1531"
Local vessel minimum thickness	0.75"
Liquid static head included	1.18 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,128.17*0.72 / (20,000*1 - 0.6*1,128.17) =	0.042"
Stress ratio = t_r*E^* / (t_n - c) = 0.042*1 / (0.4675 - 0.0625) =	0.1038
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,101.18 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)

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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
Weld strength calculations are not required for external pressure

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)

Nozzle Pipe (C1)

ASME Section VIII Division 1, 2015 Edition				
Component		Nozzle Pipe		
Material		SA-106 B Smls pipe (II-D p. 14, ln. 15)		
Pipe NPS and Schedule		NPS 1 Sch 160		
Attached To		Drain (Sump) (C1)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
No	No	No	No	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1,100	150	-20
External		15	150	
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Operating		1.57	43.5	1
Test vertical		5.89	163.125	1
Dimensions				
Outer Diameter		1.315"		
Length		13"		
Pipe Nominal Thickness		0.25"		
Pipe Minimum Thickness[1]		0.2188"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		3.08		0.03
Corroded		2.44		0.04
Radiography				
Longitudinal seam		Seamless No RT		
Left Circumferential seam		None UW-11(c) Type 1		
Right Circumferential seam		None UW-11(c) Type 1		

[1] Pipe minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

Results Summary	
Governing condition	UG-16
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	0.1109"
Design thickness due to external pressure (t_e)	0.0741"
Maximum allowable working pressure (MAWP)	3,815.39 psi
Maximum allowable pressure (MAP)	5,879.63 psi
Maximum allowable external pressure (MAEP)	3,045.24 psi
Rated MDMT	-155 °F

UCS-66 Material Toughness Requirements	
Impact test exempt per UCS-66(d) (NPS 4 or smaller pipe) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Design thickness, (at 150 ° F) Appendix 1-1

t = $P*R_o / (S*E + 0.40*P)$ + Corrosion
= 1,101.57*0.6575 / (17,100*0.85 + 0.40*1,101.57) + 0.0625
= 0.1109"

Maximum allowable working pressure, (at 150 ° F) Appendix 1-1

P = $S*E*t / (R_o - 0.40*t) - P_s$
= 17,100*0.85*(0.25*0.875 - 0.0625) / (0.6575 - 0.40*(0.25*0.875 - 0.0625)) - 1.57
= 3,815.39 psi

Maximum allowable pressure, (at 60 ° F) Appendix 1-2

P = $S*E*\ln(R_o / (R_o - t))$
= 17,100*0.85*ln(0.6575 / (0.6575 - (0.25*0.875)))
= 5,879.63 psi

External Pressure, (Corroded & at 150 ° F) UG-28(c)

L / D_o = 15.1531 / 1.315 = 11.5233
D_o / t = 1.315 / 0.0116 = 113.0335

From table G: A = 0.000098
From table CS-2: B = 1,404.696 psi

P_a = $4*B / (3*(D_o / t))$
= 4*1,404.7 / (3*(1.315 / 0.0116))
= 16.57 psi

Design thickness for external pressure P_a = 16.57 psi

t_a = t + Corrosion = 0.0116 + 0.0625 = 0.0741"

Maximum Allowable External Pressure, (Corroded & at 150 ° F) UG-28(c)

L / D_o = 15.1531 / 1.315 = 11.5233
D_o / t = 1.315 / (0.25*0.875 - 0.0625) = 8.4160

From table G: A = 0.016230
From table CS-2: B = 17,491.7246 psi
$S_y = 2*B_{(sy)} = 2*17,600 = 35,200$ psi
$S_1 = 2*S_e = 2*17,100 = 34,200$ psi
$S_2 = 0.90*S_y = 0.90*35,200 = 31,680$ psi
$S = \min(S_1, S_2) = \min(34,200, 31,680) = 31,680$ psi

P_{a1} = [2.167 / (D_o / t) - 0.08333]*B - Pse
= [2.167 / 8.4160 - 0.08333]*17,492 - 1.57
= 3,045.24 psi

P_{a2} = (2*S / (D_o / t))*[1 - 1/(D_o / t)] - Pse
= (2*31,680 / 8.416)*[1 - 1/8.416] - 1.57
= 6,632.4 psi
Maximum Allowable External Pressure = $\min(P_{a1}, P_{a2})$ = 3,045.24 psi

Drain (Coalescer) (C2)

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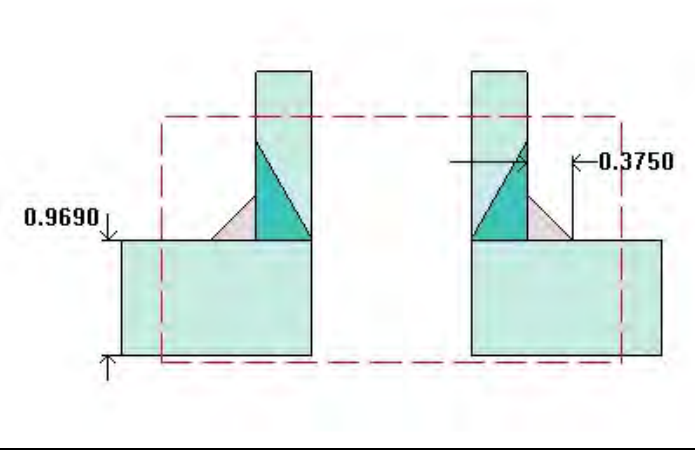
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	0°
Nozzle center line offset to datum line	48.5"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.72 / (20,000*1 - 0.6*1,126.98) =	0.042"
Stress ratio = t_r*E^* / (t_n - c) = 0.042*1 / (0.4675 - 0.0625) =	0.1037
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)

Reinforcement Calculations for External Pressure

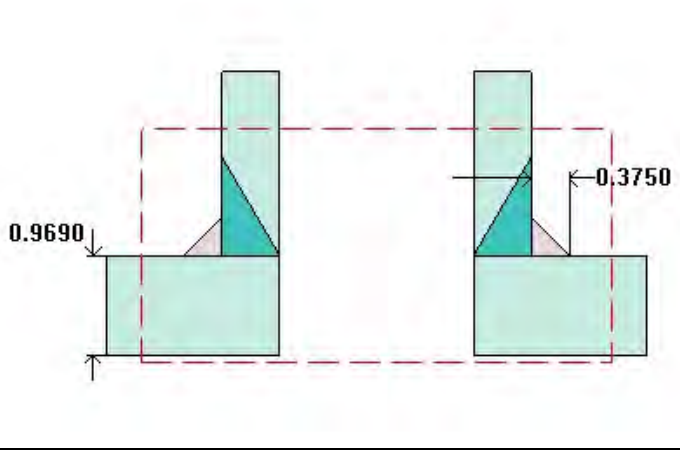
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.4675

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Level Control (Sump) (C3A)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	135°
Nozzle center line offset to datum line	14"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1.5 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.9"
Nominal wall thickness	0.55"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0.25 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,127.23*1.0125 / (20,000*1 - 0.6*1,127.23) =	0.0591"
Stress ratio = t_r*E^* / (t_n - c) = 0.0591*1 / (0.55 - 0.0625) =	0.1212
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.25 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)							0.1432	0.55

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)

Reinforcement Calculations for External Pressure

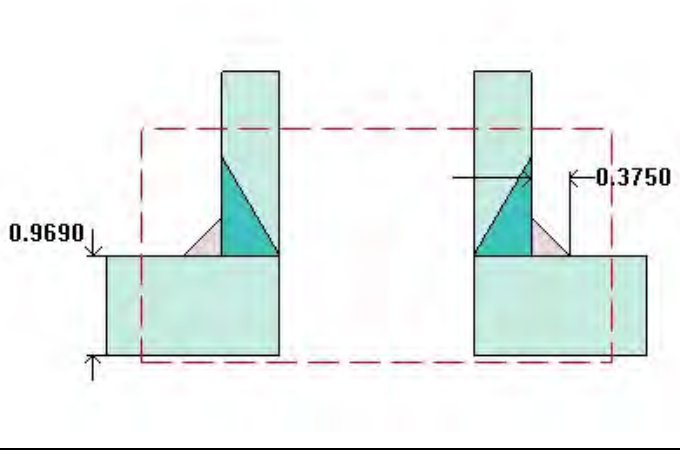
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.55

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Level Control (Sump) (C3B)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	135°
Nozzle center line offset to datum line	0"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1.5 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.9"
Nominal wall thickness	0.55"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0.76 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,127.74*1.0125 / (20,000*1 - 0.6*1,127.74) =	0.0591"
Stress ratio = t_r*E^* / (t_n - c) = 0.0591*1 / (0.55 - 0.0625) =	0.1212
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.76 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)							0.1433	0.55

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)

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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	0.55

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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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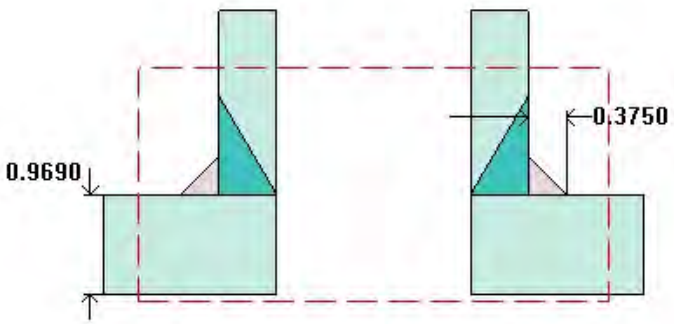	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	135°
Nozzle center line offset to datum line	62.5"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1.5 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.9"
Nominal wall thickness	0.55"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*1.0125 / (20,000*1 - 0.6*1,126.98) =	0.0591"
Stress ratio = t_r*E^* / (t_n - c) = 0.0591*1 / (0.55 - 0.0625) =	0.1211
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)							0.1432	0.55

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)

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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	0.55

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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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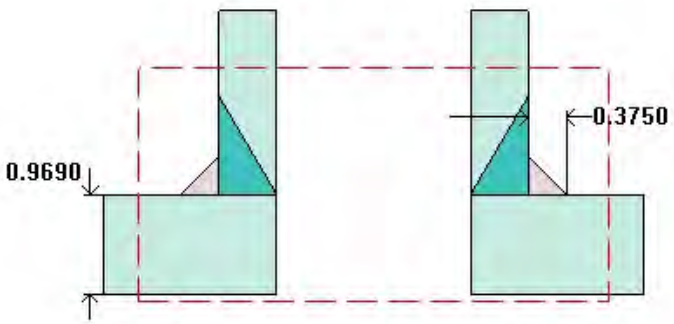
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	135°
Nozzle center line offset to datum line	48.5"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 1.5 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.9"
Nominal wall thickness	0.55"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*1.0125 / (20,000*1 - 0.6*1,126.98) =	0.0591"
Stress ratio = t_r*E^* / (t_n - c) = 0.0591*1 / (0.55 - 0.0625) =	0.1211
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)							0.1432	0.55

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)

Reinforcement Calculations for External Pressure

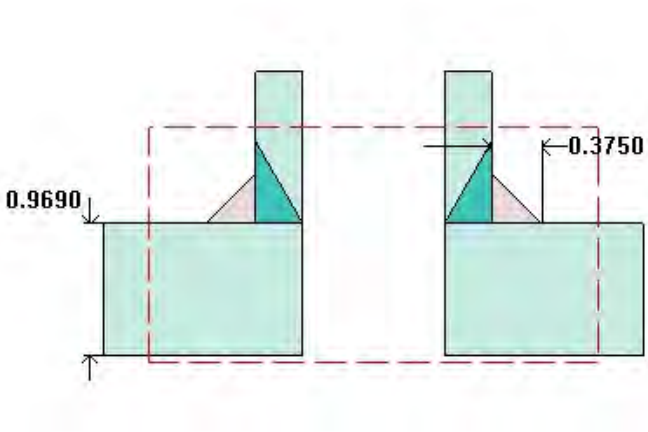
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.55

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Sight Glass (Sump) (C5A)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	14"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0.24 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,127.22*0.5875 / (20,000*1 - 0.6*1,127.22) =	0.0343"
Stress ratio = t_r*E^* / (t_n - c) = 0.0343*1 / (0.35 - 0.0625) =	0.1192
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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)

Reinforcement Calculations for External Pressure

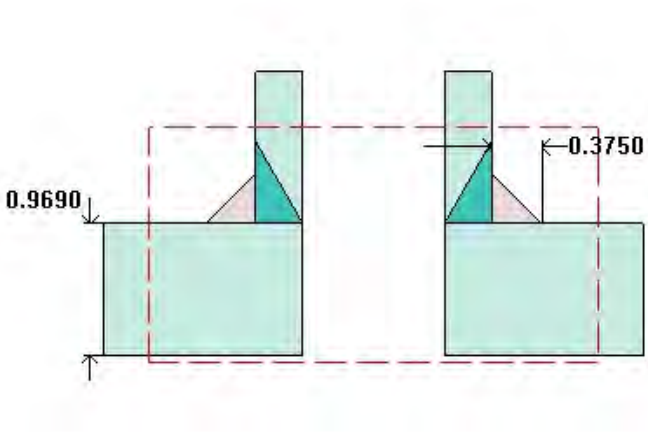
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Sight Glass (Sump) (C5B)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	0"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0.74 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,127.72*0.5875 / (20,000*1 - 0.6*1,127.72) =	0.0343"
Stress ratio = t_r*E^* / (t_n - c) = 0.0343*1 / (0.35 - 0.0625) =	0.1193
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.74 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)

Reinforcement Calculations for External Pressure

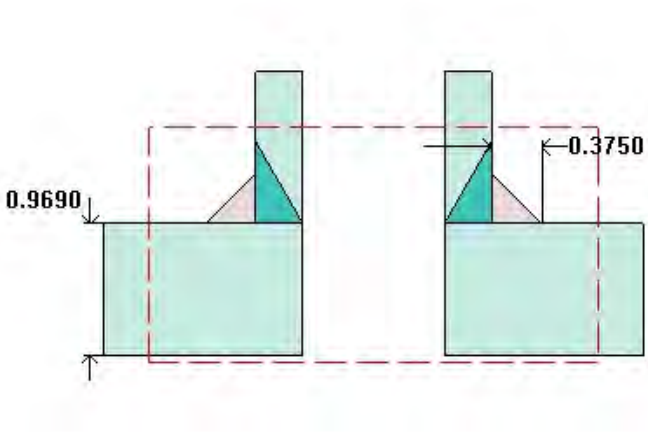
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Sight Glass (Coalescer) (C6A)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	62.5"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.5875 / (20,000*1 - 0.6*1,126.98) =	0.0343"
Stress ratio = t_r*E^* / (t_n - c) = 0.0343*1 / (0.35 - 0.0625) =	0.1192
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)

Reinforcement Calculations for External Pressure

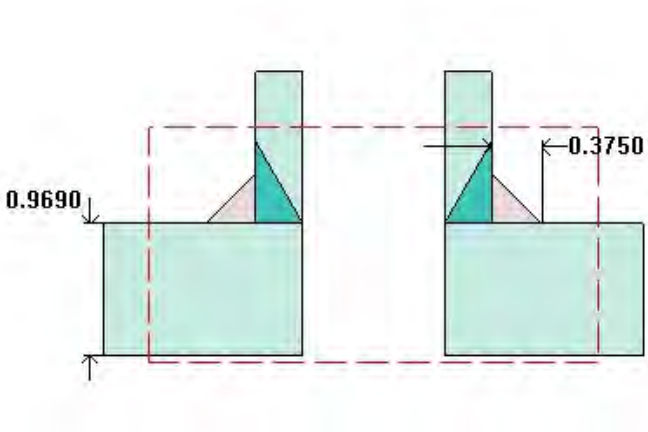
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Sight Glass (Coalescer) (C6B)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	48.5"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.5875 / (20,000*1 - 0.6*1,126.98) =	0.0343"
Stress ratio = t_r*E^* / (t_n - c) = 0.0343*1 / (0.35 - 0.0625) =	0.1192
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)

Reinforcement Calculations for External Pressure

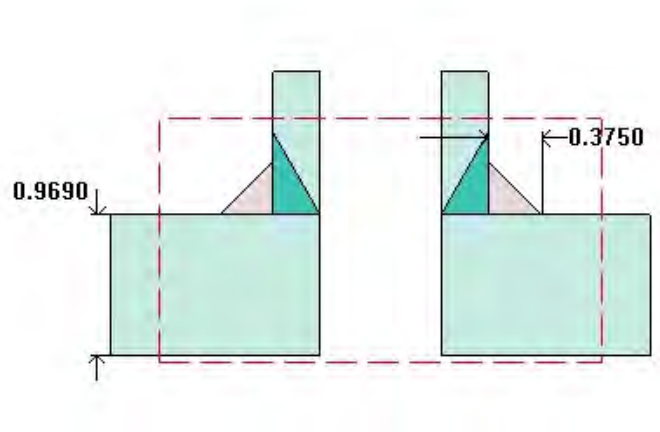
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.35

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

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)

Differential Pressure (C7A)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	117"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.5 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	0.84"
Nominal wall thickness	0.33"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.4825 / (20,000*1 - 0.6*1,126.98) =	0.0281"
Stress ratio = t_r*E^* / (t_n - c) = 0.0281*1 / (0.33 - 0.0625) =	0.1052
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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	0.33

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})	0.1872	0.2625	weld size is adequate

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

Reinforcement Calculations for External Pressure

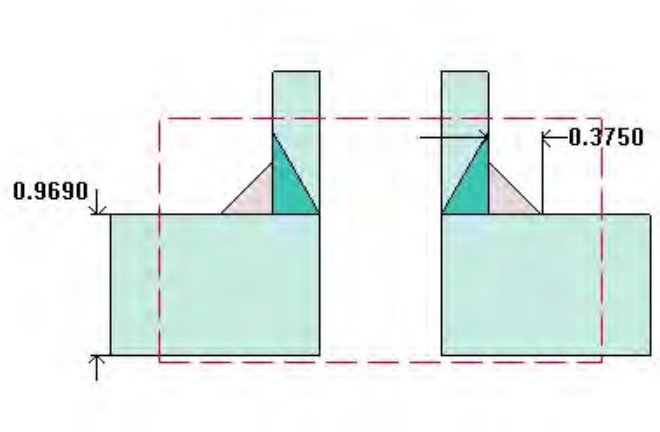
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.33

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.1872	0.2625	weld size is adequate

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

Differential Pressure (C7B)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	30"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.5 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	0.84"
Nominal wall thickness	0.33"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.4825 / (20,000*1 - 0.6*1,126.98) =	0.0281"
Stress ratio = t_r*E^* / (t_n - c) = 0.0281*1 / (0.33 - 0.0625) =	0.1052
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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	0.33

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})	0.1872	0.2625	weld size is adequate

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

Reinforcement Calculations for External Pressure

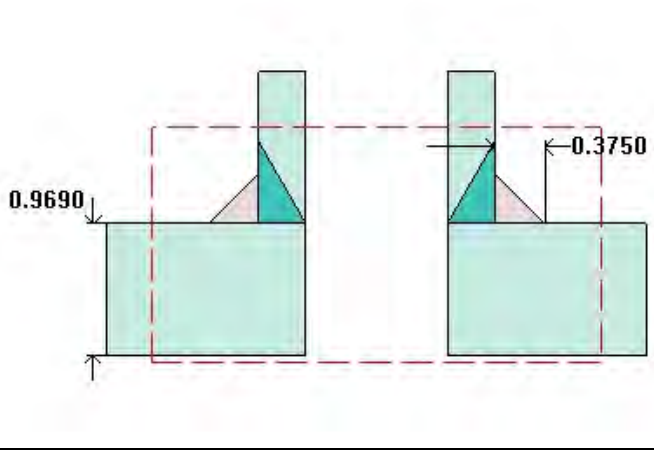
UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 psi @ 150 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.125	0.33

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.1872	0.2625	weld size is adequate

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

Vent (C8)

ASME Section VIII Division 1, 2015 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	0°
Nozzle center line offset to datum line	117"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.75 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.05"
Nominal wall thickness	0.35"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.5875 / (20,000*1 - 0.6*1,126.98) =	0.0343"
Stress ratio = t_r*E^* / (t_n - c) = 0.0343*1 / (0.35 - 0.0625) =	0.1192
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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
Weld strength calculations are not required for external pressure

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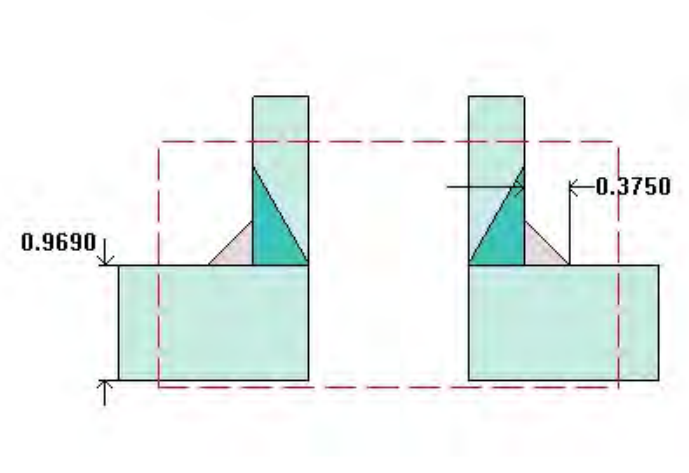
Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	Shell
Orientation	225°
Nozzle center line offset to datum line	23"
End of nozzle to shell center	14"
Passes through a Category A joint	No

Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1

Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.72 / (20,000*1 - 0.6*1,126.98) =	0.042"
Stress ratio = t_r*E^* / (t_n - c) = 0.042*1 / (0.4675 - 0.0625) =	0.1037
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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
Weld strength calculations are not required for external pressure

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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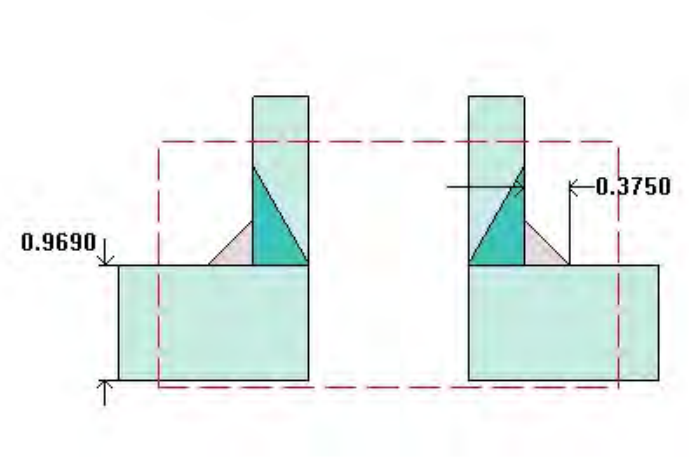

Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	Shell
Orientation	225°
Nozzle center line offset to datum line	9"
End of nozzle to shell center	14"
Passes through a Category A joint	No

Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0.42 psi
Longitudinal joint efficiency	1

Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,127.4*0.72 / (20,000*1 - 0.6*1,127.4) =	0.042"
Stress ratio = t_r*E^* / (t_n - c) = 0.042*1 / (0.4675 - 0.0625) =	0.1037
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1,100.42 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)

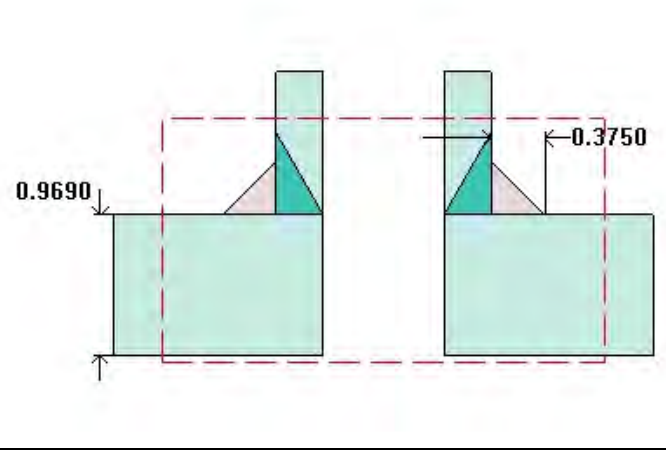
Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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
Weld strength calculations are not required for external pressure

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
Orientation	0°
Nozzle center line offset to datum line	74"
End of nozzle to shell center	14"
Passes through a Category A joint	No
Nozzle	
Description	NPS 0.5 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	0.84"
Nominal wall thickness	0.33"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.4825 / (20,000*1 - 0.6*1,126.98) =	0.0281"
Stress ratio = t_r*E^* / (t_n - c) = 0.0281*1 / (0.33 - 0.0625) =	0.1052
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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	0.33

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})	0.1872	0.2625	weld size is adequate

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

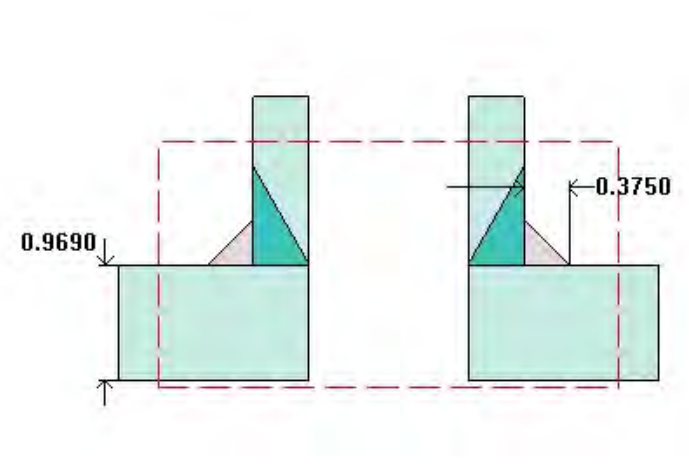
Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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	0.33

UG-41 Weld Failure Path Analysis Summary
Weld strength calculations are not required for external pressure

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to shell fillet (Leg_{41})	0.1872	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
Orientation	225°
Nozzle center line offset to datum line	71.5"
End of nozzle to shell center	14"
Passes through a Category A joint	No

Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1

Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.72 / (20,000*1 - 0.6*1,126.98) =	0.042"
Stress ratio = t_r*E^* / (t_n - c) = 0.042*1 / (0.4675 - 0.0625) =	0.1037
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)

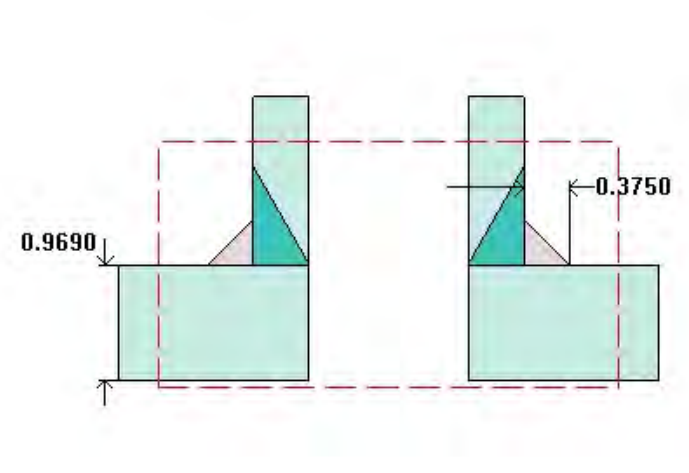
Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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
Weld strength calculations are not required for external pressure

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
Orientation	225°
Nozzle center line offset to datum line	57.5"
End of nozzle to shell center	14"
Passes through a Category A joint	No

Nozzle	
Description	NPS 1 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 23)
Inside diameter, new	1.315"
Nominal wall thickness	0.4675"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	2"
Local vessel minimum thickness	0.8479"
Liquid static head included	0 psi
Longitudinal joint efficiency	1

Welds	
Inner fillet, Leg_{41}	0.375"

UCS-66 Material Toughness Requirements Nozzle	
t_r = 1,126.98*0.72 / (20,000*1 - 0.6*1,126.98) =	0.042"
Stress ratio = t_r*E^* / (t_n - c) = 0.042*1 / (0.4675 - 0.0625) =	0.1037
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°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 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)

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For Pe = 15 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
Weld strength calculations are not required for external pressure

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)

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

165051

SECTION 4

MATERIAL TEST REPORTS AND/OR MATERIAL CERTIFICATIONS

165051 INDEX OF MATERIAL CERTIFICATION				
ITEM	QTY. REC	DESCRIPTION	HEAT NUMBERS	MATERIAL
1	1	SHELL, PIPE, 24" SCH 60 (0. 969" NOM) SMLS x 11' - 0 LG	943966	SA-106-C
2	1	HEAD, 24" OD x 7/8" NOM, 2: 1 ELLIP. W/ 2" S.F. (HOT FORMED)	YZN	SA-516- 70 N
3	1	CLOSURE, 24" OD 600# ANSI (YALE/HUBER FIG. 500)	ZH549	CS
4	1	SKIRT, PIPE, 24" SCH STD (.375" NOM) X 19" LG (TRIM TO FIT)	M94176	SA-53-B
5	2	FLANGE, 8" 600# RFLWN x 13" LG	A673AN	SA-105 N
6	2	PLATE, INSULATION RING, 26" OD X 24 1/4" ID X 1/4" THK	W4H550	SA-516-70N
7	6	COUP-O-LET, LONG, 1" 6000# NPT X 3" LG	A153140	SA-105
8	5	COUP-O-LET, LONG, 3/4" 6000# NPT X 3" LG	A160977	SA-105
9	3	COUP-O-LET, LONG, 1/2" 6000# NPT X 3" LG	A143365	SA-105
12	2	LIFTING LUGS, PHOENIX SERIES 2-899-MLL	ADOB	A105
13	1	PLATE, TUBESHEET, 21 3/4" OD x 1 1/4 " THK (SEE DETAIL)	E6H121	SA-516- 70N
14	1	PIPE, (SIPHON) 1" SCH 80	1015482122	SA-53-B
15	1	PLATE (BASE) 30" OD x 22" ID **x 3/4"** THK	E6A079	SA-516- 70 N
18	4	COUP-O-LET, LONG, 1 1/2" 6000# NPT X 3" LG	J6328	SA-105
19	2	FLANGE, 1" 600# RFLWN x 9" LG	CTJP	SA-105 N
20	1	PIPE, DRAIN, 1" SCH 160 SMLS	1015378774	SA-106-B
21	1	ELBOW, 1" 3000# 90° SOCKETWELD	138VVV	SA-105
22	1	COUPLING, FULL, 1" 3000# THREADED	413DD	SA-105

24" shell

KMI FAB
S/O 165051
Date 2-8-17
Item # 1

FSDA2460

INSPECTION CERTIFICATE
CERTIFICATO DI COLLAUDO
(UNI EN 10204 3.1 / ISO 10474 3.1.B)

Number / Numero: 01/14/11267 | Page / Pagina: 1 / 6

Date / Data: October 23, 2014

Dalmine S.p.A. – Dalmine plant
Piazza Caduti 6 Luglio 1944 1
24044 Dalmine (BG) – Italy
+39 035 560 111 tel

Customer / Cliente: INDUSTRIAL PIPING SPECIALISTS, INC.	Customer's Order Item / Rifer. Ordine Cliente - Item: HR053361	Customer's Reference / Posizione Cliente:	Manufacturer's Works Order N° / Conferma Posizione: 1232043/001
Manufacture Process / Processo di fabbricazione:	Product Type / Tipo di prodotto: SEAMLESS LINE PIPES (WITH EXTRA REQUIREMENTS) TUBI S.S. LINE PIPE (CON RICHIESTE SUPPLEMENTARI)		Surface / Superficie: See note nr.3 Vedi nota nr.3
Standard or Specification / Norme o specifica: See note nr.1 Vedi nota nr.1		Steel Grade / Grado dell'Acciaio: See note nr.2 Vedi nota nr.2	Ends / Estremità: BEVEL API 5L / ISO 3183 CT4:8825 SMUSSATI SECONDO API 5L / ISO 3183 CT4:8825
Dimensions / Dimensioni: ø 24.000" O.D. x 0.969" W.T. ø 610mm O.D. x 24.61mm W.T.	Schedule / Scheda: 60	Length / Lunghezza: 32.808 ft ÷ 42.001 ft 10000 mm ÷ 12802 mm	Quantity / Quantità: 35Pcs/Pz 1314,93 ft 314178,1 lb 400.79 mt 142509 kg	Nominal Weight / Peso nominale: 238.77 lb/ft 355.33 Kg/m

DELIVERY NOTES / AVVISI DI SPEDIZIONE

Delivery Notes / Avvisi di spedizione	Delivery Notes / Avvisi di spedizione
Job number: 0031099785 / 000070 Shipping note: 97130177 - 22/10/2014 Address: PO BOX 581270	Town: 74158 TULSA Country: USA

TENSILE TEST / PROVA DI TRAZIONE

Heat N° / Colata N°	Sample N° / Prova N°	Specimen condition / Condizioni della provetta: Ls	Sc	Type / Tipo	Ori	Specimen dimensions / Dimensioni della provetta: Size / Dimensioni mm	Area mm2	Test temp / Temp. di prova °C	Y.S. EUL 0.5% Min: 421.00 Max: – KSI*10	U.T.S. Req. Min: 703.00 Max: – KSI*10	Elongation / Allungamento: Lo cal.	Min. mm	Min. %	Obt. %
943966	L0143	B	AM	Cs	L	12,79	128,50	+20	516,00	717,00	2"	50.8	22.0%	32.1%
943967	L0145	B	AM	Cs	L	12,60	128,70	+20	479,00	724,00	2"	50.8	22.0%	29.5%

AM: As manufactured / Come laminato
B: Body / Corpo
Cs: Cylindrical specimen / Cilindrica
L: Longitudinal / Longitudinale
Lo: Initial length / Lunghezza iniziale
Ls: Location of sample / Ubicazione provetta
Max: Maximum / Massimo
Min: Minimum / Minimo
Obt: Obtained / Ottenuto
Ori: Orientation / Orientamento
Req: Required / Richiesto
Sc: Specimen condition / Condizioni Provetta
U.T.S: Ultimate Tensile Strength / Rottura
Y.S: Yield Strength / Snervamento

FOR03171

HR053361SMTSA$1/1

Material Test Report (MTR)

SO# 165051

[| 10352 | | | 943966] | [IN: 1] | TY023201-1 | FSDA2460 |

INSPECTION CERTIFICATE
CERTIFICATO DI COLLAUDO
(UNI EN 10204 3.1 / ISO 10474 3.1.B)

Number / Numero: 01/14/11267 | Page / Pagina: 2 / 6

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Dalmine S.p.A. – Dalmine plant
Piazza Caduti 6 Luglio 1944, 1
24044 Dalmine (BG) – Italy
+39 035 560 111 tel

Customer / Cliente: INDUSTRIAL PIPING SPECIALISTS, INC.	Customer's Order Item / Rifer. Ordine Cliente – Item: HR053361	Customer's Reference / Posizione Cliente: -	Manufacturer's Works Order N° / Conferma Posizione: 1232043/001
Manufacture Process / Processo di fabbricazione: -	Product Type / Tipo di prodotto: SEAMLESS LINE PIPES (WITH EXTRA REQUIREMENTS) / TUBI S.S. LINE PIPE (CON RICHIESTE SUPPLEMENTARI)		Surface / Superficie: See note nr.3 / Vedi nota nr.3
Standard or Specification / Norme o specifica: See note nr.1 / Vedi nota nr.1		Steel Grade / Grado dell'Acciaio: See note nr.2 / Vedi nota nr.2	Ends / Estremità: BEVEL API 5L / ISO 3183 CT4:8825 / SMUSSATI SECONDO API 5L / ISO 3183 CT4:8825
Dimensions / Dimensioni: ø 24.000" O.D. x 0.969" W.T. / ø 610mm O.D. x 24.61mm W.T.	Schedule / Schedule: 60 / -	Length / Lunghezza: 32.808 ft ÷ 42.001 ft / 10000 mm ÷ 12802 mm	Quantity / Quantità: 35Pcs/Pz; 1314,93 ft 314178,1 lb / 400.79 mt 142509 kg	Nominal Weight / Peso nominale: 238.77 lb/ft / 355.33 Kg/m

CHEMICAL COMPOSITION / COMPOSIZIONE CHIMICA

			Composition % / Composizione %															
			x 100										x 1000					x 10000
			C	Mn	Si	Ni	Cr	Mo	Cu	Ce LF	F1	F2	P	S	Ti	Nb	V	B
		H Max	23	120	–	40	40	15	40	41	100	12	30	30	–	–	80	10
		Min	–	29	10	–	–	–	–	–	–	–	–	–	–	–	–	–
Heat N° / Colata N°	Sample N° / Prova N°	P Max	23	120	–	40	40	15	40	41	100	12	30	30	–	–	80	10
		Min	–	29	10	–	–	–	–	–	–	–	–	–	–	–	–	–
943966		H	11	110	20	10	12	8	15	36	52	9.1	14	1	2	21	70	1
943966	L0143	P	12	107	20	10	11	8	16	37	51	8	13	2	2	20	60	2
943966	L0144	P	12	107	20	10	11	8	15	37	50	8	13	2	2	20	60	2
943967		H	12	111	21	10	11	8	15	37	50	8	14	2	2	20	60	1
943967	L0146	P	11	108	20	10	11	8	15	36	50	7.9	14	2	2	19	60	2
943967	L0147	P	12	107	20	10	11	8	15	37	50	7.9	13	2	2	19	60	2

Ce LF: C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15 | F2: (Nb+V) | Max: Maximum / Massimo | P: Product / Prodotto

F1: (V +Ni+Cr+Mo+Cu) | H: Heat / Colata | Min: Minimum / Minimo

SUPERFICIAL HARDNESS / DUREZZA SUPERFICIALE

Heat N° / Colata N°	Sample N° / Prova N°	Ls	Sc	External / Esterna: Scale / Scala: HRB; Req. Min: – Req. Max: 100.0
943966	L0143	B	AM	78.0

Heat N° / Colata N°	Sample N° / Prova N°	Ls	Sc	External / Esterna: Scale / Scala: HRB; Req. Min: – Req. Max: 100.0
943967	L0146	B	AM	80.0

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Tenaris

INSPECTION CERTIFICATE
CERTIFICATO DI COLLAUDO
(UNI EN 10204 3.1 / ISO 10474 3.1.B)

Number / Numero: 01/14/11267
Page / Pagina: 3 / 6
Date / Data: October 23, 2014

Dalmine S.p.A. – Dalmine plant
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24044 Dalmine (BG) – Italy
+39 035 560 111 tel

Customer / Cliente: INDUSTRIAL PIPING SPECIALISTS, INC.	Customer's Order Item / Rifer. Ordine Cliente - Item: HR053361	Customer's Reference / Posizione Cliente: .	Manufacturer's Works Order N° / Conferma-Posizione: 1232043/001
Manufacture Process / Processo di fabbricazione: .	Product Type / Tipo di prodotto: SEAMLESS LINE PIPES (WITH EXTRA REQUIREMENTS) TUBI S.S. LINE PIPE (CON RICHIESTE SUPPLEMENTARI)		Surface / Superficie: See note nr.3 Vedi nota nr.3
Standard or Specification / Norme o specifica: See note nr.1 Vedi nota nr.1		Steel Grade / Grado dell'Acciaio: See note nr.2 Vedi nota nr.2	Ends / Estremità: BEVEL API 5L / ISO 3183 CT4:8825 SMUSSATI SECONDO API 5L / ISO 3183 CT4:8825
Dimensions / Dimensioni: ø 24.000" O.D. x 0.969" W.T. ø 610mm O.D. x 24.61mm W.T.	Schedule / Schedula: 60 .	Length / Lunghezza: 32.808 ft ÷ 42.001 ft 10000 mm ÷ 12802 mm	Quantity / Quantità: 36Pcs/Pz 1314,93 ft 314178,1 lb 400.79 mt 142509 kg
Nominal Weight / Peso nominale: 238.77 lb/ft 355.33 Kg/m			

SUPERFICIAL HARDNESS / DUREZZA SUPERFICIALE

AM: As manufactured / Come laminato   B: Body / Corpo   Ls: Location of sample / Ubicazione provetta   Sc: Specimen condition / Condizioni Provetta

FLATTENING TEST / PROVA DI SCHIACCIAMENTO

Standard / Norma:

Heat N° Colata N°	Sample N° Prova N°	Zone Zona	Sc	Test Frequency Frequenza prova	Result Esito
943966	L0142	E1	AM	pipes of the lot	Good /Buono

Standard / Norma:

Heat N° Colata N°	Sample N° Prova N°	Zone Zona	Sc	Test Frequency Frequenza prova	Result Esito
943967	L0145	E1	AM	pipes of the lot	Good /Buono

AM: As manufactured / Come laminato   E1 / E2: Ends of Sampling / Estremità della provetta   Sc: Specimen condition / Condizioni Provetta

FOR03171

[| 10352 | | | 943966] | [LN: 1] | TY023201-1 | FSDA2460 |

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INSPECTION CERTIFICATE
CERTIFICATO DI COLLAUDO
(UNI EN 10204 3.1 / ISO 10474 3.1.B)

Number / Numero:	Page / Pagina:
01/14/11267	4 / 6
Date / Data: October 23, 2014	

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24044 Dalmine (BG) – Italy
+39 035 560 111 tel

Customer / Cliente: INDUSTRIAL PIPING SPECIALISTS, INC.	Customer's Order Item / Rifer. Ordine Cliente - Item: HR053361	Customer's Reference / Posizione Cliente:	Manufacturer's Works Order N° / Conferma-Posizione: 1232043/001
Manufacture Process / Processo di fabbricazione:	Product Type / Tipo di prodotto: SEAMLESS LINE PIPES (WITH EXTRA REQUIREMENTS) TUBI S.S. LINE PIPE (CON RICHIESTE SUPPLEMENTARI)		Surface / Superficie: See note nr.3 Vedi nota nr.3
Standard or Specification / Norma o specifica: See note nr.1 Vedi nota nr.1		Steel Grade / Grado dell'Acciaio: See note nr.2 Vedi nota nr.2	Ends / Estremità: BEVEL API 5L / ISO 3183 CT4:8825 SMUSSATI SECONDO API 5L / ISO 3183 CT4:8825

Dimensions / Dimensioni:	Schedule / Schedula:	Length / Lunghezza:	Quantity / Quantità: 35Pcs/Pz		Nominal Weight / Peso nominale:
ø 24.000" O.D. x 0.969" W.T.	60	32.808 ft ÷ 42.001 ft	1314,93 ft	314178,1 lb	238.77 lb/ft
ø 610mm O.D. x 24.61mm W.T.	.	10000 mm ÷ 12802 mm	400.79 mt	142509 kg	355.33 Kg/m

HYDROSTATIC TEST / PROVA IDRAULICA

Pressure / Pressione		Time / Tempo	Results / Risultato
Unit / Unità	Value / Valore	Seconds / Secondi	
psi	2,970	5	Satisfactory / Soddisfacente

SUPPLEMENTARY INFORMATION / INFORMAZIONI SUPPLEMENTARI

STANDARD EDITIONS EDIZIONI NORME	
Standard:API 5L Year:2012 Revision:Ed... Revision year:45th	Norma:API 5L Anno:2012 Revisione:Ed... Anno della revisione:45th
Standard:ASTM A53/A106 Year:2010	Norma:ASTM A53/A106 Anno:2010
Standard:ASME SA53/SA106 Year:2013	Norma:ASME SA53/SA106 Anno:2013
Standard:NACE MR0175/ISO 15156 Year:2009	Norma:NACE MR0175/ISO 15156 Anno:2009
Standard:NACE MR0103 Year:2012	Norma:NACE MR0103 Anno:2012

PRODUCT DESCRIPTION NOTES NOTE DI DESCRIZIONE DEL PRODOTTO	
Note 1 is the full description of the 'Standard or specification'	La nota 1 è la descrizione completa della 'Norma o specifiche'
ACC. TO THE NORM API 5L PSL1 45TH ED. ,A/SA 106/53,IPS SPEC.1,NACE MR01.75/01.03 + TEMP TQ NO.1 20013058/4.1 V.4	NORMA API 5L PSL1 45A EDIZ., ,A/SA 106/53,IPS SPEC.1,NACE MR01.75/01.03 + TEMP TQ NO.1 20013058/4.1 V.4
Note 2 is the full description of the 'Steel grade'	La nota 2 è la descrizione completa del 'Grado acciaio'
STEEL GR. X42 PSL1 GR.B PSL1,GR.B/C A/SA 106,GR. B A/SA 53	ACCIAIO GR. X42 PSL1 GR.B PSL1,GR.B/C A/SA 106,GR. B A/SA 53
Note 3 is the full description of the 'Surface'	La nota 3 è la descrizione completa della 'Superficie'
BARE INSIDE, EXTERNALLY PROTECTED BY VARNISH , SUITABLE FOR COATING,	GREZZI INTERNAMENTE, OLEATI ESTERNAMENTE ATTI AL RIVESTIMENTO

16505

INSPECTION CERTIFICATE
CERTIFICATO DI COLLAUDO
(UNI EN 10204 3.1 / ISO 10474 3.1.B)

Number / Numero:	Page / Pagina:
01/14/11267	5 / 6
Date / Data: October 23, 2014	

Dalmine S.p.A. – Dalmine plant
Piazza Caduti 6 Luglio 1944, 1
24044 Dalmine (BG) – Italy
+39 035 560 111 tel

Customer / Cliente: INDUSTRIAL PIPING SPECIALISTS, INC.	Customer's Order Item / Rifer. Ordine Cliente - Item: HR053361	Customer's Reference / Posizione Cliente: .	Manufacturer's Works Order N° / Conferma-Posizione: 1232043/001
Manufacture Process / Processo di fabbricazione: .	Product Type / Tipo di prodotto: SEAMLESS LINE PIPES (WITH EXTRA REQUIREMENTS) TUBI S.S. LINE PIPE (CON RICHIESTE SUPPLEMENTARI)		Surface / Superficie: See note nr.3 Vedi nota nr.3
Standard or Specification / Norme o specifica: See note nr.1 Vedi nota nr.1		Steel Grade / Grado dell'Acciaio: See note nr.2 Vedi nota nr.2	Ends / Estremità: BEVEL API 5L / ISO 3183 CT4:8825 SMUSSATI SECONDO API 5L / ISO 3183 CT4:8825

Dimensions / Dimensioni:	Schedule / Schedula:	Length / Lunghezza:	Quantity / Quantità: 35Pcs/Pz		Nominal Weight / Peso nominale:
ø 24.000" O.D. x 0.969" W.T.	60	32.808 ft ÷ 42.001 ft	1314,93 ft	314178,1 lb	238.77 lb/ft
ø 610mm O.D. x 24.61mm W.T.	.	10000 mm ÷ 12802 mm	400.79 mt	142509 kg	355.33 Kg/m

SUPPLEMENTARY INFORMATION / INFORMAZIONI SUPPLEMENTARI

Supplementary Information	Informazioni supplementari
AFTER INSPECTION OPERATION, THE MATERIAL HAS NOT A RESIDUAL MAGNETISM GREATER THAN 20 GAUSS	DOPO LE OPERAZIONI DI CONTROLLO, IL MATERIALE NON PRESENTA UN MAGNETISMO RESIDUO SUPERIORE A 20 GAUSS
HARDNESS HRC 22 MAX, ACCORDING TO NACE MR-01-75/ISO 15156	DUREZZA HRC 22 MAX, IN ACCORDO ALLA SPEC. NACE MR-01-75/ISO 15156
HARDNESS HBW 225 MAX, ACCORDING TO NACE MR-01-03	DUREZZA HBW 225 MAX, IN ACCORDO ALLA SPEC. NACE MR-01-03
COUNTRY OF MELT: TENARIS DALMINE (ITALY)	PAESE FUSIONE ACCIAIO: TENARIS DALMINE (ITALIA)
SEAMLESS HOT FINISHED PIPES	TUBI SENZA SALDATURA FINITI A CALDO
VISUAL AND DIMENSIONAL CONTROL HAS BEEN CARRIED OUT WITH SATISFACTORY RESULT	IL CONTROLLO VISIVO E DIMENSIONALE HA DATO ESITO SODDISFACENTE
STEEL IS FULLY KILLED AND PRODUCED BY ELECTRIC FURNACE TO A FINE GRAIN PRACTICE	L'ACCIAIO E' DI TIPO CALMATO, A GRANO FINE, PRODOTTO AL FORNO ELETTRICO
THE PRODUCT SUPPLIED IS IN COMPLIANCE WITH THE REQUIREMENTS OF THE ORDER.	IL MATERIALE FORNITO E' IN ACCORDO AI REQUISITI DELL'ORDINE.
MANUFACTURED BY TENARIS DALMINE	FABBRICATO DA TENARIS DALMINE
NO WELD REPAIR, MERCURY AND RADIATION FREE	NON RIPARATO MEDIANTE SALDATURA, ESENTE DA MERCURIO E RADIAZIONI
Tenaris IT identification number for MTC: 56p}YRI\	Numero identificativo Tenaris IT per MTC: 56p}YRI\

MARKING / MARCATURA

Marking	Marcatura
STENCILING _T SPEC 5L 0038.1 _API _DATA 24 0,969 B-X42 PSL 1 SMLS ASTM ASME A SA 106 B/C PSI:2970 ASTM ASME A SA 53 B S HEAT: _C OLATA FT _FT LBS _LBS NR. _NR LEGEND _T = TENARIS Logo	VERNICIATURA _T SPEC 5L 0038.1 _API _DATA 24 0,969 B-X42 PSL 1 SMLS ASTM ASME A SA 106 B/C PSI:2970 ASTM ASME A SA 53 B S HEAT: _C OLATA FT _FT LBS _LBS NR. _NR LEGENDA _T = Logo TENARIS

S0#116505

INSPECTION CERTIFICATE
CERTIFICATO DI COLLAUDO
(UNI EN 10204 3.1 / ISO 10474 3.1.B)

Number / Numero:	Page / Pagina:
01/14/11267	6 / 6
Date / Data: October 23, 2014	

Dalmine S.p.A. – Dalmine plant
Piazza Caduti 6 Luglio 1944, 1
24044 Dalmine (BG) – Italy
+39 035 560 111 tel

Customer / Cliente: INDUSTRIAL PIPING SPECIALISTS, INC.	Customer's Order Item / Rifer. Ordine Cliente – Item: HR053361	Customer's Reference / Posizione Cliente:	Manufacturer's Works Order N° / Conferma Posizione: 1232043/001
Manufacture Process / Processo di fabbricazione:	Product Type / Tipo di prodotto: SEAMLESS LINE PIPES (WITH EXTRA REQUIREMENTS) TUBI S.S. LINE PIPE (CON RICHIESTE SUPPLEMENTARI)		Surface / Superficie: See note nr.3 Vedi nota nr.3
Standard or Specification / Norma o specifica: See note nr.1 Vedi nota nr.1		Steel Grade / Grado dell'Acciaio: See note nr.2 Vedi nota nr.2	Ends / Estremità: BEVEL API 5L / ISO 3183 CT4:8825 SMUSSATI SECONDO API 5L / ISO 3183 CT4:8825

Dimensions / Dimensioni:	Schedule / Schedula:	Length / Lunghezza:	Quantity / Quantità: 35Pcs/Pz	Nominal Weight / Peso nominale:
ø 24.000" O.D. x 0.969" W.T. ø 610mm O.D. x 24.61mm W.T.	60	32.808 ft ÷ 42.001 ft 10000 mm ÷ 12802 mm	1314,93 ft 314178,1 lb 400.79 mt 142509 kg	238.77 lb/ft 356.33 Kg/m

MARKING / MARCATURA

Marking Marcatura	
_API = API Logo _DATA = Marking Date _FT = Pipe/Tube Length in feet _LBS = Pipe/Tube Weight in pounds _NR = Pipe/Tube Identifier	_API = Logo API _DATA = Data di marcatura _FT = Lunghezza del tubo in piedi _LBS = Peso del tubo in libbre _NR = Identificativo numerico del tubo

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

Si certifica che il prodotto descritto è stato prodotto, provato, testato e controllato in conformità ai requisiti dell'ordine del cliente. Questo certificato non è una dichiarazione d'origine e non può essere usato come tale.

	CUSTOMER THIRD PARTY	TENARIS QUALITY DEPARTMENT SIGNATURE	
	INSPECTION COMPANY COMPAGNIA D'ISPEZIONE	QUALITY CERTIFICATION DEPT. UFFICIO CERTIFICAZIONE QUALITA' TASSO Ezio Giorgio	CHIEF OF QUALITY CERTIFICATION DEPT. RESPONSABILE DELL'UFFICIO CERTIFICAZIONE QUALITA' RAVANELLI Pietro

SO#165051

BAKER TANKHEAD
INCORPORATED

BAKER TANKHEAD, INC.
P.O. BOX 77021
10405 NORTH FREEWAY
FORT WORTH, TX 76177
United States of America
Ph: 866-232-8030
Fax: 817-847-7244

Cert # 93563

Material Certification

Date :7-Dec-16

To:

KMI FABRICATORS, INC.
410 BOYD ROAD
MINERAL WELLS, TX 76067

Phone: 940-325-7841 Fax: 940-325-3765

Ship To:

ERBY ATKINS
KMI FABRICATORS, INC.
410 BOYD ROAD
MINERAL WELLS, TX 76067

Phone: 940-325-7841 Fax: 940-325-3765

Job # / Customer PO	Qty	Code/Lot	Material	Mill*	Heat No*	SLab/Pc No*
169083 10349	1	YZN	24 X 7/8 E HP PFS INV	* See Mill Test Report		

24 X 7/8 E HP PFS
24"OD X 7/8"NOM 2:1 ELLIP
.6877"MIN - SA516 70 - 2"SF
7 9/16"IOH - 6 3 3/8"OSC
30 DEG OS BEVEL W/ 1/16"LD
31'DIA - 188#
NORMALIZED IN HOT FORMING
DOMESTIC MATERIAL
CUSTOMER: 165051

* The items listed above were formed in strict accordance with all applicable requirements of the ASME Boiler and Pressure Vessel Code Section VIII, Div. 1.

* We hereby certify that these parts comply with tolerances of UG-81 of ASME Section VIII, Div. 1.

* We hereby certify that these heads were heated to 1650 degree F min, held for one hour per inch of thickness, hot formed and still air cooled.

KMI FAB
S/O 165051
Date 2-8-17
Item # 2

PO#45396 (2 pcs) 120X480X 7/8" SA516-60/65/70N Code: YZN

SSAB

Test Certificate

12400 Highway 43 North, Axis, Alabama 36505, US

Form TC1: Revision 2: Date 23 Apr 2014

Customer:
DELTA STEEL, INC.
5599 SAN FELIPE-STE 600
P.O BOX 2289
HOUSTON
TX 77252

Customer P.O.No.: DFW-240377 | **Mill Order No.** 41-402982-02 | **Shipping Manifest:** AR189795

Product Description: ASME SA516-70/SA516-65/SA516-60(13)
ASTM A516-70/A516-65/A516-60(10)
MAX CEV .43%;LCVN15/12FT.LBS@-60F/A673-P
NORMALIZED

Ship Date: 11 Sep 14 | **Cert No:** 081466697
Cert Date: 11 Sep 14 | (Page 1 of 1)

Size: 0.875 X 120.0 X 480.0 (IN)

Tested Pieces:				Tensiles:						Charpy Impact Tests							
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in 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
YZN W4H786	A39	0.880 (DISCRT)	C	49	72		28	T		94 98 101 98		-60F	L	10.	

Heat Id	Chemical Analysis C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	Cev	ORGN
YZN W4H786	.19	.99	.010	.001	.23	.028	.027	.26	.14	.14	.04	.000	.004	.009	.0003	.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
CEV (IIW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
NACE MR0175 ANNEX A2.1.2 COMPLIANT
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
NORMALIZED PLATES. HEATED AT 1665F FOR 40 MINUTES.
TEST COUPONS TAKEN FROM HEAT TREATED PLATE.
PRODUCTS SHIPPED:
W4H786 A39 6552015 PCES: 1, LBS: 14293 W4H786 A39 6552017 PCES: 1, LBS: 14293

Robert Thomas 11-14-14

(P) Cust Part #:

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

Justin Ward +1 251 662 4400
SENIOR METALLURGIST - PRODUCT

SO#165051

24" 21549

NATIONAL OILWELL VARCO

Process & Flow Technology
10906 FM 2920
Tomball, TX 77375
Telephone: (281) 351-2222
Facsimile: (281) 351-6557

SO# 165051

CUSTOMER: KMI FABRICATORS, INC.

P.O.# 10350

S.O.#: 1531971

PER YOUR INSTRUCTIONS, WE ARE ENCLOSING THE FOLLOWING DOCUMENTS:

	COPIES OF APPROVED DRAWINGS
	COPIES OF CERTIFIED DIM. DRAWINGS
X	COPIES OF PARTIAL DATA REPORT
X	COPIES OF MILL TEST REPORTS
	(ONE COPY ON CAP & ONE COPY ON HUB)
	COPIES OF SPARE PARTS LIST
	COPIES OF WELDING INSTRUCTIONS
	COPIES OF MAINTENANCE & OPERATIONS INSTRUCTIONS
	COPIES OF ASME CERTIFICATIONS
	COPIES OF DOT CERTIFICATIONS
	COPIES OF NACE CERTIFICATIONS
	COPIES OF API CERTIFICATIONS
	COPIES OF NDE CERTIFICATIONS

KMI FAB
S/O 165051
Date 2-8-17
Item # 3

NATIONAL OILWELL VARCO

Customer: KMI FABRICATORS, INC.
P.O. No. 10350
S.O. No. 1531971

Qty	Size	Serial No.	Cap	Hub
			Heat Code	Heat Code
1	24"	ZH549	U701	W731
2	20"	ZH550, ZH551	3T325	W703

SO No 1531971-1
PO No 10350

FORM U-2A MANUFACTURER'S PARTIAL DATA REPORT (ALTERNATE FORM)

A Part of a Pressure Vessel Fabricated by One Manufacturer for Another Manufacturer
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by: NATIONAL OILWELL VARCO 10906 FM 2920 TOMBALL, TEXAS 77375 (Name and address of Manufacturer)

2. Manufactured for: KMI FABRICATORS INC. 410 BOYD ROAD MINERAL WELLS, TX 76067 (Name and address of Purchaser)

3. Location of Installation: UNKNOWN (Name and address)

4. Type: (1) 24" CLOSURE [Description of vessel part (shell, two-piece head, tube bundle)] ZH549 (Mfg.'s Serial No.) N/A (CRN)

N/A (National Board Number) 1531971-1R2 (Drawing Number) NATIONAL OILWELL VARCO (Drawing prepared by:) 2017 (Year Built)

5. ASME Code, Section VIII, Div. 1: 2015 EDITION [Edition and Addenda (Date)] N/A (Code Case No.) N/A [Special service per UG-120(d)]

6. Shell (a) No. of course(s): 1 (b) Overall length (ft. and in.): 1-00.

Course(s)			Material	Thickness, in.		Long Joint (Cat. A)			Circum. Joint (Cat. A, B, & C)			Heat Treatment	
No.	Diameter, in	Length,ft+in	Spec./Grade or Type	Nom.	Corr.	Type	Full, Spot, None	Eff.	Type	Full, Spot, None	Eff.	Temp., F	Time
1	22.064	1-00.	SA 350 LF2 CLASS 1	0.968	0.063	S	NONE	1	S	NONE	1	N/A	N/A

Body Flanges on Shells

No.	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Location	Bolting: Num & Size	Bolting: Bolting Material	Bolting: Washer (OD, ID, Thk)	Bolting: Washer Material
N/A												

7. Heads: (a) SA 350 LF2 CLASS 1 (Mat'l Spec. no., Grade or Type)(H.T. - Time and Temp.) (b) N/A (Mat'l Spec. no., Grade or Type)(H.T. - Time and Temp.)

	Location (Top, Bottom Ends)	Thickness, in. Min.	Thickness, in. Corr.	Radius, in. Crown	Radius, in. Knuckle	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure Convex	Side to Pressure Concave	Category A Type	Category A Full, Spot, None.	Effc.
(a)	TOP	0.791	0.063	-----	-----	2:1	-----	-----	-----		X	S	NONE	1
(b)														

Body Flanges on Heads

	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Bolting: Num & Size	Bolting: Bolting Material	Bolting: Washer (OD, ID, Thk)	Bolting: Washer Material
(a)	N/A											

8. MAWP 1100 (internal) [ ] (external) PSI @ max temp.= 150 (internal) [ ] (external) °F. Min Design Metal Temp -20 °F at 1100 PSI

9. Impact test: Yes - CAP, HUB, & FITTING [Indicate yes or no and the component(s) impact tested] At a test temp of -51 & -50 & -50 °F

10. Hydro., pneu., or comb. Test pressure: SEE REMARKS Proof Test: N/A

11. Nozzles, inspection, and safety valve openings: UG-125(a) At PSIG

Purpose (Inlet, Outlet, Drain, etc.)	No.	Dia. or Size, in.	Flange Type	Material: Nozzle	Material: Flange	Nozzle Thickness, in: Nom.	Nozzle Thickness, in: Corr.	Reinforcement Material	How Attached: Nozzle	How Attached: Flange	Location (Insp. Open.)
SEE REMARKS											
OUTLET	1	1/2" NPT	TH'D	SA 350 LF2 CL1		0.500	0.063	INHERENT	*WELDED		HEAD
PAV	1	1/2" NPT	TH'D	SA 350 LF2 CL1		N/A	N/A	INHERENT	INT THD		SHELL

12. Identification of part(s)

Name of Part	Qty.	Line No.	Mfg's. Identification No.	Mfg's. Dwg No.	CRN	National Board No.	Year
N/A							

13. Supports: Skirt ---- (Yes or No) Lugs ---- (Number) Legs ---- (Number) Others ---- (Describe) Attached ---- (Where and How)

14. Remarks: THIS TEMPERATURE APPLICABLE TO CLOSURE METAL COMPONENTS ONLY. ACTUAL SERVICE TEMPERATURE IS DETERMINED BY TEMPERATURE LIMITATIONS OF O-RING MATERIAL.
UG-120,c,2 DESIGN & CALCULATION BY NATIONAL OILWELL VARCO.
CLOSURE ASSEMBLY IS NOT HYDROSTATICALLY TESTED, PRESSURE ALERT VALVE FURNISHED.
*Fig. UW-16.1(x-2).

FORM U-2A (Back)

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of material, construction, and workmanship of this pressure vessel part conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1.

U Certificate of Authorization No. 10052 Expires: July 16, 2017

Date: 01/20/17 Name: NATIONAL OILWELL VARCO (Manufacturer) Signed: (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by The Hartford Steam Boiler Inspection and Insurance Company of CONNECTICUT have inspected the pressure vessel part described in this Manufacturer's Data Report on 01-20, 2017, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel part 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 part 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: 01/20/2017 Signed: (Authorized Inspector) Commissions: NB 14370 A/S (National Board (incl. endorsements))

Frisa Forjados SA, de C.V.
Valentín G. Rivero No. 127 Los Treviño
C.P. 66350 Tels- 52(8) 153-0321,153-0302
Fax: 52(8) 336-3560
Sta. Catarina, N.L. , México

CERTIFIED COMPANY
ISO 9001: 2008

Material Test Report No.606141

Certificate per: EN 10204:2004 3.1
Client: NATIONAL OILWELL VARCO L.P. (RMES)
Spec: SA-350/SA-350M LF2 CL1 Ed. 2015

NOV HEAT CODE # M16

Qty	Date	P.O. Number	Part No.	Job Order
3	26/08/2016	7307953	H60282	471891

Description: Forged Shell 29.740" X 0.000" X 12.450"
.MELTING PRACTICE: EAF LR VD
.SERIAL NUMBER NOTE: 471891-02, 471891-03, 471891-10

HEAT: MM16100223 (3/3) PCS

CHEMICAL ANALYSIS

HEAT No.		C %	Mn %	P %	S %	Si %	Ni %	Cr %	Mo %
MM16100223	Ladle	0.19000	1.17000	0.00900	0.01900	0.23000	0.09000	0.07000	0.06000
Supplier		**Cu %**	**V %**	**Nb %**	**CrMo %**	**NiCrMoCuV %**	**CE %**		
NUC	Ladle	0.20000	0.00000	0.00300	0.13000	0.42000	0.43033		

Hardness (HBW) PCS

Hardness
146
146

HEAT TREATMENT

Quantity	Heat Treat Lot No.	Heat Treatment	Temp. (°F)	Time at Temp (Hrs)	Cooling Medium	Quench. M. Temp. (°F)
1 PCS	484167	Normalized	1652	5.00	Air	
2 PCS	487282	Normalized	1652	5.00	Air	
QTC	478241	Normalized	1652	3.00	Air	

Approved for Manufacture
by
Date 8/29/16

2460

WE HEREBY CERTIFY THAT ALL TEST RESULTS AND PROCESS INFORMATION CONTAINED HEREIN ARE CORRECT AND TRUE AS CONTAINED IN THE RECORDS OF THE COMPANY AND MEET THE PURCHASE ORDER / SPECIFICATIONS REQUIREMENTS.

NO WELDING REPAIRS IS ALLOWED AND USED IN FRISA ALL MATERIALS ARE MERCURY FREE

CER F-001-3

Gloria Carolina Lugo Perez
QUALITY ASSURANCE ENGINEER

Frisa Forjados SA, de C.V.
Valentin G. Rivero No. 127 Los Treviño
C.P. 66350 Tels- 52(8) 153-0321,153-0302
Fax: 52(8) 336-3560
Sta. Catarina, N.L. , México

CERTIFIED COMPANY
ISO 9001: 2008

Material Test Report No.606141

Certificate per: EN 10204:2004 3.1
Client: NATIONAL OILWELL VARCO L.P. (RMES)
Spec: SA-350/SA-350M LF2 CL1 Ed. 2015

Qty	Date	P.O. Number	Part No.	Job Order
3	26/08/2016	7307953	H60282	471891

Description Forged Shell 29.740" X 0.000" X 12.450"
.MELTING PRACTICE: EAF LR VD
.SERIAL NUMBER NOTE: 471891-02, 471891-03, 471891-10

Heat: MM16100223 **Track ID:** 104/032-16

MECHANICAL PROPERTIES

TENSILE TEST

Orientation	Position	Location	Heat Treat Lot No.	Yield Strength (PSI)	Tensile Strength (PSI)	Elong. % (2")	A.R.(%)	Temp Tens °F	Post Welding HT Temp °F	Time	Cycle
Long	1/4 T		478241	45600	72700	37	70	77			

Heat: MM16100223

IMPACT TEST

Orientation	Position	Location	Heat Treat Lot No.	CVN (ft-lb)			Lat Exp (IN)			Shear (%)			Temp (F)	Post Welding HT T °F	T	C
Long	1/4 T		478241	30	33	30	0.0270	0.0310	0.0270	30	30	30	-51			

Heat: MM16100223

HARDNESS HBW QTC

Orientation	Position	Location	Heat Treat Lot No.	Point	Hardness	Post Welding HT Temp °F	Time	Cycle
Long	1/4 T		478241		146			
Long	1/4 T		478241		146			

OBSERVATIONS

. FORGING RATIO: 3.0 TO 1
. QTC SIZE (4 X 4 X 12)
. IMPACT TEST: 0.390" X .390" X 2.160" CVN SPECIMEN
. TENSILE TEST: 0.500" DIAMETER SPECIMEN AND 2.0" GAUGE LENGTH
. FURNACE CALIBRATED AND SURVEYED PER API 6A ANNEX M 20th EDITION REQUIREMENTS
. HARDNESS ON TEST SPECIMEN IS REPRESENTED BY TWO VALUES.
. FURNACE TEMPERATURE MONITORING AND RECORDING METHOD: AIR THERMOCOUPLE
. FULLY KILLED MATERIAL
. TESTING ACCORDING TO ASTM A370 REV.14
. FINE GRAIN PRACTICE
. STEEL MELTED IN: UNITED STATES

WE HEREBY CERTIFY THAT ALL TEST RESULTS AND PROCESS INFORMATION CONTAINED HEREIN ARE CORRECT AND TRUE AS CONTAINED IN THE RECORDS OF THE COMPANY AND MEET THE PURCHASE ORDER / SPECIFICATIONS REQUIREMENTS.

NO WELDING REPAIRS IS ALLOWED AND USED IN FRISA ALL MATERIALS ARE MERCURY FREE

CER F-001-3

Gloria Carolina Lugo Perez
QUALITY ASSURANCE ENGINEER

Reg. Nr.: 10537

STOOSS

Herstellerzeichen
Manufacturer's stamp (ST)

TÜV nach AD 2000 W 0 / TRD 100 / PED 97/23EC Annex I- Bureau Veritas
DET NORSKE VERITAS - Germanischer Lloyd - Lloyd's Register of Shipping
URZAD DOZURU TECHNICZNEGO, UDT-Polen, American Bureau of Shipping
Russian Maritime Register of Shipping, RMRS

ORIGINAL

NOV HEAT CODE #

Abnahmeprüfzeugnis — EN 10 204 3.1 — *Inspection certificate*

Kunde *Customer*	NATIONAL OILWELL VARCO 10906 FM 2920 TOMBALL/TEXAS 77375 USA		
Kd.Bestell Nr. *Cust.Order no.*	7318978	Position *Item* 1	unsere Ref. *Job no./Certificate no.* 56076A13
Bezeichnung *Designation*	24" 150/600 Ring Forging		Anzahl *Quantity* 2
Kd. Material *Cust. Material*	SA 105/SA 350 LF2 Cl. 1 / A694 F48		Charge Nr. *Heat no.* J0285
Lieferzustand *condition of delivery*	unmachined		Probe Nr. *Test no.* 50205
Kd. Zeichn. Nr. *Cust. Drawing*	Stock Ring Forging Rev. 1		Dimension *Dimension* FS d 667/558 x 305 mm
Artikel No. *Part no*	H61534		Liefergewicht *Weight of delivery* --
Kd. Spezifikation *Cust. Specification*	ASME Sect. II Part A SA105: 2013 Ed./ ASME Sect. II Part A SA 350 LF2-Cl. 1: 2013 Ed. – ASTM A694-F48: 08		
Stempelung *Marking*	56076A13 - SA 105/SA 350 LF2 Cl. 1 / A694 F48 – J0285 – 3140 – Stock Ring Forging (1) – ST 50205 QI – Item:1		

Wärmbehandlung / *Heat treatment:* 900°C/3h/water//600°C/5h/air
watertemperature before quenching: 26°C after quenching: 28°C

Chemische Zusammensetzung gem. Hersteller / *Chemical composition acc. to manufacturer:*

```
Heat no.   C      Si     Mn     P       S       Cr      Mo
J0285      0.20   0.24   0.97   0.015   0.007   0.10    0.04
ESB        Ni     V      Al     Cu      N       Ti      Nb
           0.17   0.001  0.019  0.18    0.0070  0.002   0.002
           Co     W      Sn     Ca      B       H       As
           0.013  0.007  0.009  0.0014  0.0003  0.0001  0.007
           Sb     CE1    Cr+Mo   Ni+Cr+Mo+Cu
           0.002  0.413  0.140    0.490
Melting practices: VD, E

Product analysis   C      Si      Mn     P       S      Cr     Mo
Heat no.           0.21   0.25    0.97   0.015   0.008  0.096  0.037
J0285              Ni     V       Cu     Nb      CE1    Cr+Mo  Ni+Cr+Mo+Cu
                   0.17   <0.010  0.18   <0.010  0.4236 0.133  0.483
```

Mech. Werkstoffprüfung / *Mechanical testing* — Zugversuch / *tensile test* ASTM A370-12a; Kerbschlagbiegeversuch / *Impact test* ASTM A370-12a

	ReH Yield strength MPa	Rp 0,2 % MPa	Rp 1 % MPa	Rm Tensile strength MPa	A 5 d El. %	Z ROA %	A_v Joule Charpy-V -46 °C	°C	Probenlage *Orientation of specimen*
Sollwerte/ *Requirements*	min. 330	min.	min.	485-655	min. 22	min. inf.	single 16 average 20		
50205	400			575	31	76	153/164/168		tangential ¼ T

Härteprüfung / *Hardness test:* ASTM E 10 :2008
Sollwerte/ *Requirements* : 145 – 187 HBW
Resultate/ *Results* : 180, 177, 183, 185, 187, 185, 181, 175, 187, 180, 177, 174, 179, 175, 181, 187, 185, 183, 177, 179, 180, 179, 181, 187, 184, 180 HBW

Approved for Manufacture
by ______
Date ______

Hedingen, 22. September 2014/sk

Werksachverständige / Inspector :

FO 62-09

SCHMIEDEWERK STOOSS AG

Maienbrunnenstrasse 8 CH-8908 Hedingen Tel. 043 322 62 00 Fax 043 322 62 01 www.stooss.com e-mail: info@stooss.com

Reg. Nr.: 10537

STOOSS
SCHMIEDEWERK

Herstellerzeichen
Manufacturer's stamp

ST

TÜV nach AD 2000 W 0 / TRD 100 / PED 97/23EC Annex I- Bureau Veritas
DET NORSKE VERITAS - Germanischer Lloyd - Lloyd's Register of Shipping
URZAD DOZURU TECHNICZNEGO, UDT-Polen, American Bureau of Shipping
Russian Maritime Register of Shipping, RMRS

ORIGINAL

Abnahmeprüfzeugnis — EN 10 204 3.1 — *Inspection certificate*

56076A13

Visuelle Prüfung / *Visual inspection* in Ordnung / *accepted*
Masskontrolle / *dimension* in Ordnung / *accepted*

Manufactured and tested in acc. with STOOSS Quality Assurance System EN-ISO 9001 and the General Terms and Conditions of Purchase
STOOSS USA P.O.No. : 3140

Beilagen / *Enclosure:* 2 heat treatment charts
1 certificate of steelmaker

Hedingen, 22. September 2014/sk

Werksachverständige / Inspector :

SCHMIEDEWERK STOOSS AG
Maienbrunnenstrasse 8 CH-8908 Hedingen Tel. 043 322 62 00 Fax 043 322 62 01 www.stooss.com e-mail: info@stooss.com

skint

FERWHU24STD

INSPECTION CERTIFICATE

주식회사 휴스틸
HUSTEEL Co.,Ltd.

HEAD OFFICE : SHINAN B/D 15F, 943-19, DAECHI-DONG, KANGNAM-GU, SEOUL, KOREA
DAEBUL PLANT : 3RO, DAEBUL INDUSTRIAL COMPLEX, SAMHO-EUP, YEONGAM-GUN, JEOLLANAM-DO, KOREA

P/O No. : MIP00020
L/C No. : HU20110829001

ISSUED DATE : 2014.02.12

COMMODITY : E.R.W. STEEL PIPE
SPECIFICATION : API 5L X-42 PSL1/API 5LB/ ASTM A53B/ASME SA 53B

CERTIFICATE No. : 140212-045
MANUFACTURED No. : 2014-01-207
SUPPLIER : HUSTEEL CO., LTD.
CUSTOMER : HUSTEEL USA INC.

KMI FAB
S/O 165051
Date 2-8-17
Item # 4

NO.	HEAT_NO	QUAN-TITY	TYPE	NOMINAL SIZE	ORDER SIZE O.D	ORDER SIZE W.T	ORDER SIZE LENGTH	WEIGHT	TENSILE TEST DIR.	TS	YS	EL	YR	WTS	DIV	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Nb	Ti	B	CEQ	PCM
		PCS	*1		inch	inch	ft	lb/ft	*3	PSI		%	%	PSI	*5	-2			-3					-4				-5	-3	
					*2					*4						*6														
01	M94170	72	BPEB	24	24.000	0.375	42	94.71	T	70,920	59,463	39	84	76,577	H	6	1	73	11	4	12	10	20	TR	10	240	10	10		
															P	6	1	77	11	4	11	9	19	12	10	283	10	10		
															P	6	1	76	10	4	11	8	17	10	7	274	9	10		
02	M95672	13	BPEB	24	24.000	0.375	42	94.71	T	70,195	62,799	38	89	74,256	H	7	1	76	10	4	17	20	20	TR	TR	260	10	10		
															P	6	1	78	10	3	16	13	17	10	8	269	8	10		
															P	6	1	79	10	4	16	13	15	10	5	278	7	10		
03	M94173	42	BPEB	24	24.000	0.375	42	94.71	T	68,165	56,127	35	82	72,226	H	7	1	73	12	4	15	10	20	TR	10	240	10	20		
															P	6	1	74	12	3	16	8	23	10	8	248	9	10		
															P	6	2	75	12	3	16	9	22	10	8	259	9	10		

NO.	HYDROSTATIC TEST T.P	HYDROSTATIC TEST H.T	HYDROSTATIC TEST RESULT	HEAT TREATMENT	ZINC COATING TEST WZC	ZINC COATING TEST CST	THREADS TPI	THREADS ETL	HARDNESS TEST	IMPACT TEST (0)℃ DIV	IMPACT TEST Energy (Ind, J)	IMPACT TEST SIZE
	PSI	sec		℃	g/㎡	TIMES		inch	HV	*7		*8
	*9			*10	*11		*12					
01	1190	10	GOOD	950								
02	1190	10	GOOD	950								
03	1190	10	GOOD	950								

*13 N·D·T (UT)	FLATTENING OR BEND TEST	VISUAL& DIMENSION	METALLOGRAPHIC TEST	RESIDUAL MAGNETISM
GOOD	GOOD	GOOD	GOOD	GOOD
FLANGE TEST	REVERSE FLATTENING TEST	CRUSH TEST		

- Latest edition per API 5L(45th,2013) ASTM(2012) ASME SA 53B(2012)
- HARDNESS MAX 22 HRC AS PER NACE MR 0175 / ISO 15156

NOTE

*1.Type of Pipe Ends

BPE	Black Plain Ends	GPE	Galvanized Plain Ends
BPEB	BPE Bevelled	GPEB	GPE Bevelled
BTE	Black Threaded Ends	GTE	Galvanized Threaded Ends
BTC	BlackThreaded & Coupled	GTC	Galvanized Threaded& Coupled

*2. O.D : Outsid Diameter, W.T : Wall Thickness *3. Direction- L : Longitudinal, T : Transverse
*4. Tensile Test -TS : Tensile Strength, YS : Yield Strength, YR : Yield Ratio, EL : Elongation, WTS : Weld tensile strength, Gauge Length : 2 inch, Y.P method : 0.5% Underload
*5. H : Heat analysis, P : Product analysis *6. -2 : x1/100, -3 : x1/1000, -4 : x1/10000, -5 : x1/10000, Tr : Trace *7. B : Base Metal, W : Weld Line, H : Heat Affected Zone
*8. Specimen Size -A:10x10mm, B:10x7.5mm, C:10x6.6mm, D:10x5.0mm, Direction: Transverse *9. T.P : Testing Pressure, H.T : Holding Time *10. Heat Treatment Seam Normalizing
*11. WZC : Weight of Zinc Coating, CST : Copper Sulphate Test *12. TPI : Threads per inch, ETL : Effective length of threads *13. NDT : UT, Reference Standard 3.2 ⌀ Drilled Hole

WE HEREBY CERTIFY THAT THE MATERIAL HEREIN HAS BEEN MADE AND TESTED IN ACCORDANCE WITH THE ORDER AND ABOVE SPECIFICATION
THIS CERTIFICATE IS ISSUED ACCORDING TO EN 10204 3.1(ISO 10474 3.1 B)

SURVEYOR

MANAGER OF Q.A TEAM

[| 10352 | | M94176] | [LN: 2] | TY023201-1 | FERWHU24STD |

SO# 165051

INSPECTION CERTIFICATE

주식회사 휴스틸

HUSTEEL Co., Ltd.

HEAD OFFICE : SHINAN B/D 15F, 943-19, DAECHI-DONG, KANGNAM-GU, SEOUL, KOREA

DAEBUL PLANT : 3RO, DAEBUL INDUSTRIAL COMPLEX, SAMHO-EUP, YEONGAM-GUN, JEOLLANAM-DO, KOREA

P/O No. : MIP00020
L/C No. : HU20110829001

ISSUED DATE : 2014.02.12

COMMODITY : E.R.W. STEEL PIPE

SPECIFICATION : API 5L X-42 PSL1/API 5LB/ ASTM A53B/ASME SA 53B

CERTIFICATE No. : 140212-045

MANUFACTURED No. : 2014-01-207

SUPPLIER : HUSTEEL CO., LTD.

CUSTOMER : HUSTEEL USA INC.

NO.	HEAT_NO	QUAN-TITY	TYPE	NOMINAL SIZE	ORDER SIZE			WEIGHT	TENSILE TEST						CHEMICAL COMPOSITION(%)																
					O.D	W.T	LENGTH		DIR.	TS	YS	EL	YR	WTS	DIV	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Nb	Ti	B	CEQ	PCM
		PCS	*1		inch	inch	ft	lb/ft	*3	PSI		%	%	PSI	*5	-2			-3					-4				-5	-3	
					*2					*4						*6														
04	M94176	69	BPEB	24	24.000	0.375	42	94.71	T	69,615	56,417	39	81	73,966	H	6	1	76	12	5	14	10	20	TR	TR	230	10	10		
															P	5	1	79	12	5	15	11	18	10	9	271	8	10		
															P	6	1	79	12	5	14	9	18	10	8	265	7	10		
05	590265	4	BPEB	24	24.000	0.375	42	94.71	T	67,440	48,876	41	72	71,501	H	15	2	81	17	2	10	10	10	50	10	10	10	TR		
															P	14	2	83	17	3	12	8	16	10	8	23	8	10		
															P	14	2	82	17	3	11	8	15	10	9	22	9	10		

NO.	HYDROSTATIC TEST			HEAT TREATMENT	ZINC COATING TEST		THREADS		HARDNESS TEST	IMPACT TEST (0) ℃			*13 N·D·T (UT)	FLATTENING OR BEND TEST	VISUAL& DIMENSION	METALLOGRAPHIC TEST	RESIDUAL MAGNETISM
	T.P	H.T	RESULT		WZC	CST	TPI	ETL		DIV	Energy (Ind, J)	SIZE	GOOD	GOOD	GOOD	GOOD	GOOD
	PSI	sec		℃	g/㎡	TIMES		inch	HV	*7		*8	FLANGE TEST	REVERSE FLATTENING TEST	CRUSH TEST		
	*9			*10	*11		*12										
04	1190	10	GOOD	950													
05	1190	10	GOOD	950													

- Latest edition per API 5L(45th,2013) ASTM(2012) ASME SA 53B(2012)
- HARDNESS MAX 22 HRC AS PER NACE MR 0175 / ISO 15156

NOTE

*1.Type of Pipe Ends

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*2. O.D : Outskl Diameter, W.T : Wall Thickness *3. Direction L : Longitudinal, T : Transverse
*4. Tensile Test -TS : Tensile Strength, YS : Yield Strength, YR : Yield Ratio, EL : Elongation, WTS : Weld tensile strength, Gauge Length : 2 inch, Y.P method : 0.5% Underload
*5. H : Heat analysis, P : Product analysis *6. -2 : x1/100, -3 : x1/1000, -4 : x1/10000, -5 : x1/10000, Tr :Trace *7. B : Base Metal, W : Weld Line, H : Heat Affected Zone
*8. Specimen Size -A :10x10mm, B :10x7.5mm, C:10x6.6mm, D:10x5.0mm, Direction: Transverse *9. T.P : Testing Pressure, H.T : Holding Time *10. Heat Treatment Seam Normalizing
*11. WZC : Weight of Zinc Coating, CST : Copper Sulphate Test *12. TPI : Threads per Inch, ETL : Effective length of threads *13. NDT : UT, Reference Standard 3.2 ℄ Drilled Hole

WE HEREBY CERTIFY THAT THE MATERIAL HEREIN HAS BEEN MADE AND TESTED IN ACCORDANCE WITH THE ORDER AND ABOVE SPECIFICATION
THIS CERTIFICATE IS ISSUED ACCORDING TO EN 10204 3.1(ISO 10474 3.1 B)

SURVEYOR

MANAGER OF Q.A TEAM

50#165051

SO# 165051

[| 10352 | | | A673AN] | [LN: 5] | TY023201-2 | D860RFLN14 |

FVC an AFGlobal Company

Material Test Report

FVC Heat Nbr: A673AN

Forged Vessel Connections
An AFGlobal Company
2525 De Soto, Houston, TX 77091
Sales: (713) 868-4421 Fax: (713) 455-8366

ISO 9001:2008 Certified

Industrial Piping 00011500	PO: HP232569	Sales Order: 150716	Line: 39
P.O. Box 581270	Item Code: LWN080600140A002A1	Qty: 2	
Tulsa, OK 74158-1270	Item Desc: LWN,SA105N,600#,8"x14",RF		
Spec: ASME SA105N: 2015 Edition			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18			
Mn	Manganese	1.16		✓	7439-96-5
P	Phosphorous	0.011			
S	Sulphur	0.02			
Si	Silicon	0.28			
Cu	Copper	0.10		✓	7440-50-8
Ni	Nickel	0.08		✓	7440-02-0
Cr	Chromium	0.09		✓	7440-47-3
Mo	Molybdenum	0.08			
V	Vanadium	0.06			
Cb	Columbium (N	0.021			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
Sn	Tin	0.008			
Ti	Titanium	0.024		✓	7440-02-0
Al	Aluminum	0.023			
Ca	Calcium	0.0002			
N	Nitrogen	0.0136			
O	Oxygen	0.0006			
As	Arsenic	0.003		✓	7440-38-2
Sb	Antimony	0.002		✓	7440-36-0
CE	C+Mn/6+(Cr+M	0.43			
Cb+V		0.085			

Mechanical Testing

Test Lab	AFG 54796
BHN (QTC)	143
Elg (%)	33.0
RA (%)	59.0
Tensile Specimen Size (in)	.496
Tensile (ksi)	72.883
Yield (ksi)	47.558

Heat Treat

Heat Treatment	Normalized

Other

MHC	N1781
Production Method	EF/VD
VD	Yes
Fully Killed	Yes
Reduction Ratio (Mill) x:1	6.9
Gr.Sz.	6
Made to Fine Grain Practice	Yes

Certification No.: 1236288
Certification Date: 1/21/2016
Issued By: Ana Robles

This report is issued in compliance with the requirements of EN10204 3.1 / ISO 10474 3.1.b

KMI FAB
S/O 165051
Date 2-8-17
Item # 5

5

SO# 165051

[| 10352 | | | A673AN] | [LN: 5] | TY023201-2 | D860RFLN14 |

Material Test Report

FVC Heat Nbr: A673AN

Forged Vessel Connections
An AFGlobal Company
2525 De Soto, Houston, TX 77091
ISO 9001:2008 Certified Sales: (713) 868-4421 Fax: (713) 455-8366

Industrial Piping 00011500	PO: HP232569	Sales Order: 150716	Line: 39
P.O. Box 581270	Item Code: LWN080600140A002A1	Qty: 2	
Tulsa, OK 74158-1270	Item Desc: LWN,SA105N,600#,8"x14",RF		
Spec: ASME SA105N: 2015 Edition			

CE=C+(Mn/6)+((Cr+Mo+V)/5)+((Ni+Cu)/15)
PRODUCT COMPLIANT TO NACE MR0175 AND NACE MR0103 LATEST EDITION.
YIELD STRENGTH CALCULATED AT 0.2% OFFSET.

FVC STANDARD MANUFACTURING PRACTICES:
1) FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5. 2015 EDITION
2) SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.
3) MATERIAL SPECIFICATION COMPLIES WITH ASME SECT. II PART A.
4) ALL FVC MATERIAL MANUFACTURED PER FINE GRAIN PRACTICE.
5) ALL FVC MATERIAL CERTIFIED PER EN 10204 Type 3.1 UNLESS OTHERWISE SPECIFIED.
6) CERTIFICATE OF INSURANCE AVAILABLE UPON REQUEST.
7) PRODUCT FREE OF MERCURY CONTAMINATION.
8) ALL FVC MATERIAL MANUFACTURED UNDER ISO 9001:2008 QUALITY MANAGEMENT SYSTEM.

Certification No.: 1236288
Certification Date: 1/21/2016
Issued By: Ana Robles

Ana Robles - QA Technician

This report is issued in compliance with the requirements of EN10204 3.1 / ISO 10474 3.1.b

Insulation Amgo

Certificate of Mill Test Results 11-Feb-15 Page 1 of 1

PO/Rel: 155005 /

B/L: DFW-36662 W/O: DFW-284206-1

DELTA STEEL, INC.
KMI FABRICATORS INC.
Heat No. W4H550 Slab No. A53
Doc No. 100006 Indexed 17-Sep-14 by jhoyle

SSAB

Test Certificate

12400 Highway 43 North, Axis, Alabama 36505, US

Form TC1: Revision 2: Date 23 Apr 2014

Customer:
DELTA STEEL, INC.
5599 SAN FELIPE-STE 800
P.O BOX 2289
HOUSTON
TX 77252

Customer P.O.No.: DFW-240502 | **Mill Order No.** 41-405549-02 | **Shipping Manifest:** AR190120

Product Description: ASTM A516-70(10)/ASME SA516-70(13)
A20 S20.1 CEV.43MAX;TEST NORM 1650+/-25F 1HR/";NACE MR0175 ANNEX A2.1.2 COMPLIANT

Ship Date: 15 Sep 14 | **Cert Date:** 15 Sep 14 | **Cert No:** 081467668 (Page 1 of 1)

Size: 0.250 X 108.0 X 432.0 (IN)

Tested Pieces:				Tensiles:						Charpy Impact Tests						
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in 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
W4H550	A53	0.247 (DISCRT)	L	59	80		24	T							
W4H550	A53*	0.247 (DISCRT)	L	53	74		26	T							
W4H635	C43	0.247 (DISCRT)	L	57	77		22	T							
W4H635	C43*	0.247 (DISCRT)	L	56	76		25	T							

Chemical Analysis

Heat Id	C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	Cev	
W4H550	.18	.96	.014	.002	.24	.025	.024	.31	.17	.14	.04	.000	.006	.008	.0001	.42	ORGN
W4H635	.20	.98	.008	.001	.22	.030	.029	.26	.14	.10	.04	.001	.006	.010	.0001	.42	USA
																	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
CEV (IIW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
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:
W4H635 C43 PCES: 6, LBS: 19848 W4H550 A53 PCES: 2, LBS: 6616

(P) Cust Part #:

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

Justin Ward +1 251 662 4400
SENIOR METALLURGIST - PRODUCT

KMI FAB
S/O 155051
Date 2-8-17
Item # 6

6

SO# 165051

[| 10352 | | | A153140] | [LN: 9] | TY023201-4 | *FITT |

MATERIAL TEST REPORT

Universal Outlets, Inc.

P.O. Box 2609
Kilgore,Texas 75663
800-242-2489 Fax 903-983-0281

Invoice#:
Inv Date: 12/14/2016
S/O#: 0047550

BILL TO:
INDUSTRIAL PIPING
P.O. BOX 581270
TULSA, OK
74158-1270

SHIP TO:
TYLER

Cust PO#: TYP50260X

ITEMS

Item	Qty	Description	Heat No.
2	6	1 6MTHD COUPLET X 3 A105	A153140

CHEMICAL PROPERTIES

C	SIL	MN	PHOS	SUL	CR	NI	MO	AL	CB	CU
.21	.21	1.06	.008	.028	.14	.06	.02	.027		.12

V	SN	CE	CO	TA	Nitro
.001	.006	.43	.005		.009

PHISICAL PROPERTIES

Yield	Tensile	Elong.	Red. Area	Hardness
46,700	72,600	30	60	151/148

CharpyTest	Lat. Exp.	Sear Frac.	Test Temp.
AVG 62	AVG 42	AVG47	

Heat Treat: NORM

Temp.	Time	AGrain	FGrain	Misc
1670F				

NOTES

A:
B:
1: ASTM A105 ASME SA105 A/SA350 LF 2 CL1
2: NO WELD REPAIR FREE FROM MERCURY EN10204 3.1
3: MELT AND MFG USA
4:

KMI FAB
S/O 165051
Date 2-8-17
Item # 7

SO#165051

[| 10352 | | | A160977] | [LN: 10] | TY023201-4 | *FITT |

MATERIAL TEST REPORT

Universal Outlets, Inc.

P.O. Box 2609
Kilgore,Texas 75663
800-242-2489 Fax 903-983-0281

Invoice#:
Inv Date: 12/14/2016
S/O#: 0047550

BILL TO:
INDUSTRIAL PIPING
P.O. BOX 581270
TULSA, OK
74158-1270

SHIP TO:
TYLER

Cust PO#: TYP50260X

ITEMS

Item	Qty	Description	Heat No.
3	5	3/4 6M THD COUPLET X 3 A105	A160977

CHEMICAL PROPERTIES

C	SIL	MN	PHOS	SUL	CR	NI	MO	AL	CB	CU
.2	.21	1.1	.009	.02	.14	.07	.04	.024	.001	.17

SN	V	PB	CE	CO	TA	Nitro
.01	.002	.002	.44	.008		.008

PHISICAL PROPERTIES

Yield	Tensile	Elong.	Red. Area	Hardness
52,900	76,900	29	61	151/154
CharpyTest		Lat. Exp.	Sear Frac.	Test Temp.
AVG 76 -50F		AVG 65	AVG 10	
Heat Treat: NORM				
Temp.	Time	AGrain	FGrain	Misc
1670F				

NOTES

A:
B:
1: ASTM A105 ASME SA105 A/SA350 LF 2`
2: NO WELD REPAIR FREE FROM MERCURY EN 10204 3.1
3: MELT AND MFG USA
4:

KMI FAB
S/O 165053
Date 2-8-17
Item # 8

8

SO#165051

[| 10352 | | | A143365] | [LN: 11] | TY023201-4 | *FITT |

MATERIAL TEST REPORT

Universal Outlets, Inc.

P.O. Box 2609
Kilgore,Texas 75663
800-242-2489 Fax 903-983-0281

Invoice#:
Inv Date: **12/14/2016**
S/O#: **0047550**

BILL TO:
INDUSTRIAL PIPING
P.O. BOX 581270
TULSA, OK
74158-1270

SHIP TO:
TYLER

Cust PO#: **TYP50260X**

ITEMS

Item	Qty	Description	Heat No.
4	3	1/2 6M THD COUPLET X 3 A105	A143365

CHEMICAL PROPERTIES

C	SIL	MN	PHOS	SUL	CR	NI	MO	AL	CB	CU
.22	.22	1.08	.007	.025	.16	.05	.02	.03		.11

V								CO	TA	Nitro
.003								.005		.008

PHISICAL PROPERTIES

Yield		Tensile	Elong.	Red. Area	Hardness
47,100		73,400	33	68	142/141
	CharpyTest		Lat. Exp.	Sear Frac.	Test Temp.
	AVG 76		AVG 51	AVG 67	
Heat Treat:	NORM				
Temp.		Time	AGrain	FGrain	Misc
1670F					

NOTES

A:
B:
1: ASTM A105 ASME SA105 A/SA 350 LF 2 EN 10204 3.1
2: NACE MRO 103 NACE MRO 175
3:
4:

KMI FAB
S/O 165051
Date 2-8-17
Item # 9

9

Phoenix * Capitol * Camco CapProducts

Certified Mill Test Report

Heat Code: ADOB
Heat Number: 031794
Item: 2.1.0900.134: MEDIUM LIFTING LUG

Material: ASTM A105-2011a / ASME SA105-2010 Edition

Chemistry Properties

C	Mn	P	S	Si	Cu	Cr
0.2000	0.9200	0.0080	0.0370	0.2200	0.3700	0.0700
Ni	**Mo**	**V**	**Co**	**Al**	**Cb**	**N**
0.0900	0.0300	0.0240				
Pb	**Sn**	**Ta**	**Ti**	**C Eq. Long**		
				0.4088		

Additional Chemical Properties

Mechanical Properties

Tensile(PSI)	Yield(PSI)	Elong. % in 2 in. or 4D	Reduction	HBW	HBW 2
76000	48800	30%	65	152	156

Charpy Minimum Impact - ft/lbs

Test 1	Test 2	Test 3	Avg.	Test Temp.

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements. We further certify that this material was inspected using independent inspectors conforming to the requirements of EN 10204 3.1. These products meet the requirements of the latest editions of NACE MR0175, NACE MR0103, and ISO 15156. No weld repair has been performed on these products. This material was not exposed to mercury or any other metal alloy that is liquid at ambient temperatures during processing or while in our possession.

Meets ASME SA-181-70 2013 Edition. Manufactured in the USA.

KMI FAB
S/O 165051
Date 2-8-17
Item # 12

12

Tube sheet

SSAB

Test Certificate

12400 Highway 43 North, Axis, Alabama 36505, US

Form TC1: Revision 2: Date 23 Apr 2014

Customer:
DELTA STEEL, INC.
5599 SAN FELIPE-STE 600
P.O BOX 2289
HOUSTON
TX 77252

Customer P.O.No.: DFW-244477 | **Mill Order No.** 41-473724-02 | **Shipping Manifest:** AR231157

Product Description: ASME SA516-70/SA516-65/SA516-60(15)
ASTM A516-70/A516-65/A516-60(10/15)
LCVN 15/12 FT.LBS @ -60F/A673-P
~~NORMALIZED~~

Ship Date: 30 Aug 16 | **Cert No:** 081575417
Cert Date: 30 Aug 16 | (Page 1 of 1)

Size: 1.250 X 96.00 X 480.0 (IN)

Tested Pieces:				Tensiles:						Charpy Impact Tests								
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in 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
E6H121	C11	1.259 (DISCRT)	C	49	74		29	T		85 45 37 56		-60F	L	10.	

Chemical Analysis

Heat Id	C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	IIW	ORGN
E6H121	.18	1.10	.011	.001	.23	.028	.027	.27	.14	.15	.04	.001	.003	.009	.0001	.43	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
CEV (IIW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
NACE MR0175/ISO15156-2:2015 ANNEX A2.1.2 COMPLIANT
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
WELD REPAIRING HAS NOT BEEN PERFORMED
NORMALIZED PLATES. HEATED AT 1665F FOR 54 MINUTES.
TEST COUPONS TAKEN FROM HEAT TREATED PLATE.
PRODUCTS SHIPPED:
E6H121 C11 6677231 PCES: 1, LBS: 16335

KMI FAB
S/O 165051
Date 2-8-17
Item # 13

(P) 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

DELTA STEEL, INC.
KMI FABRICATORS INC.
Heat No. E6H121 Slab No. C11
Doc No. 150919 Indexed 31-Aug-16 by sholman

PO/Rel: 10310 /
B/L: DFW-58620-1
W/O: DFW-225315-1

Certificate of Mill Test Results
05-Oct-16
Page 1 of 1

13

165051

1" S80 Syphon drain

[| 10308 | RFQ | | 1015482122] | [LN: 3] | TY022731-1 | FSVAT1XH |

voestalpine Tubulars GmbH & Co KG

Alpinestrasse 17
8652 Kindberg-Aumuchl
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 0582684, VAT Nr. ATU 43630408

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

FSVAT1XH

INSPECTION - CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

No. 118168

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

Hersteller: Manufacturer: Producteur:	voestalpine Tubulars GmbH & Co KG, Austria
Besteller: Purchaser: Archeteur:	VOEST-ALPINE TUBULAR CORPORATION HOUSTON, TEXAS 77077, US 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:	ASTM A 53 / A 53 M-2013, ASME SA 53- 2013 ASTM A 106 / A 106 M-2014, ASME SA 106-2013 API 5 L (PSL1) - 45.edition-2012 NACE MR 0175 / ISO 15156-2009 NACE MR0103-2012 (latest edition) 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" 12.2015 1.315" 0.179" B PSL1 SMLS TESTED 2500 PSI length ft heat no A/SA53 GRADE B S A/SA 106 GRADE B SCHED.80 PO.No.: HR064335 Made in Austria
Colour coding:	Fully painted: Bands: purple
Label:	PO No.: HR064335, DAT Port of Houston, TX
Remarks:	"SI units have been converted to US customary units"

Auftrags-Nr.: Our works order No.: No usine:	20258 / 2
Bestellnr.: Your order No.: No de la commande:	HR064335/VATC PO# 511603
Zeichen des Lieferwerks: Marking of producer: Marque du fabricant:	va
Erschmelzungsart: Melting process: Procédé d'élaboration:	BOF fully killed, produced to fine grain practice

Kindberg, 17.02.2016

No. 118168

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.

KMI FAB
S/O 165051
Date 2-8-17
Item # 14

14

[| 10308 | RFQ 1 | 1015482122] | [LN: 3] | TY022731-1 | FSVAT1XH |

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:
	2	1.315 in x 0.179 in; 2.17 lbs/ft SCHED.80	1-3	354	7 723.425ft	7 494.00kg		

Volume of delivery

Heat	Lot	Remark
1015482122	205289 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: 2500 PSI (duration min. 5 sec.) bestanden/passed

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.

Kindberg, 17.02.2016

No. 118168

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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.

[| 10308 | RFQ | 1015482122] | [LN: 3] | TY022731-1 | FSVAT1XH |

voestalpine Tubulars GmbH & Co KG

:nsile testing

Lot No		Test Type	Heat treatment	Temp [°C]	No.	Specimen Type	Dimension [mm]			Yield Strength [PSI]	Tensile Strength [PSI]	Elong. [%]	Reduct. In area [%]	Rt/Rm
										Requ. from	35 534	60 190	30.00	
										Requ. to				
205289	AD 01	Standard	as rolled	20	1	Full Section	33.55	x	4.60	Rt0.50	45 542	67 297	48.40	0.68
205289	AD 01	Standard	as rolled	20	2	Full Section	33.55	x	4.75	Rt0.50	45 397	65 992	45.70	0.69

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	
205289	AD01	Standard	as rolled	1	Body HRB	74.10	75.30	74.43	74.93	0.50

Kindberg, 17.02.2016

No. 118168

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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.

voestalpine Tubulars GmbH & Co KG

Chemical test results

Product analysis

C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
max. Requ.																	
0.2300		1.0600	0.0300	0.0300	0.4000	0.4000	0.4000			0.1500	0.0800						0.4000
min. Requ.																	
0.0000	0.1000	0.2900															
1015482122																	
0.1524	0.2090	0.7440	0.0152	0.0068	0.0221	0.0187	0.0194	0.0218	0.0008	0.0018	0.0010	0.0020	0.0002	0.0050	0.0000	0.0021	0.2839

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. 205289 AD 01 1 Standard Heat No. 1015482122																	
0.1561	0.2019	0.7307	0.0149	0.0081	0.0250	0.0247	0.0224	0.0194	0.0014	0.0023	0.0033	0.0028	0.0002	0.0067	0.0011	0.0000	0.2871
Lot No. 205289 AD 01 2 Standard Heat No. 1015482122																	
0.1564	0.2010	0.7297	0.0154	0.0071	0.0234	0.0211	0.0213	0.0184	0.0014	0.0020	0.0032	0.0028	0.0002	0.0067	0.0011	0.0000	0.2866
Lot No. 205289 AD 01 3 Standard Heat No. 1015482122																	
0.1547	0.1991	0.7296	0.0149	0.0073	0.0250	0.0253	0.0226	0.0190	0.0014	0.0025	0.0033	0.0030	0.0002	0.0061	0.0013	0.0000	0.2857
Lot No. 205289 AD 01 4 Standard Heat No. 1015482122																	
0.1557	0.1972	0.7271	0.0147	0.0074	0.0233	0.0214	0.0211	0.0179	0.0013	0.0021	0.0030	0.0028	0.0002	0.0061	0.0010	0.0000	0.2854

Kindberg, 17.02.2016

No. 118168

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.

Base R

15

SSAB

Test Certificate

12400 Highway 43 North, Axis, Alabama 36505, US

Form TC1: Revision 2: Date 23 Apr 2014

Customer:
DELTA STEEL, INC.
5599 SAN FELIPE-STE 600
P.O BOX 2289
HOUSTON
TX 77252

Customer P.O.No.: DFW-243134 | **Mill Order No.** 41-453379-07 | **Shipping Manifest:** AR217514

Product Description: ASTM A516-70(10/15)/ASME SA516-70(15)
A20 S20.1 CEV.43%MAX
TEST NORM 1650+/-25F 1HR/"

Ship Date: 12 Jan 16
Cert Date: 12 Jan 16
Cert No: 081537387
(Page 1 of 1)

Size: 0.750 X 96.00 X 480.0 (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
E6A079	C11	0.747 (DISCRT)	L	50	73			24	T													
E6A079	C11*	0.747 (DISCRT)	L	48	72			26	T													
E6A079	C12	0.747 (DISCRT)	L	51	74			23	T													
E6A079	C12*	0.747 (DISCRT)	L	48	72			24	T													

Chemical Analysis

Heat Id	C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	Cev	ORGN
E6A079	.19	1.01	.007	.001	.23	.026	.026	.20	.11	.13	.06	.001	.005	.010	.0001	.41	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
CEV (1IW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
RESULTS OF TESTS PERFORMED ON NORMALIZED TEST COUPONS ARE LABELED ABOVE WITH *
NACE MR0175(09) ANNEX A2.1.2 COMPLIANT
NACE MR0103(12) 2.1.2(A) AND 2.1.2(C) COMPLIANT
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
PRODUCTS SHIPPED:
E6A079 C12 PCES: 1, LBS: 9801 E6A079 C11 PCES: 4, LBS: 39204

KMI FAB
S/O 165961
Date 2-8-17
Item # 15

(P) 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

DELTA STEEL, INC.
KMI FABRICATORS INC.
Heat No. E6A079 Slab No. C11
Doc No. 133080 Indexed 13-Jan-16 by cdaughen

PO/Rel: 10310 /
B/L: DFW-58620-2
W/O: DFW-225315-2

Certificate of Mill Test Results
05-Oct-16
Page 1 of 1

SO# 165051

[| 10352 | | | J6328] | [LN: 8] | TY023201-4 | *FITT |

MATERIAL TEST REPORT

Universal Outlets, Inc.

P.O. Box 2609
Kilgore,Texas 75663
800-242-2489 Fax 903-983-0281

Invoice#:
Inv Date: **12/14/2016**
S/O#: **0047550**

BILL TO:
INDUSTRIAL PIPING
P.O. BOX 581270
TULSA, OK
74158-1270

SHIP TO:
TYLER

Cust PO#: **TYP50260X**

ITEMS

Item	Qty	Description	Heat No.
1	4	1-1/2 6M THD COUPLET X 3 A105	J6328

CHEMICAL PROPERTIES

C	SIL	MN	PHOS	SUL	CR	NI	MO	AL	CB	CU
.7	.273	1.19	.007	.011	.127	.119	.029	.023	.013	.139

V	SN	TI	B					CO	TA	Nitro
.015	.005	.001	.000							.006

PHISICAL PROPERTIES

Yield		Tensile	Elong.	Red. Area	Hardness
57,087	CharpyTest	76,725	35.9 Lat. Exp.	75 Sear Frac.	158 BHN Test Temp.

Heat Treat:	NORM				
Temp.		Time	AGrain	FGrain	Misc
1652*F					

NOTES

A:
B:
1: ASTM A105 ASME SA105 NO WELD REPAIR FREE FROM MERCRUY
2:
3:
4:

KMI FAB
S/O 165051
Date 2-8-17
Item # 18

Piping Products, Inc.

FORGED STEEL FLANGES AND SPECIAL FITTINGS
1681 Kress St., Houston, Texas 77020-8126
Ph: (713) 675-5374, (800) 775-5374, Fax: (713) 675-7910

*** MILL TEST REPORT ***

KMI FAB
S/O 165051
Date 2-8-17
Item # 19

S IPS	S IPS	CUST #:	IPS03
O PO BOX 581270	H 11942 MASSEY ROAD	CUST PO:	TYP32256
L	I	DATE:	04/21/15
D TULSA, OK 74158	P TYLER, TX 75708	PPI S/O #:	272464
		TAG #:	

COUNTRY OF MANUF: USA

ITEMS

ITM	DESCRIPTION	
40	1 600 LWN X 9 RF	SA105N 125-250 AARH
50	3 900 LWN X 9 RF	SA105N 125-250 AARH
50	3 900 LWN X 9 RF	SA105N 125-250 AARH

CHEMICAL PROPERTIES

ITM	HEAT NO.	C	SIL	MN	PHOS	SUL	CR	NI	MO	N	CO	CU	V	AL	NB	C/EQ
40	CTJP	0.190	0.230	1.200	0.024	0.008	0.012	0.014	0.001	0.000	0.000	0.015	0.003	0.000	0.000	0.395
50	CXJN	0.205	0.200	1.160	0.015	0.010	0.011	0.009	0.006	0.000	0.000	0.011	0.003	0.000	0.000	0.404
50	CQSD	0.190	0.210	0.096	0.030	0.016	0.020	0.020	0.002	0.000	0.000	0.021	0.003	0.000	0.000	0.214

PHYSICAL PROPERTIES

ITM	YIELD STRENGTH	TENSILE STRENGTH	ELONG. % IN 2"	RED. AREA	BHN HARDNESS	CHARPY TEST
40	53,694	76,148	34.80	68.89	149-159	
50	48,197	75,875	32.36	62.87	149-167	
50	44,901	75,150	31.80	60.05	163	

ITEM NOTES

40 NORM @ 1625F.
50 NORM @ 1650F.
50 NORMALIZED @ 1688F.

ORDER NOTES

NACE MR0175 MR0103 EN10204 3.1

Additional Notes or Comments:

NACE MR0175-03
NACE MR0103
EN10204 3.1

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

Quality Assurance Asst. Mgr.

[| 10352 | | CTJP] | [IN: 6] | TY023201-1 | DA160RFLN9 |

SO# 165051

19

16505/

1" S160 pipe

[| 10308 | RFQ | 1015378774] | [LN: 4] | TY022731-1 | FSVAT1160 |

voestalpine Tubulars GmbH & Co KG

Alpinestrasse 17
8652 Kindberg-Aumuchl
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

FSVAT1160

INSPECTION - CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

No. 119903

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 15156-2009 NACE MR 0103-2012 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" 04.2016 1.315" 0.250" B PSL1 SMLS TESTED 2500 PSI Length ft Heat No. A/SA 53 GRADE B S A/SA 106 GRADE B SCHED.160 PO No.: HR066557 Made in Austria
Colour coding:	Fully painted: Bands: purple
Label:	PO No.: HR066557, DAT Port of Houston
Remarks:	*) SI units have been converted to US customary units

Auftrags-Nr.: Our works order No.: No usine:	20850 / 3
Bestellnr.: Your order No.: No de la commande:	HR066557/VATC PO# 602604
Zeichen des Lieferwerks: Marking of producer: Marque du fabricant:	va
Erschmelzungsart: Melting process: Procédé d'élaboration:	**BOF** fully killed, produced to fine grain practice

Kindberg, 18.04.2016

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

No. 119903

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

voestalpine
ONE STEP AHEAD.

KMI FAB
S/O 16505/
Date 2-8-17
Item # 20

20

[| 10308 | RFQ | 1015378774] | [LN: 4] | TY022731-1 | FSVAT1160 |

voestalpine Tubulars GmbH & Co KG

Jmfang 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:
	3	1,315 in x 0,250 in; 2,84 lbs/ft SCHED.160	1-8	894	19 792.075ft	25 209.50kg		

Volume of delivery

Heat	Lot	Remark
1015378774	206455 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: 2500 PSI (duration min. 5 sec.) bestanden/passed

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.

Kindberg, 18.04.2016

No. 119903

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voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
WEITZER
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voestalpine
ONE STEP AHEAD.

[| 10308 | RFQ | 1015378774] | [LN: 4] | TY022731-1 | FSVAT1160 |

voestalpine Tubulars GmbH & Co KG

ensile 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	30.00		
							Requ. to					
206455	AD 01	Standard	as rolled	20	1	Full Section	33.40 x 6.35 Rt0.50	47 572	65 847	50.40		0.72
206455	AD 01	Standard	as rolled	20	2	Full Section	33.40 x 6.35 Rt0.50	45 977	64 686	52.10		0.71
206455	AD 01	Standard	as rolled	20	3	Full Section	33.40 x 6.35 Rt0.50	46 702	64 977	49.20		0.72
								yield strength: Gr B: 35500 PSI				
								tensile strength: Gr. B: 60200 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	
206455	AD01	Standard	as rolled	1	Body	HRB	74.70	75.60	74.97	75.50	0.53

Kindberg, 18.04.2016

No. 119903

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

voestalpine
ONE STEP AHEAD.

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. Requ.																	
0.2300		1.0600	0.0300	0.0300	0.4000	0.4000	0.4000			0.1500	0.0800						0.4000
min. Requ.																	
0.0000	0.1000	0.2900															
1015378774																	
0.1557	0.1953	0.7289	0.0146	0.0073	0.0260	0.0212	0.0230	0.0288	0.0009	0.0036	0.0018	0.0013	0.0002	0.0059	0.0000	0.0022	0.2664

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. 206455 AD 01 1 Standard Heat No. 1015378774																	
0.1545	0.1737	0.6971	0.0137	0.0072	0.0233	0.0215	0.0242	0.0233	0.0012	0.0041	0.0033	0.0019	0.0002	0.0067	0.0007	0.0000	0.2799
Lot No. 206455 AD 01 2 Standard Heat No. 1015378774																	
0.1539	0.1665	0.6953	0.0107	0.0067	0.0237	0.0232	0.0291	0.0236	0.0013	0.0042	0.0032	0.0022	0.0002	0.0063	0.0007	0.0000	0.2795
Lot No. 206455 AD 01 3 Standard Heat No. 1015378774																	
0.1522	0.1790	0.7090	0.0114	0.0075	0.0244	0.0227	0.0297	0.0263	0.0016	0.0044	0.0041	0.0025	0.0002	0.0061	0.0013	0.0000	0.2804
Lot No. 206455 AD 01 4 Standard Heat No. 1015378774																	
0.1590	0.1867	0.7181	0.0146	0.0071	0.0241	0.0211	0.0252	0.0254	0.0015	0.0042	0.0041	0.0022	0.0002	0.0066	0.0013	0.0000	0.2883
Lot No. 206455 AD 01 5 Standard Heat No. 1015378774																	
0.1524	0.1837	0.7065	0.0146	0.0069	0.0269	0.0215	0.0247	0.0248	0.0014	0.0040	0.0039	0.0023	0.0002	0.0060	0.0011	0.0000	0.2802
Lot No. 206455 AD 01 6 Standard Heat No. 1015378774																	
0.1535	0.1828	0.7042	0.0145	0.0071	0.0267	0.0213	0.0248	0.0246	0.0014	0.0039	0.0038	0.0022	0.0002	0.0055	0.0010	0.0000	0.2808

Kindberg, 18.04.2016

No. 119903

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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.

S0# 165051

[| 10352 | | | 138VVV] | [LN: 14] | TY023201-1 | D13S90 |

Capitol Manufacturing
1125 Capitol Avenue
Crowley, LA 70526

Phoenix * Capitol * Camco
CapProducts

Commanding a Higher Standard℠

Certified Mill Test Report

Printed: 3/14/2016
Customer
INDUSTRIAL PIPING SPECIALISTS
P.O. BOX 581270
TULSA, OK 74158

Certified: 03/11/2016
P.O. HP235613
Tag

Heat No 166142
Heat Code 138VVV
Phoenix Order # 1187112

Material ASTM A105-2014 / ASME SA105-2015 Edition

Part Number
12400110

Description
1 90 FS 3M SW ELL

Chemical Properties

C	Mn	P	S	Si	Cu	Ni	Cr
0.2100	0.9100	0.0080	0.0230	0.2300	0.1600	0.0930	0.1410

C Eq. Long
0.4199

Mo	V	Co	Al	Cb	N	Pb	Sn	Ta	Ti
0.0330	0.0330								

Additional Chemical Properties

Cr + Cu + Ni
0.3940

Mechanical Properties

Tensile (PSI)	Yield (PSI)	Elong. % in 2 in. or 4D	R of A	HBW	HBW2
88,000	59,500	26.0%	64.0%	179	179

Charpy Minimum Impact - ft/lbs

Test 1	Test 2	Test 3	Average
N/A	N/A	N/A	N/A

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements.
We further certify that this material was inspected using independentinspectors conforming to the requirements of EN 10204 3.1. These products meet the requirements of the latest editions of NACE MR0175, NACE MR0103, and ISO 15156. No weld repair has been performed on these products. This material was not exposed to mercury or any other metal alloy that is liquid at ambient temperatures during processing or while in our possession

Meets ASME SA-181-70 2013 Edition. Manufactured in the USA.

KMI FAB
S/O 165051
Date 2-8-17
Item # 21

21

SO# 165051-

[| 10352 | | | 413DD] | [LN: 21] | TY023201-1 | D13TCO |

Capitol Manufacturing
1125 Capitol Avenue
Crowley, LA 70526

Phoenix * Capitol * Camco

CapProducts

Commanding a Higher Standard℠

Certified Mill Test Report

Printed: 9/30/2016
Customer
INDUSTRIAL PIPING SPECIALISTS
P.O. BOX 581270
TULSA, OK 74158

Certified: 07/13/2016
P.O. CP170450
Tag

Heat No 166339
Heat Code 413DD
Phoenix Order # 1232832

Material ASTM A105-2014 / ASME SA105-2015 Edition

Part Number	Description
12202010	1 FS 3M THD COUPLING

Chemical Properties

C	Mn	P	S	Si	Cu	Ni	Cr
0.2000	0.9200	0.0050	0.0220	0.2400	0.1700	0.0730	0.1130

C Eq. Long
0.4029

Mo	V	Co	Al	Cb	N	Pb	Sn	Ta	Ti
0.0180	0.0360								

Additional Chemical Properties

Cr + Cu + Ni
0.3560

Mechanical Properties

Tensile (PSI)	Yield (PSI)	Elong. % in 2 in. or 4D	R of A	HBW	HBW2
71,500	42,500	31.0%	64.0%	143	143

Charpy Minimum Impact - ft/lbs

Test 1	Test 2	Test 3	Average	Test Temp.
N/A	N/A	N/A	N/A	N/A

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements.
We further certify that this material was inspected using independentinspectors conforming to the requirements of EN 10204 3.1. These products meet the requirements of the latest editions of NACE MR0175, NACE MR0103, and ISO 15156. No weld repair has been performed on these products. This material was not exposed to mercury or any other metal alloy that is liquid at ambient temperatures during processing or while in our possession

Meets ASME SA-181-70 2013 Edition. Manufactured in the USA.

KMI FAB
S/O 165051
Date 2-8-17
Item # 22

22

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

165051

SECTION 5

NDE REPORTS

4T-NDT & INSPECTIONS LLC	RADIOGRAPHIC TECHNIQUE AND REVIEW FORM	PROCEDURE: 4T-NDT-RT 1

Customer: KMI		Job No. 165051	PO No.	Page 1 of 1
Description: 24 " PRESSURE VESSEL		Code /Spec ASME SECT VIII RT 2		Film Type: AGFA D7
Energy Type: Iridium 192	Source Strength: 15 curies	Focal spot: .146	Lead Screens: .010 Front and Back	Geometric Unsharpness: .02 max

Exposure Arrangement see Sect V Article 2 C/S = Carbon Steel S//S = Stainless Steel S= Single D = Double

Weld Joint ID	Film ID	Accepted	Rejected	Defect Code	Date Accepted	Exposure Arrangement	Welder	IQI Size Location S-source side F- film side	Wall Thickness	Outside Diameter	Material	Source To Object	Source Side of Object To Film	Weld Reinforcement	Weld thickness	Film Load	Film Exposure	Film Viewing	No. of Exposure
G2	1-2	X				A	P	F/B-SET	.969"	24"	C/S	11.031"	1.094"	.125"	1.094"	S	S	S	1

Defect Codes: 1-Slag; 2-Porosity; 3-Crack; 4-Incomplete Penetration; 5-Incomplete Fusion; 6-Surface; 7-Underfill; 8-Excessive Reinforcement; 9-Other

Interpreted by/ Date 2/2/17

ASNT / ACCP LEVEL II
BUTCH JOHNSON
RT
CERT.NO. 180764

Radiographer: Dale Young ASNT/ACCP II 180763

Radiographer :Butch Johnson ASNT/ACCP II 180764

Manufacturer Representative Date

Karen Barnes 2-7-17

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

165051

SECTION 6

PROCESS CONTROL SHEETS (TRAVELERS)

KMI FABRICATORS, LLC STANDARD INSPECCTION CHECKLIST FOR PRESSURE VESSELS FOR PRESSURE VESSELS ASME SECTION VIII, DIVISION 1	CUSTOMER: UOP RUSSELL KMI PROJECT: Q160140R1 PO: 44500749401	JOB/SERIAL NO. 165051 TAG: F-441	MODEL NO. GU2408H08A 24"OD X 11' S/S	PAGE 1 OF 2 165051

NO	CHECKLIST ATTRIBUTES/TESTS TO BE VERIFIED			MFG HP	MFG INIT/DATE	AI WITNESS HP	AI WITNESS INIT/DATE	QA AUDIT/NDE HP	QA AUDIT/NDE INIT/DATE	CI
1.	MATERIAL TRACEABILITY	VERIFY THAT MATERIAL TRACEABILITY HAS BEEN CONFIRMED BY QA AND THAT MATERIAL IS IDENTIFIED WITH HEAT/QC NUMBERS. REVIEW MTR'S		X	JV 1-3-17			X	KBarnes 2-7-17	
2.	JOINT FIT UP (SHELL SEAMS)	VERIFY WELD JOINT FITUP IN ACCORDANCE WITH APPROVED DRAWINGS FOR ALL SEAMS ON THE VESSEL AND SUMP		X	JV 1-4-17					
3.	LAYOUT	VERIFY NOZZLE/COUPLING OPENINGS IN VESSEL IS PROPERLY LOCATED PER DRAWING.		X	JV 1-5-17					
4.	NOZZLES	VERIFY NOZZLES/COUPLINGS FITUP IN ACCCORDANCE WITH APPROVED DRAWINGS, VERIFY NOZZLES INSTALLED PLUMB/LEVEL		X	JV 1-7-17					
5.	OPEN END/ INTERNALS	VERIFY INTERNALS ARE INSTALLED IN ACCORDANCE WITH DIMENSIONS, CONFIGURATION, ORIENTATION SHOWN ON DRAWING. VESSEL ■ SUMP □ **A.I. HOLD POINT**	1ST STAGE	X	JV 1-7-17	X	1-11-17			
			2ND STAGE*	N/A		N/A				
6.	WELDING INSPECTION	VISUALLY EXAMINE COMPLETED WELDMENTS IN ACCORDANCE WITH APPROVED DRAWINGS. INSPECT ALL ACCESSIBLE WELDS (FILLET, GROOVE, etc.-INTERNAL & EXTERNAL). DIRECT VISUAL EXAMINATION	VERIFY WELD SURFACE QUALITY	X	JV 1-8-17			X	KBarnes 2-8-17 PRIOR TO HYDRO	
		VERIFY THAT WELDS ARE STAMPED WITH WELDERS'S SYMBOL (S) & THAT SYMBOLS ARE RECORDED ON INSPECTION COPY OF DRAWINGS	VERIFY LENGTH/TYPE SIZE/LOCATION	X	JV 1-8-17					
7.	DIMENSIONS & CONFIGURATION VERIFICATION	A) VERIFY FINAL CONFIGURATION OF VESSEL (INCLUDING CLOSURE, DAVIT, SUMP, VESSEL SUPPORTS, etc.) COMPLIES WITH DIMENSIONS AND ORENTATIONS SHOWN ON DRAWING.		X	JV 1-31					
		B) VERIFY HEAT /QC NUMBERS AND BOLT MARKINGS REMAIN VISIBLE AND LEGIBLE AND THAT NO MATAERIAL HAS BEEN SUBSTITUTED WITHOUT ENG. APPROVAL: RECORD HEAT/QC NUMBERS ON INSPECTION COPY OF VESSEL DRAWING.		X	JV 1-31			X		
		C) VERIFY THAT NOZZLES/COUPLINGS ARE INSTALLED PLUMB/LEVEL WITH FLANGE BOLTHOLES STRADDLING VESSEL CENTERLINE.		X	JV 1-31					
		D) VERIFY THAT VESSEL SHELL ROUNDNESS COMPLIES WITH ASME VIII UG80		X	JV 1-31				PRIOR TO HYDRO	
		E) VERIFY THAT MATERIAL TYPES INSTALLED IN VESSEL CONFORM TO REQUIREMENTS OF BILL OF MATERIAL/ENG. DATA SHEET/JOB PICK LIST.		X	JV 1-25-17					
		F) VERIFY THAT BASE METAL IS FREE OF DAMAGE (DENTS, GOUGES, etc.).		X	JV 12-5-17					

APPROVED WPS (USE CURRENT REVISION) 1047A ■ 1064 □ 1071 □ OTHER WPS □ * WHERE APPLICABLE

HEAT TREAT: YES □ NO ■

LEGEND: HP = HOLD INSPECTION POINT AI = AUTHORIZED INSPECTOR CI = CUSTOMER INSPECTOR

APPROVED BY QUALITY ASSURANCE: Karen Barnes DATE: 12-29-16

KMI FABRICATORS, INC.
STANDARD INSPECTION CHECKLIST FOR PRESSURE VESSELS

JOB NO.: 165051 PROJECT: Q160140R1
TAG: F-441

165051

NO	CHECKLIST ATTRIBUTES/TESTS TO BE VERIFIED (CON'T FROM PG 1)		MFG		AI WITNESS		QA AUDIT/NDE		CP
			HP	INIT/DATE	HP	INIT/DATE	HP	INIT/DATE	
8.	NONDESTRUCTIVE EXAMINATION (CONTACT QA TO PERFORM/VERIFY NDE)	MAGNETIC PARTICLE INSPECTION	N/A						
		LIQUID PENETRANT INSPECTION	N/A						
		ULTRASONIC INSPECTION (SUBCONTRACT)	N/A						
		BRINELL HARDNESS TESTING ☐ OTHER ☐	N/A						
		RT (SUBCONTRACT) RT1 ☐ RT2 ■ RT3 ☐ RT4 ☐ RADIOGRAPH ☐ USE TYPE _____ FILM	X	JV 2-7-17					
9.	PRESSURE TEST	A) PERFORM REINFORCING PAD LEAK TEST IAW SPECIFICATION DATA SHEET	N/A		N/A				
		B) PERFORM HYDROSTATIC TEST IAW SPECIFICATION DATA SHEET **1430 PSIG for 15 minutes**	X	TC 2-21-17	X	2-21-17	X	KBarnes 2/9/17	
10.	NAMEPLATE	VERIFY NAMEPLATE (CODE OR NON-CODE) AND CUSTOMER NAMEPLATE WHEN REQUIRED IS ATTACHED PER DRAWING (AFTER HYDRO/PRIOR TO SHIPPING)	X	TC 2-21-17	X	"	X	"	"
11.	DAVIT TEST	PERFORM DAVIT TEST	X	TC 2-21-17					
12.	COATINGS	A) VERIFY BLAST CLEANING IN ACCORDANCE WITH PAINT SPECIFICATION	X	2-21-17 JC					
		B) VERIFY COATINGS APPLICATION IS ACCORDANCE WITH PAINT SPEC AND SPEC DATA SHEET							
13.	INTERNAL CLEANING	VERIFY INTERNAL CLEANING IN ACCORDANCE WITH SPECIFICATION DATA SHEET	X	2-21-17 JC					
14.	ELEMENTS	VERIFY FILTER MEDIA (ELEMENTS, REPACK, etc.) IS INSTALLED PER DRAWING	N/A						
15.	AUXILIARY EQUIPMENT	VERIFY AUXILIARY EQUIPMENT (PIPING, VALVES, etc.) IS INSTALLED FOR TRIAL FIT (WHEN REQUIRED) IN ACCORDANCE WITH THE DRAWINGS	N/A						
16.	BOLT TORQUING	VERIFY THAT ALL PERMANENT BOLTING IS INSTALLED AND TORQUED	X	2-21-17 JC					
17.	PREPARATION FOR SHIPMENT	VERIFY THAT SHIPPING PREPARATIONS ARE COMPLETE, IN ACCORDANCE WITH THE REQUIREMENTS OF THE SPECIFICATION DATA SHEET AND DRAWINGS.	X	JC			X	KBarnes 9/20/17	

OTHER REQUREMENTS

NOTES: **Use TRCo Painting System 3 per the Specification Data Sheet.**

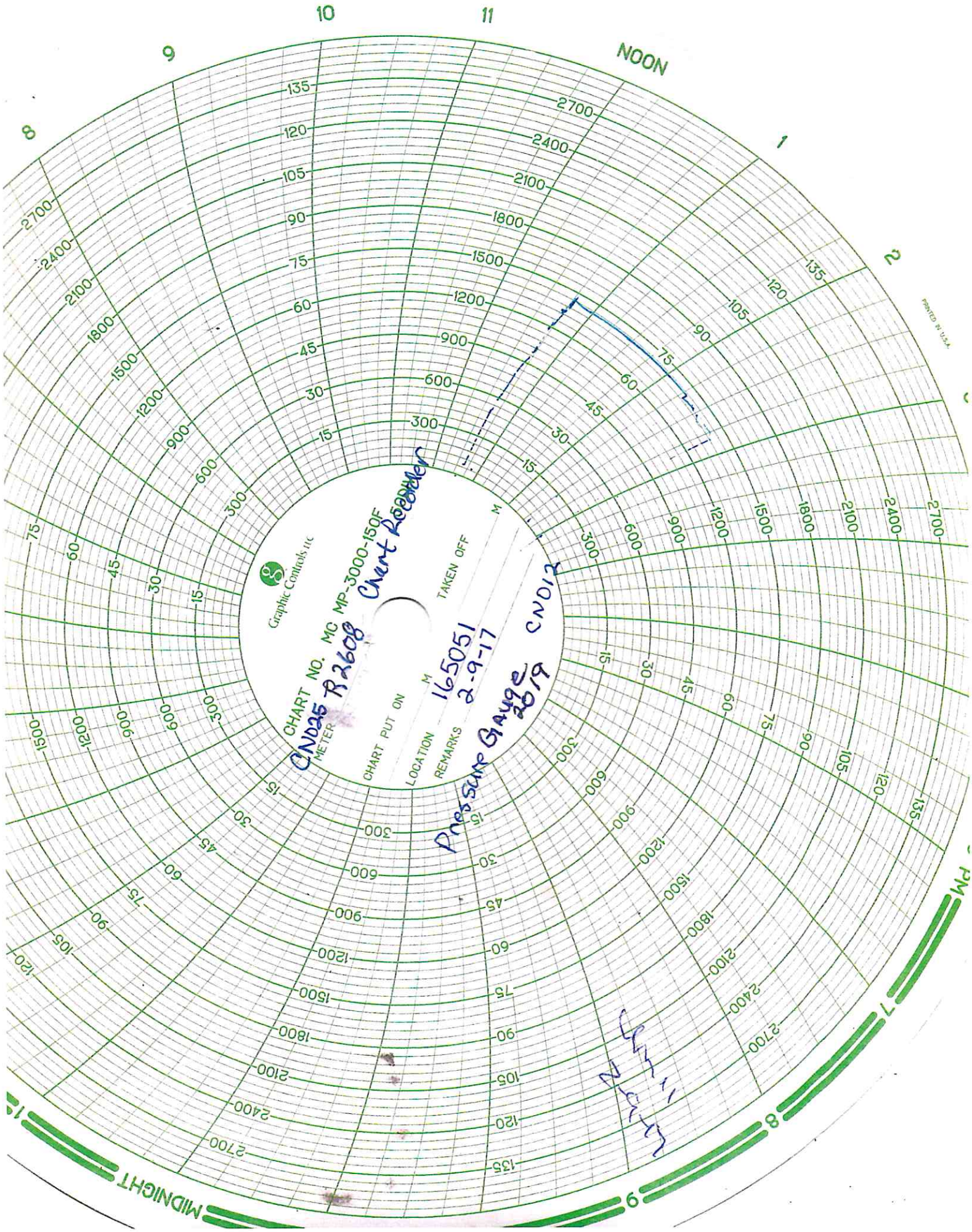
KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

165051

SECTION 7

HYDROSTATIC / PRESSURE TEST RECORDS


Graphic Controls LLC
CHART NO. MC MP-3000-150F
CN025 R2608 Chart Recorder
METER
CHART PUT ON M
LOCATION
REMARKS
TAKEN OFF M
165051
2-9-17
Pressure Gauge
2619 CN012
NOON
MIDNIGHT
PRINTED IN U.S.A.

CALIBRATION CERTIFICATE

P.O. BOX 7172
FORT WORTH, TEXAS 76111
(817) 838-2834
FAX (817) 838-2816

PRESS. ✓ TEMP. _____ GAUGE ✓ REC. _____ PK/DeadWt. _____

SERIAL NUMBER 2019 MODEL NOSHOK RANGE 0-3000 ACCURACY .5%

CALIBRATION

AS FOUND			AS LEFT		
TEST	INDICATED	DIFFERENCE	TEST	INDICATED	DIFFERENCE
500	500	-	500	500	-
1000	1000	-	1000	1000	-
1500	1500	-	1500	1500	-
2000	2002	+2	2000	2002	+2
2500	2503	+3	2500	2503	+3
3000	3005	+5	3000	3005	+5

CALIBRATED IN Vertical POSITION. AMBIENT TEMPERATURE 70°

THIS IS TO CERTIFY THAT THIS INSTRUMENT HAS BEEN INSPECTED AND TESTED AGAINST PRESSURE STANDARD T155116004
TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS TECHNOLOGY.
TRACEABILITY REFERENCE 88003
SPECIAL CONDITIONS:

DATE OF CALIBRATION 9-28-16 INSPECTOR [signature]

Calibration Specialty

2500 E. Grauwyler
Irving, TX 75061
(972) 438-3774

Calibration Certification

Calibration Report #: 387441

Customer Info
KMI FABRICATORS, INC
410 BOYD ROAD

MINERAL WELLS TX 76067

Unit:	TEMP/PRESS RECORDER				
Make:	ITT BARTON				
Model:	242E				
Primary ID#:	CN025				
Secondary ID #:	R2608				
Date Received:	11/17/2016				
Date of Calibration:	11/17/2016	**Temp:**	71 °F		
Expiration Date:	11/17/2017	**Humidity**	42 %		
Received:	INOPERABLE			**Returned:**	IN TOLERANCE

Uncertainty Statement: All test accuracy ratios meet or exceed 4:1 unless otherwise stated.

Procedures:

OEM-9A-10135 RV. 02

REMARKS: TIGHTENED LOOSE LINKAGE AND ADJUSTED

Test Equipment Report

MFG:	MODEL:	TestEQ_ID	UNIT:	CAL DATE	RECAL DATE:
JOFRA	D40	011599-01236	DRY BLOCK TEMP. CALIBRATOR	4/6/2016	4/6/2017
NIST Reports	42804				
FLUKE	744	9414029	DOCUMENTING PROCESS CALIBRATO	5/31/2016	5/31/2017
NIST Reports	1-7184264005-1	176054	GPS UTC		
FLUKE	700P30	17923008	PRESSURE MODULE	8/16/2016	8/16/2017
NIST Reports	1500153358	1500153361			

TECH: RICK KIRKLAND

Authorized Signature

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

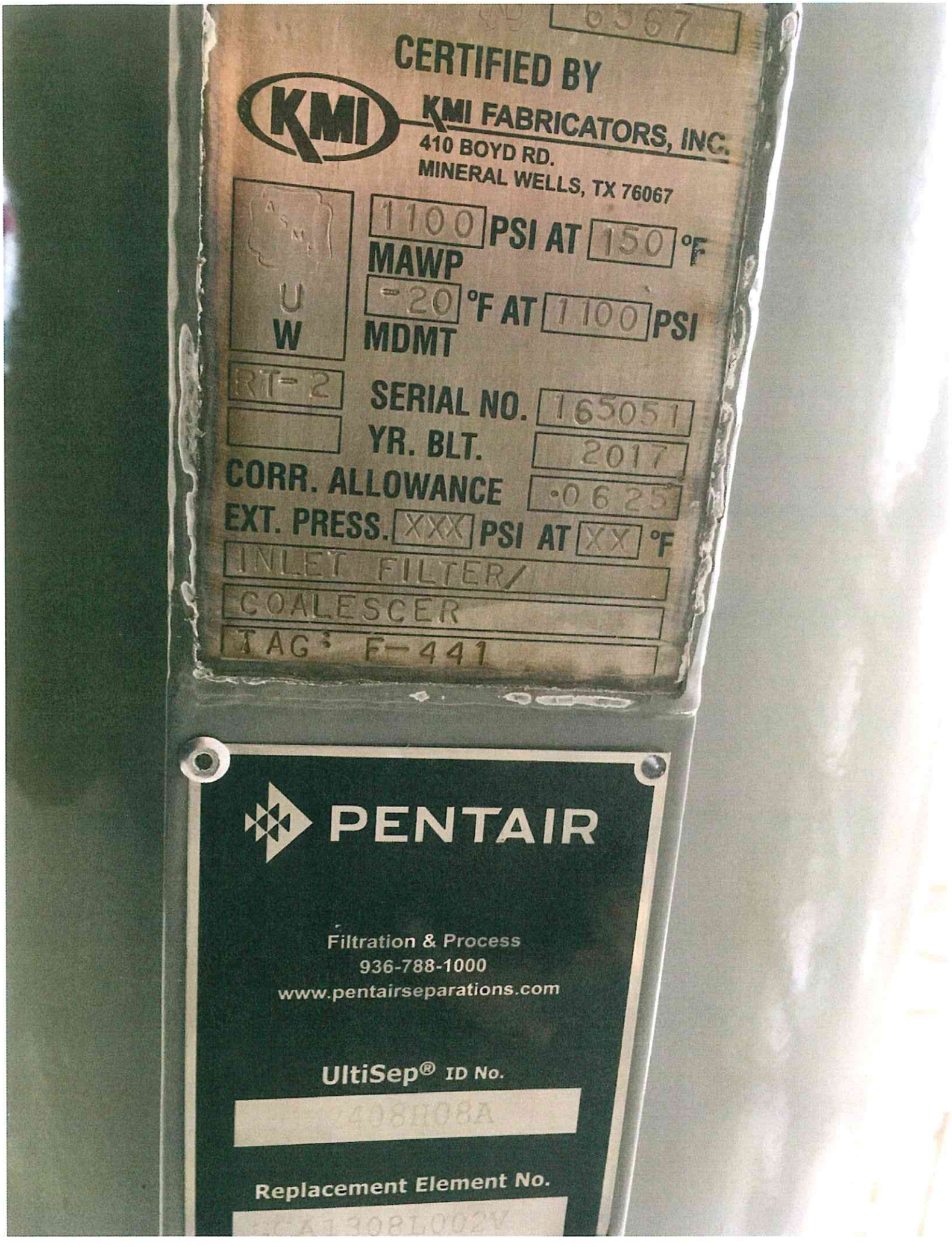
165051

SECTION 8

NAMEPLATE FASCIMILE


PENTAIR
Filtration & Process
936-788-1000
www.pentairseparations.com
UltiSep® ID No.
GU2408H08A
Replacement Element No.
GCA1308L002V


NB 6567
CERTIFIED BY
KMI FABRICATORS, INC.
410 BOYD RD.
MINERAL WELLS, TX 76067
1100 PSI AT 150 °F
MAWP
-20 °F AT 1100 PSI
MDMT
U
W
RT-2
SERIAL NO. 165051
YR. BLT. 2017
CORR. ALLOWANCE .0625"
EXT. PRESS. XXX PSI AT XX °F
INLET FILTER/
COALESCER
TAG: F-441


6367
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MINERAL WELLS, TX 76067
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RT-2
SERIAL NO. 165051
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CORR. ALLOWANCE .0625
EXT. PRESS. XXX PSI AT XX °F
INLET FILTER/
COALESCER
TAG: F-441
PENTAIR
Filtration & Process
936-788-1000
www.pentairseparations.com
UltiSep® ID No.
Replacement Element No.

KMI FABRICATORS, INC

410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

165051

SECTION 9

PAINT REPORT

165051

PRESS-O-FILM™ No. ____ Reading ____ Gage less 2.0 mils or 50 microns COARSE (.8-2.0 mils) or (20 to 50 microns) TESTEX NEWARK, DE 19715 USA

KMI FABRICATORS, INC
410 BOYD ROAD
MINERAL WELLS, TEXAS 76067
PHONE: 940-325-7841
FAX: 940-325-3765

PAINT LOG

Description of Item: 1100 PSIG Inlet Filter /Coalescer
Serial No. 165051 Note: Use TRCo Painting System 3

1. **Date of Blasting** 2-15-2017 **Type of Sand:** 2
2. **Atmospheric Temp.** 74 °F
3. **Surface Temp.** 76 °F
4. **Wet Bulb Temp.** 55 °F, **Dry Bulb Temp.** 74 °F
5. **Dew Point** 40 °F, **Humidity** 61 °F
6. **Surface Preparation Quality**
7. **Blast Profile** 2 SSPC-SP 6 Commercial Blast **MILS**
8. **Method of Checking Profile TEXTEX PROFILE Comparator**

9. **Date of Prime Coat** 2-15-2017
10. **Atmospheric Temp.** 74 °F
11. **Surface Temp.** 76 °F
12. **Wet Bult Temp.** 55 °F, **Dry Bulb Temp.** 74 °F
13. **Dew Point** 40 °F, **Air Quality** good **Humidity** 61
14. **Product Name** Sherwin Williams Macropoxy 646 (B58-600) **Batch No.** XM3476FM
15. **Cure Time** 24 **Hrs. Dry Film Thk.** **MILS (AVG.)**

16. **Date of Intermediate Coat** 2-16
17. **Atmospheric Temp.** 85 °F
18. **Surface Temp.** 89 °F
19. **Wet Bult Temp.** 61 °F, **Dry Bulb Temp.** 85 °F
20. **Dew Point** 46 °F, **Air Quality** good **Humidity** 63
21. **Product Name** Sherwin Williams Macropoxy 646 (B58-600) **Batch No.** XM3476FM
22. **Cure Time** 24 **Hrs. Dry Film Thk.** **MILS (AVG.)**

23. **Date of Intermediate Coat** 2-17-2017
24. **Atmospheric Temp.** 88 °F
25. **Surface Temp.** 90 °F
26. **Wet Bult Temp.** 59 °F, **Dry Bulb Temp.** 88 °F
27. **Dew Point** 44 °F, **Air Quality** good **Humidity** 58
28. **Product Name** Sherwin Williams Hi-Solids Polyurethan B65 Series/B60V30 **Batch No.** XM316566SU
29. **Cure Time** 24 **Hrs. Dry Film Thk.** 10-12 **MILS (AVG.)**

THE ABOVE INFORMATION CERTIFIED CORRECT BY KMI FABRICATORS, INC

BY: Jay Cupps DATE: 2-21-17