UOP RUSSELL LLC
Tulsa, Oklahoma

JOB NO:	J-447	TAG NO:	V-442,443	DATE:	11/29/2010
CLIENT:	UOP Russell	S.O./P.O. NO:		BY:	JRG
SUBJECT:	60 MMscfd Cryo Plant	SERVICE:	Mol Sieve Dehydrator		

PRESSURE VESSELS

MECHANICAL DESIGN

Type (vertical, horizontal, tower)	Vertical
Diameter: (inch)	78" ID
S/S Length (ft-inch)	24' - 0" S/S
Skirt Length(ft-inch)	5' - 6"
Design Pressure (psig)	1095
Design Temperature (°F)	600
MDMT (°F) @ Pressure (psig)	-20 @ 1095
Corrosion Allowance (inch)	0.0625
Radiography	RT-1
PWHT Req'd?	Yes
Wind / Seismic Code	ASCE 7-10 / ASCE 7-10
Wind Code	Cf=0.7, V=120 mph, Exp. C, Cat. III
Seismic Code	Site D, I=1.25, S_S=100% , S_1=40%
Insulation	4" H
Fireproof	No
Code	ASME VIII, Div I
Code Stamp Req'd	Yes
Sandblast / Paint	SSPC-SP6 / TRCo Std ENG-36c (Note 3)
Ladder / Platform Clips Req'd?	yes
Pipe Supports Req'd?	yes

PROCESS DESIGN

Operating Pressure (psia)	959 / 989
Operating Temperature (°F)	NOTE 1
Vapor Flow (Lb/Hr)	139,198
Vapor Density (Lb/cf)	3.176
Liquid Flow (Lb/Hr)	none
Liquid Density (Lb/cf)	-----
Liquid Residence Time (Min)	N/A

MIST PAD

Req'd :	No	Diameter:	
Overall Thk:		Pad Thk:	
Removable:		Grid Matl:	
Wire Diameter:		Mesh Matl:	

MATERIAL SPECIFICATIONS

Shell	SA-	516-70N
Head	SA-	516-70N
Nozzle Necks	SA-	106B
Flanges	SA-	350-LF2
Couplings	SA-	105
Studs	SA-	193-B7
Nuts	SA-	194-2H
Skirt / Baseplate	SA-	516-70

NOZZLES

SERVICE	MK	QTY	SIZE	RATING	FACE & TYPE	NOZZLE APPURTENANCES
Inlet	A	1	8."	600	RF FLG	w/ stinger pipe and diverter plate
Outlet	B	1	8."	600	RF FLG	
Fill / Manway	C	1	18."	600	RF FLG	
Dump	D	1	18."	600	RF FLG	Blind & Davit
TI	E	2	.75"	6000	CPLG	

INTERNALS AND APPURTENANCES

MOLE SIEVE	Type & Size	Bed Height (ft.)	Pounds	INERTS	Size	Volume (cf)
Top	▲ Consult Mole Sieve Supplier for Final Design			Top	Denstone P-P2	17
Middle						
Bottom				Bottom	Denstone P-P1	17

Cycles	Drying	68	Platepack Length (inch):	Qty Break Flg Pairs:
	Regen (Heat / Cool)	7 / 2	Total Ladder Length (ft):	Qty of Hat Trays:

NOTES:
1) Vessel operating temperature will be 70 F for 68 hours and 450 F for 7 hours in each 34 hour regen cycle. Cycles will be continuous throughout the 20 year life of the vessel.
2) Provide bed supports per TRCo ES-13P. Common platform for all two (2) vessels & one (1) ladder req'd. Vendor to provide support lugs on top head.
3) Use TRCo Painting System 2 with a Top Coat 4) Duplicate of PO 206-3

Weir Plate:	No
Wave Baffle:	No
Nat'l Board Req'd:	Yes
Charcoal Bed Height (ft):	
Qty Catalyst bed Supports:	One

REVISION	3	▲ 4	1	2		
ENGINEER/DATE	TKF 7/11/13	JSR 05/11/16	BH 11/21/11	TKF 10/29/12		
ISSUED FOR	Revised	Revised	Revised	Revised		

Since 1910
BOARDMAN
1135 South McKinley Ave * Oklahoma City, Oklahoma 73108
(405) 634-5434 * Fax (405) 632-6948
STEEL & ALLOY PLATE FABRICATION * PRESSURE VESSELS AND FCCU COMPONENTS

DATA RECORD BOOK

FOR

UOP RUSSELL LLC

PURCHASE ORDER NUMBER: 4500754152
PROJECT NUMBER: J447XX
ITEM NUMBER: V-442
DESCRIPTION: 78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR

MANUFACTURER:

BOARDMAN, LLC.
1135 SOUTH McKINLEY
OKLAHOMA CITY, OK.

BOARDMAN LLC ORDER NUMBER: 70699
BOARDMAN LLC SERIAL NUMBER: 70699-A
NATIONAL BOARD NUMBER: 3979

BOARDMAN, INC.

V-442

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1. Code Data Report
2. Nameplate
3. Inspection Test Plan
4. Hydrostatic Test Report
5. PWHT
6. Non-Destructive Examination
7. Material Test Reports/Certs
8. Design Calculations
9. Vessel Drawings
10. L&P Drawings

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: Boardman, LLC 1135 South McKinley Oklahoma City, OK 73108
(Name and address of Manufacturer)

2. Manufactured for: UOP Russell LLC 7050 South Yale, Suite 210 Tulsa, Oklahoma 74136
(Name and address of Purchaser)

3. Location of installation: UOP Russell LLC 5380 Arkansas Road Port of Catoosa, Oklahoma 74015
(Name and address)

4. Type: Vertical (Horizontal or vertical, tank) | 70699-A (Manufacturer's serial number) | n/a (CRN) | 21564 (Drawing number) | 3979 (National Board number) | 2017 (Year built)

5. ASME Code, Section VIII, Division 1: 2015, No Addenda [Edition and Addenda, if applicable (date)] | ----- (Code Case numbers) | ----- [Special service per UG-120(d)]

6. Shell: SA516-70N (Material spec. number, grade) | 2.375" (Nominal thickness) | 0.0625" (Corr. allow.) | 6'-6" (Inner diameter) | 24'-4" Tangent/Tangent [Length (overall)]

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

7. Seams: Welded, Dbl-Butt [Long. (welded, dbl., sngl., lap, butt)] | Full [R.T. (spot or full)] | 100 (Eff., %) | 1,150° F. (H.T. temp.) | 2.25 (Time, hr) | Welded, Dbl-Butt [Girth (welded dbl., sngl., lap, butt)] | Full [R.T. (spot or full)] | 100 (Eff., %) | 3 (No. of courses)

8. Heads: (a) Material: SA516-70N (Spec. no., grade) (b) Material: SA516-70N (Spec. no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	Top	2.2752"	0.0625"	-----	-----	2:1	-----	-----	-----	Concave
(b)	Bottom	2.2752"	0.0625"	-----	-----	2:1	-----	-----	-----	Concave

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)												
(b)												

9. MAWP: 1,095 psig (Internal) | n/a (External) at max. temp. 600° F. (Internal) | n/a (External)
Min. design metal temp. (-)20° F. at 1,095 psig. Hydro., ~~pneu., or comb.~~ test pressure 1,424 psig
Proof test n/a.

10. Nozzles, inspection, and safety valve openings:

Purpose (Inlet, Outlet, Drain etc.)	No.	Diameter or Size	Type	Material: Nozzle	Material: Flange	Nozzle Thickness: Nom.	Nozzle Thickness: Corr.	Reinforcement Material	Attachment Details: Nozzle	Attachment Details: Flange	Location (Insp. Open.)
B - Outlet	1	8" CL. 600	RF/WN	*	SA350-LF2	Sch. 80	0.0625"	SA516-70N	UW-16(e)	Full Pen.	-----
C - Fill / Manway	1	18" CL. 600	RF/V2	SA350-LF2	SA350-LF2	-----	0.0625"	-----	UW-16(e)	-----	Top Head
D - Dump	1	18" CL. 600	RF/V3	SA350-LF2	SA350-LF2	-----	0.0625"	-----	UW-16(e)	-----	-----
E1~2 - TI	2	3/4" 6000#	CPLG	SA105	-----	-----	0.0625"	-----	UW-16(a)	-----	-----

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

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: Partial Data Reports from P & M Industries, Inc. for shells with S/N 1701033-2 and 1701033-3
(Name of part, item number, Manufacturer's name and identifying stamp)

* - SA350-LF2/SA234-WPB/SA106-B Mol Sieve Dehydrator S/N 70699-A. Yes, Charpy Impact Tests req'd per UG-84 to (-)20° F. on heads, shells, and repad. SA350-LF2 nozzles are tested per UCS-66(g). SA105 nozzles are exempt per UCS-66(b)(3). SA106-B pipe exempt per Fig. UCS-66, Curve B. Customer shall provide this vessel with an overpresure protective device per UG-125 through UG-136 prior to placing vessel in service.

FORM U-1A (Back)

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 2847 expires Oct. 25, 2019 .

Date 6-1-17 Co. name Boardman, LLC (Manufacturer) Signed (Representative)

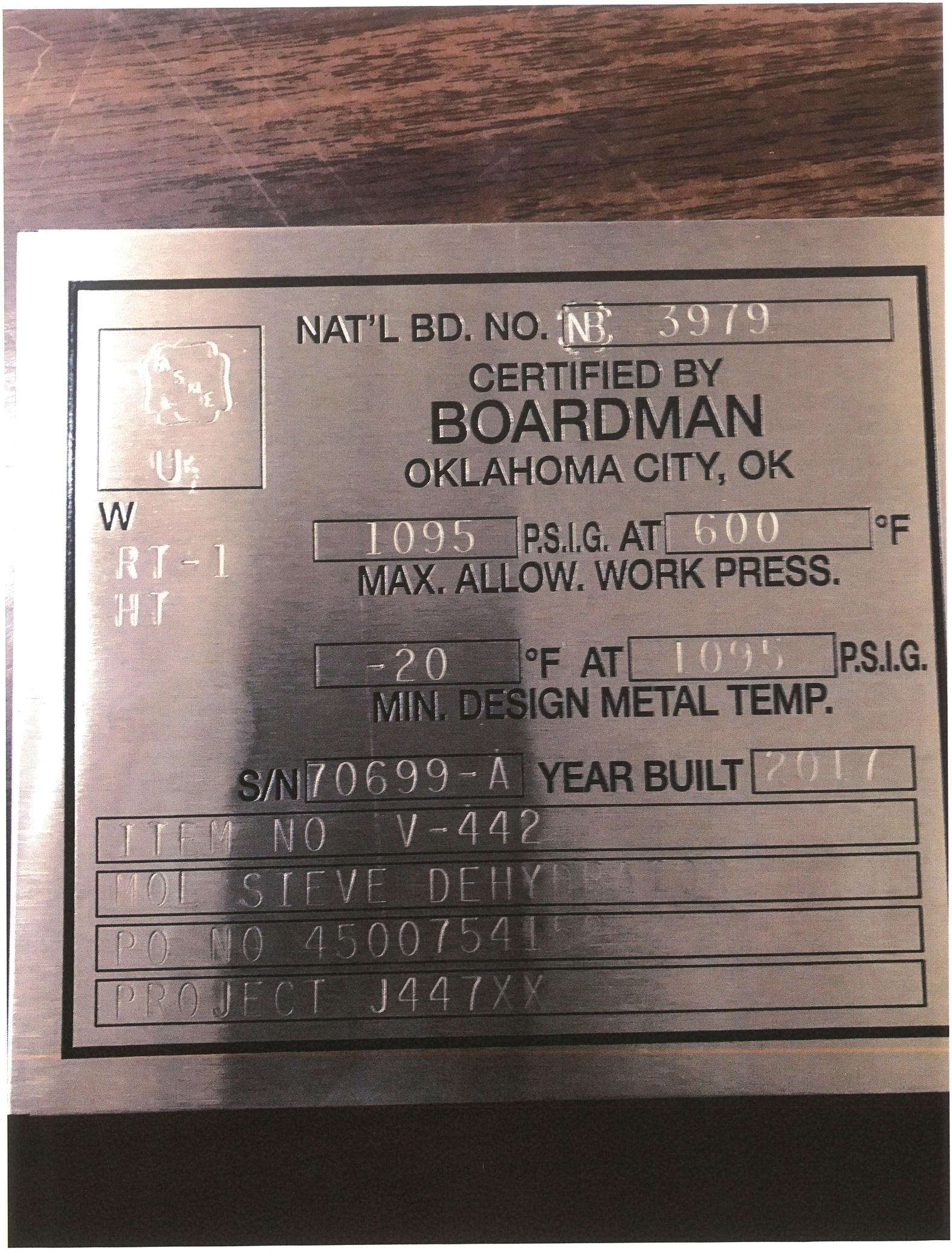
CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Boardman, LLC at Oklahoma City, Oklahoma 73108

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 5-16-17 , 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 6-1-17 Signed (Authorized Inspector) Commissions NB-7936 A/IS OK# 263 [National Board (incl. endorsements)]

(07/13)


NAT'L BD. NO. NB 3979
CERTIFIED BY
BOARDMAN
OKLAHOMA CITY, OK
W
RT-1
HT
1095 P.S.I.G. AT 600 °F
MAX. ALLOW. WORK PRESS.
-20 °F AT 1095 P.S.I.G.
MIN. DESIGN METAL TEMP.
S/N 70699-A YEAR BUILT 2017
ITEM NO V-442
MOL SIEVE DEHY
PO NO 4500754
PROJECT J447XX

BOARDMAN Since 1910

INSPECTION PLAN

JOB NO. 70699-A VESSEL UOP ITEM NO. V-442 N.B. NO. _____

P.O. NO. 4500754152

A.I. REVIEW MH 2-24-2017

DESCRIPTION	BOARDMAN	DATE	CUST.	A.I.
Per-fab Meeting				
*1. Material and MTRs/CERTs received.				
2. Impact test received.				
*3. Drawing and design cals received. *				MH 2-24-17
4. Are welders and welding operators qualified *(Welders to stencil their identification at welds)*				
5. Have edges been properly prepared, cleaned and visually accepted.				
6. Have shells and heads been properly fitted *(Alignment Tolerances UG-80, UW-31, 32 & 33)*				
7. Back-up passes complete and visually examined.				
8. Back-gouge and or back-grinding of vessel long seams visually examined and accepted as required.				
9. Back-gouge and or back-grinding of vessel girth seams visually examined and accepted as required				
10. Long seam final welds visually examined and accepted.				
11. Girth seam fianl welds visually examined and accepted.				
12. Roundness of shell checked (UG-79,80)				
*13. Radiographs accepted (full, part ____other _____) RT-1				
14. Nozzle layout checked. Shell_____Heads_____				
15. Nozzle fit-up and weld preparation examined and accepted.				
16. Back-gouge and or back-gringing nozzles visually examined and accepted as required.				
17. Final nozzle welds visually examined and accepted.				
18. Fit-up of reinforcing pads examined and accepted.				
19. Final reinforcing pad welds visually examined and accepted.				
**20. Air test of reinforcing pads accepted.				
*21. Internal inspection UG 97 (1) *			UOP MH 5/10/17 QC	5.10.17
22. Visual inspection of final welds.				
23. Final Dimensional				
24. Vessel Released for Heat Treat				
**25. Vessel received after heat treat w/chart				
**26. M.T. of lifting lugs				
*27. Vessel hydrostatic tested and accepted. *			H	5.16.17
*28. Sign and date data report. *				6.1.17
**29. Blast examined and accepted prior to coating.				
30. Fianl paint examined and accepted.				
31. Proper name and test plates attached to vessel				
**32.Verification of final shipping.				

*MANDATORY CHECK POINTS FOR CODE INSPECTION

**BOARDMAN Q.C.

Note: Columns under Boardman heading left blank for inital and date of acceptance.

Note: Other checks not indicated for Boardman Q.C. may be by foreman or leadman.

H = Hold Point

W = Witness Point

I = Inspect

R = Report

RV = Review

BOARDMAN Since 1919

INSPECTION PLAN

JOB NO. 70699-A VESSEL UOP ITEM NO. V-442 N.B. NO. _____

P.O. NO. 4500754152

A.I. REVIEW _____

DESCRIPTION	BOARDMAN	DATE	CUST.	A.I.
Per-fab Meeting				
*1. Material and MTRs/CERTs received.		3-31-17		
2. Impact test received.		4-7-17		
*3. Drawing and design cals received. *		1-16-17		
4. Are welders and welding operators qualified *(Welders to stencil their identification at welds)*		3-27-17		
5. Have edges been properly prepared, cleaned and visually accepted.		3-31-17		
6. Have shells and heads been properly fitted *(Alignment Tolerances UG-80, UW-31, 32 & 33)*		4-28-17		
7. Back-up passes complete and visually examined.		5-1-17		
8. Back-gouge and or back-grinding of vessel long seams visually examined and accepted as required.	NA			
9. Back-gouge and or back-grinding of vessel girth seams visually examined and accepted as required		5-1-17		
10. Long seam final welds visually examined and accepted.		5-8-17		
11. Girth seam fianl welds visually examined and accepted.		5-8-17		
12. Roundness of shell checked (UG-79,80)		4-28-17		
*13. Radiographs accepted (full) part ____ other _____) RT-1		5-4-17		
14. Nozzle layout checked. Shell 4-4-17 Heads 3-27-17		5-8-17		
15. Nozzle fit-up and weld preparation examined and accepted.		4-5-17		
16. Back-gouge and or back-gringing nozzles visually examined and accepted as required.		4-7-17		
17. Final nozzle welds visually examined and accepted.		5-8-17		
18. Fit-up of reinforcing pads examined and accepted.		5-4-17		
19. Final reinforcing pad welds visually examined and accepted.		5-8-17		
**20. Air test of reinforcing pads accepted.		5-16-17		
*21. Internal inspection UG 97 (1) *		5-8-17		
22. Visual inspection of final welds.		5-8-17		
23. Final Dimensional		5-8-17	H	
24. Vessel Released for Heat Treat		5-10-17		
**25. Vessel received after heat treat w/chart		5-12-17		
**26. M.T. of lifting lugs		5-12-17		
*27. Vessel hydrostatic tested and accepted. *		5-16-17	H	
*28. Sign and date data report. *		6-1-17		
**29. Blast examined and accepted prior to coating.		5-19-17		
30. Fianl paint examined and accepted.		5-22-17		
31. Proper name and test plates attached to vessel		5-22-17		
**32.Verification of final shipping.		5-24-17		

*MANDATORY CHECK POINTS FOR CODE INSPECTION

**BOARDMAN Q.C.

Note: Columns under Boardman heading left blank for inital and date of acceptance.

Note: Other checks not indicated for Boardman Q.C. may be by foreman or leadman.

H = Hold Point

W = Witness Point

I = Inspect

R = Report

RV = Review

Since 1910

BOARDMAN

FINAL INSPECTION COMPLETION

This order has been confirmed to be ready for shipment by Boardman QA/QC
Note: This is not release for shipment. Shipping release may need to be obtained from the customer.

Boardman P.O.# 4500754152	Customer: UOP RUSSELL	Project# J447XX	Boardman Job# 70699-A & 70669-B
Item # V-442 and V-443	Vessel Decription: MOL SIEVE DEHYDRATOR		

ITEM/ TAG No.	QUANTITY	FINAL INSPECTION ACCEPTED	DESCRIPTION
V-442	1	A	MOL SIEVE DEHYDRATOR
V-443	1	A	MOL SIEVE DEHYDRATOR

BOARDMAN INSPECTOR'S NAME: JAMES JOHNSON DATE: 5/24/2017

BOARDMAN INSPECTORS SIGNATURE AND DATE: James Johnson 5-24-17

CUSTOMER INSPECTOR SIGNATURE AND DATE: 5/24/17

EXCEPTANCE STATUS: BY SIGNING ABOVE, I acknowledge that the fabricated equipment has been inspected and accepted. The equipment is ready for shipping on the agreed upon date between the buyer and seller.

A. NO APPARENT DEFECTS NOTED: BOARDMAN QA/QC HAS COMPLETED FINAL INSPECTION. THIS ORDER IS NOW READY TO SHIP.

B. MINOR DEFECTS NOTED: BOARDMAN TO REMEDY DEFECTS. BOARDMAN QA/QC SHALL CONFIRM THAT DEFECTS HAVE BEEN REMEDIED BY SIGNING BELOW ON THIS FORM. A COPY OF THE SIGNED FORM SHALL BE SAVED IN BOARDMAN QA/QC FILES AND A COPY SENT TO CUSTOMER, BOARDMAN ACCOUNTING, PROJECT MANAGER, MANUFACTURING MANAGER, QA/QC MANAGER AND SHIPPING & RECEIVING FOR FINAL ACCEPTANCE.

MINOR DEFECTS NOTED IF ANY:

:

BOARDMAN QA/QC CONFIRMS THAT DESCRIBED MINOR DEFECTS HAVE BEEN REMEDIED AND REQUESTS AUTHORIZATION TO SHIP THE SPECIFIC ITEMS LISTED ABOVE.

BOARDMAN QA/QC SIGNATURE: _____ TITLE: _____

PRINT NAME: _____ DATE: _____

BOARDMAN since 1910

HYDROSTATIC TEST CERTIFICATION

DATE: 5/16/2017

JOB NO. 70699-A

CUSTOMER: UOP RUSSELL

SER. NO. 70699-A

P.O. NUMBER: ~~4500754152~~ 4500754152

F. TEST 1,424 PSI

CUSTOMER ITEM NO. V-442

This vessel was Hydrostatic tested for a period of 1 hour minimum to the above listed pressure using

Gauge No. 2001 and 2007 Calibrated 7/15/2017 No leaks were found.

MANAGER, QUALITY CONTROL

NATIONAL BOARD INSPECTOR

7/B7936

COMMISSIONS

NOTE: GAUGES ARE CALIBRATED PERIODICALLY OR ANYTIME A GAUGE IS NOT FUNCTIONING PROPERLY.

BOARDMAN

HYDROSTATIC TEST CERTIFICATION

DATE: 5/17/2017

JOB NO. 70699-A DC-2

CUSTOMER: UOP RUSSELL

SER. NO. 70699-A DC-2

P.O. NUMBER: 4500754152

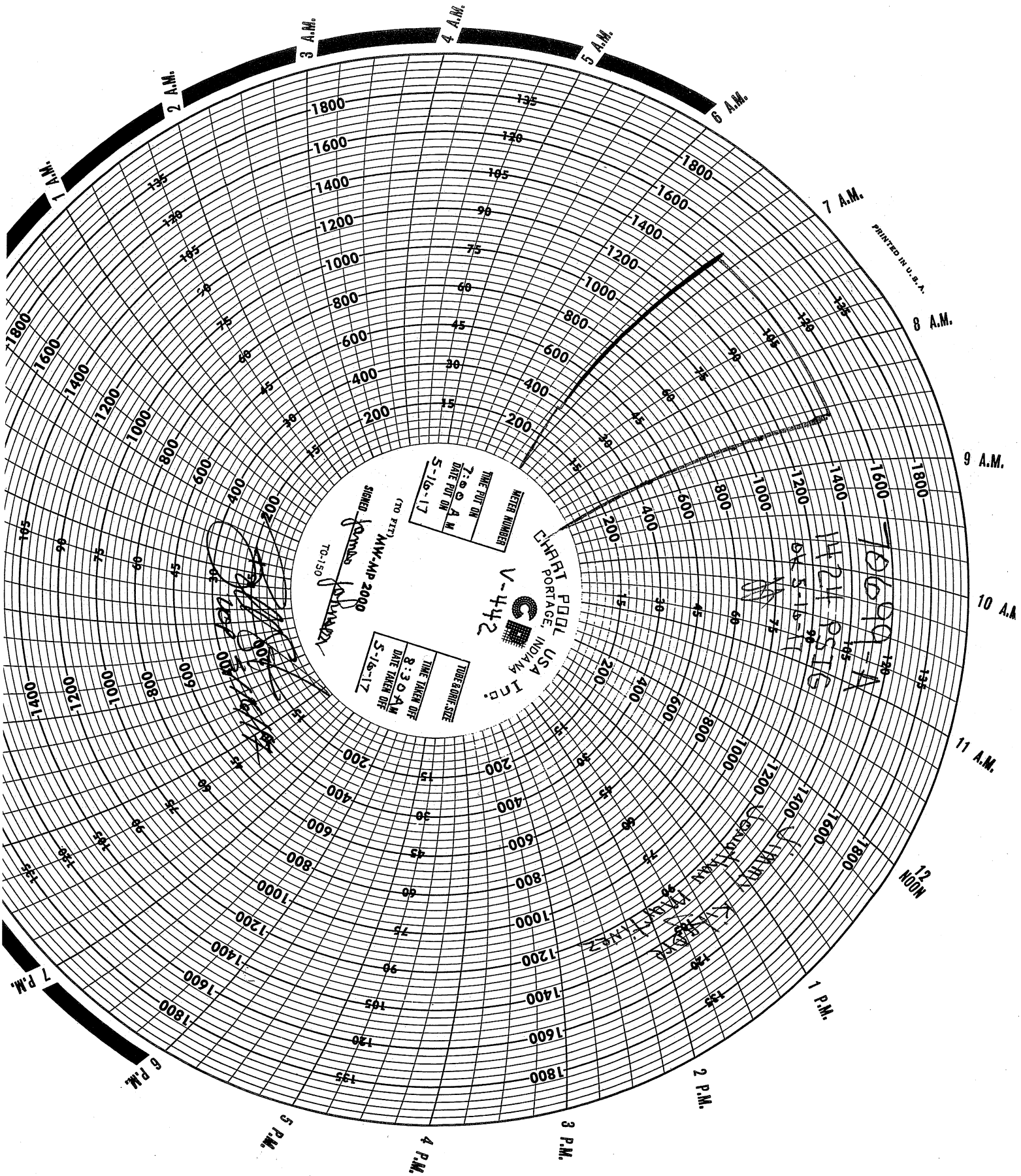
F. TEST 1,643 PSI

CUSTOMER ITEM NO. V-442

This vessel was Hydrostatic tested for a period of 1 hour minimum to the above listed pressure using Gauge No. 2001 and 2007 Calibrated 7/15/2017 No leaks were found.

James Johnson
MANAGER, QUALITY CONTROL

NOTE: GAUGES ARE CALIBRATED PERIODICALLY OR ANYTIME A GAUGE IS NOT FUNCTIONING PROPERLY.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10 A.M.
11 A.M.
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USA
Inc.
V-424
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5-16-17
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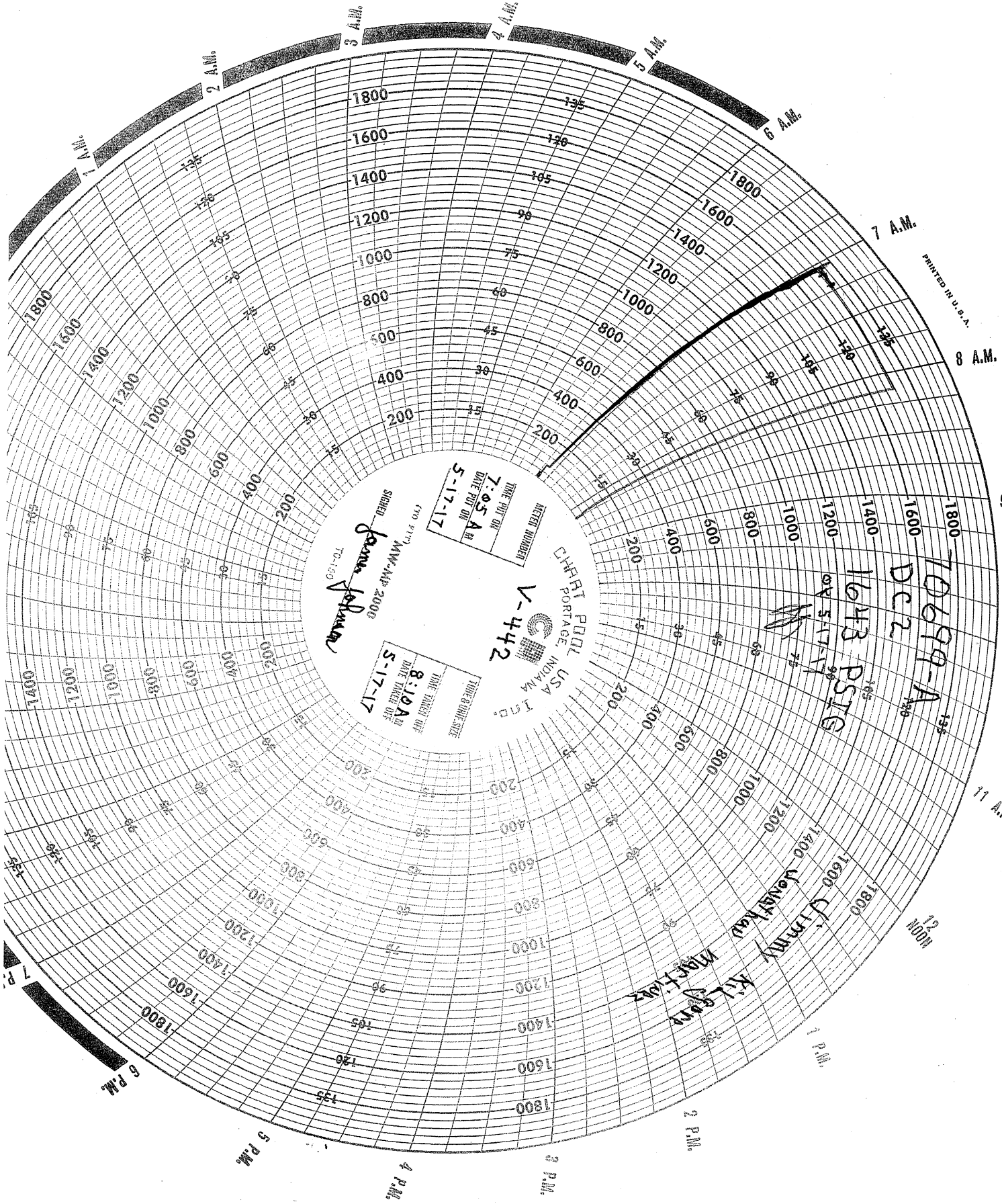
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PORTAGE, INDIANA USA INC.
V-442
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DATE PUT ON
5-17-17
TIME TAKEN OFF
TIME & DATE SEAL
DATE TAKEN OFF
5-17-17
SIGNED
MAW-MP 2000
TC-150
10698-A
DC2
1643 PSTD
GAS-VOL
Kitchen
Master Bdr
Library
Dining
Living Room

Bodycote

Shipment: 55-76532

From:	Sold To:	Shipped To:
Division: 55 **Bodycote Thermal Processing - Pine** 1520 North 170th East Avenue Tulsa, OK 74116	**Customer: 55-2426** **Boardman, Inc. (H)** 1135 S. Mckinley Ave. Oklahoma City, OK 73108 (Fax) 1 (405) 632-6948 (Voice) 1 (405) 634-5434	**Ship To: 55-2426-1** **Boardman, Inc. (H)** 1135 S. Mckinley Ave. Oklahoma City, OK 73108 (Fax) 1 (405) 632-6948 (Voice) 1 (405) 634-5434
Ship Date **5/11/2017 3:50:15 PM**		Bill Of Lading
Shipment Method **CUSTOMER PICK UP**		
Message		
Container(s) =	**1 WP**	
Required Process =	**1150 +/-25 STRESS**	

Order No. 75807 P.O. No. 70699 Recv'd 5/10/2017 4:47:44 AM Shipment COMPLETE

Qty	Part Number	Part Name	Wgt
1	**S/N 70699 V-442** Material and Description **Low Carbon Steel**	**VESSEL AND FLANGE**	**68000**

Totals...

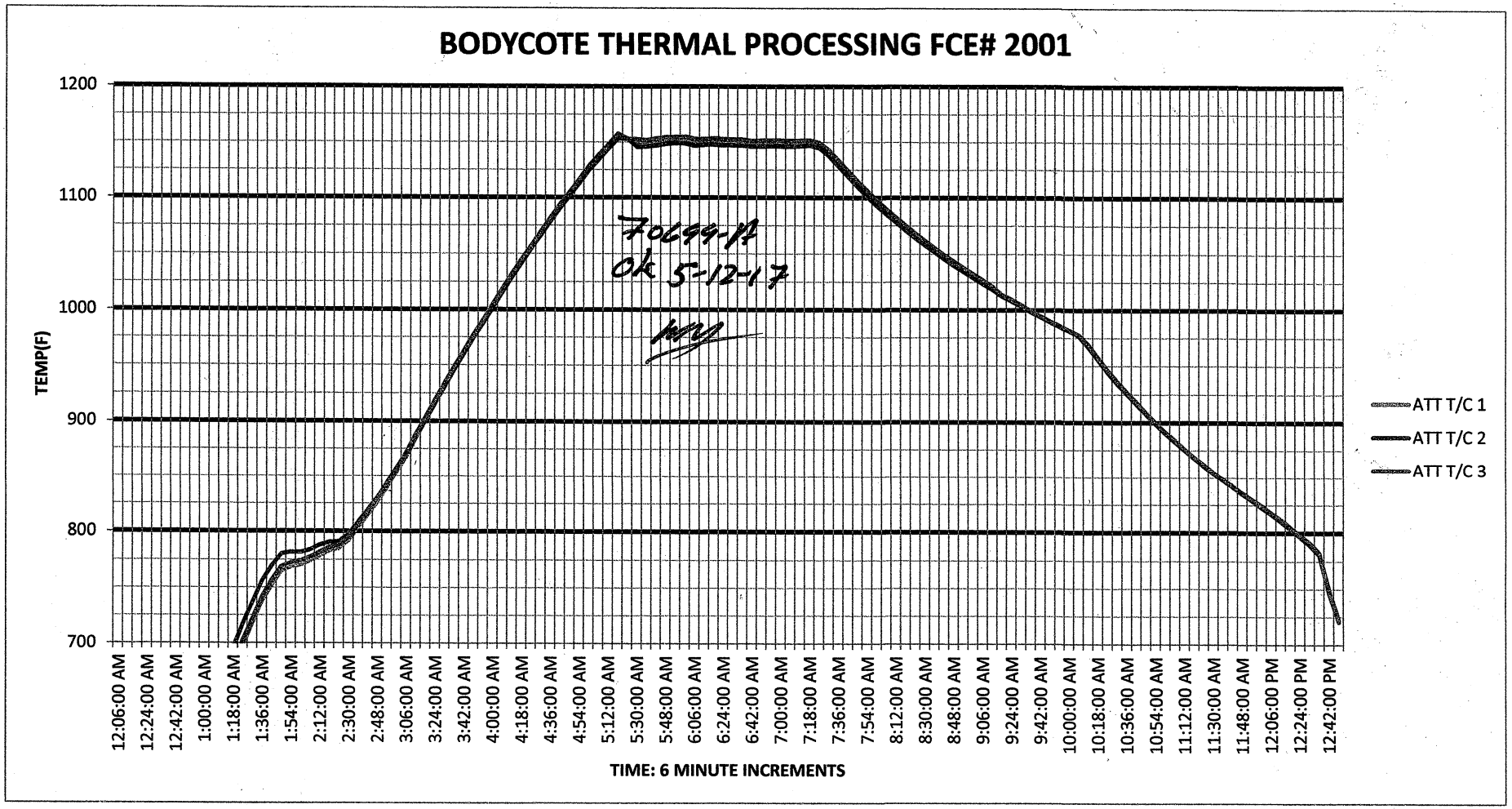
Ttl Qty	Signed For By / Date	Ttl Wgt
1		**68000**

CUSTOMER COPY

BOARDMAN
JOB# 75807
P.O.# 70699

70699 V-442

5/11/17



CALIBRATION DATE 4/6/17
CALIBRATION DUE DATE 7/6/17

SIGNED BY KEN DUVAL

BOARDMAN

QUALITY CONTROL DEPARTMENT

MAGNETIC PARTICLE TEST REPORT

PROCEDURE NO: MT-1 REVISON: 8 JOB NO: 70699-A ITEM NO: V-442

DATE TEST PERFORMED: 05/12/17 TIME TEST PERFORMED: 11:45 A.M.

TESTING PERFORMED IN ACCORDANCE WITH: 2015 ASME SECTION V - ARTICLE 7

IF OTHER, WHICH CODE WAS TESTING PERFORMED IN ACCORDANCE WITH: N/A

MAGNETIC PARTICLE TYPE: VISIBLE MAGNETIC PARTICLE COLOR: YELLOW

WET OR DRY PARTICLES: DRY MAGNETIC YOKE USED: MAGNAFLUX Y-7 AC/DC YOKE

CURRENT TYPE USED ON TEST: AC LIGHTING EQUIPMENT USED: FLASH LIGHT

MATERIAL TYPE: SA-516 GRADE 70 IF OTHER, WHAT MATERIAL TYPE:

MATERIAL THICKNESS (IN INCHES): 1-1/2 IF OTHER, WHAT MATERIAL THICKNESS: 1/2"

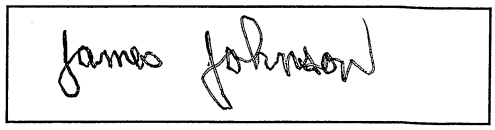
ITEMS CHECKED: Lifting lug and lift lug pad, MK 2-32 and MK 2-31.

RESULTS: MT acceptable per. ASME SECTION VIII - APPENDICES 6 2015

I, THE UNDERSIGNED, CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE WELDS AND/OR PIECES WERE EXAMINED IN ACCORDANCE WITH THE REQUIREMENTS OF THE ABOVE FABRICATION CODE AND ACCEPTANCE STANDARDS.

TECHNICIAN: JAMES JOHNSON LEVEL: II

SIGNATURE



DATE: 5/12/2017

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

CUSTOMER: *AMERICAN PIPING INSPECTION* **Job No.** 70699-A
Code: *ASME SEC VIII* **Date** 3/2/2017
Spec.: UW 51 100% RADIOGRAPHY **Page** 1 Page 1
No. of Radiographs: **Original Film** 12 Rep. Film

Source	Ir192 ■ Co60 □	Dev. Process: Man. □ Auto ■		Unsharpness	<.020
Curies	59	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.146	Source to Film	4.313 "	Mat. Type	P1
Film Type	Fuji- 80	Minimum Source to Object	3.688 "	Mat. Thickness	0.500
Film Class	I	(Source side of object to film distance	0.625 "	Weld Reinforcement	0.125 "
Film Size	3 1/2 X 17	at min. S.T.O)		Total Pene. Thickness	0.625 "

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Density	Discontinuities	Accept	Reject
1	DCA1 W1	T - 2	1		BF	X														✓	
2		2 - 3																		✓	
3		3 - T																		✓	
4	DCA1 W2	T - 2																		✓	
5		2 - 3																		✓	
6		3 - T																		✓	
7	DCA1 W3	T - 2																		✓	
8		2 - 3																		✓	
9		3 - T																		✓	
10	DCA1 W4	T - 2																		✓	
11		2 - 3																		✓	
12		3 - T																		✓	
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RADIOGRAPHER *Chris Burgett* Lev. II

INTERPRETER; ACCEPTANCE; NDT LEVEL: [signature] Lev. II Date: 3-3-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

CUSTOMER: *AMERICAN PIPING INSPECTION*
Code: *ASME SEC VIII*
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-A
Date 3/3/2017
Page 1 Page 1
No. of Radiographs: Original Film 12 Rep. Film

Source	Ir192 ■ Co60 □	Dev. Process: Man. □ Auto ■		Unsharpness	<.020
Curies	94	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.146	Source to Film	4.313 "	Mat. Type	P1
Film Type	Fuji- 80	Minimum Source to Object	3.688 "	Mat. Thickness	0.500
Film Class	I	(Source side of object to film distance	0.625 "	Weld Reinforcement	0.125 "
Film Size	3 1/2 X 17	at min. S.T.O)		Total Pene. Thickness	0.625 "

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No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Density	Discontinuities	Accept	Reject
1	DCA2 W5	T - 2	1		BF	X														✓	
2		2 - 3																		✓	
3		3 - T																		✓	
4	DCA2 W6	T - 2																		✓	
5		2 - 3																		✓	
6		3 - T																		✓	
7	DCA2 W9	T - 2																		✓	
8		2 - 3																		✓	
9		3 - T															✓		Scratch	✓	
10	DCA2 W10	T - 2																		✓	
11		2 - 3																		✓	
12		3 - T																		✓	
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RADIOGRAPHER *Chris Burgett* Lev. II

INTERPRETER; ACCEPTANCE; NDT LEVEL: Lev. II Date: 3-6-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

CUSTOMER: *AMERICAN PIPING INSPECTION* | **Job No.** 70699-A
Code: *ASME SEC VIII* | **Date** 3/16/2017
Spec.: UW 51 100% RADIOGRAPHY | **Page** 1 Page 1
No. of Radiographs: **Original Film** 6 Rep. Film

Source	Ir192 ■ Co60 ☐	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	52	RT Technique	DWR/SWV	Screens	Pb. .010
Focal Spot	0.146	Source to Film	8.625 "	Mat. Type	P1
Film Type	Fuji- 80	Minimum Source to Object	8.000 "	Mat. Thickness	0.500
Film Class	I	(Source side of object to film distance	0.625 "	Weld Reinforcement	0.125 "
Film Size	3 1/2 X 17	at min. S.T.O)		Total Pene. Thickness	0.625 "

J/T

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Density	Discontinuities	Accept	Reject
1	DC-2A W7	T - 2	1		BF	X														✓	
2		2 - 3																		✓	
3		3 - T																		✓	
4	DC-2A W8	T - 2																		✓	
5		2 - 3																		✓	
6		3 - T																		✓	
7																					
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RADIOGRAPHER *Chris Burgett* Lev. II

INTERPRETER; ACCEPTANCE; NDT LEVEL: Lev. II Date: 3-17-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

	Advanced Inspection Technologies	**Job No.**	70699-A
Code:	***ASME SEC VIII***	**Date**	3/6/2017
Spec.:	UW 51 100% RADIOGRAPHY	**Page**	1 Page 1
		No. of Radiographs:	**Original Film** 3 Rep. Film

Source	Ir192 ■ Co60 ☐	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	92	RT Technique	DWR/SWV	Screens	Pb. .010
Focal Spot	0.146	Source to Film	2.375 "	Mat. Type	P1
Film Type	Fuji- 29	Minimum Source to Object	1.907 "	Mat. Thickness	0.343
Film Class	I	(Source side of object to film distance	0.468 "	Weld Reinforcement	0.125 "
Film Size	70mm X 6	at min. S.T.O)		Total Pene. Thickness	0.468 "

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Density	Discontinuities	Accept	Reject
1	DCA2 W11	T - 2	1		BF	X														✓	
2		2 - 3																		✓	
3		3 - T																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETER; ACCEPTANCE; NDT LEVEL: James Johnson Lev. II Date: 3-7-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

AMERICAN PIPING INSPECTION

Code: ASME SEC VIII DIV 1
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-A
Date 4/26/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 19 **Rep. Film**

Source	Ir192 ☐ Co60 ■	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	115	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.212	Source to Film	41.500 "	Mat. Type	P1
Film Type	Fuji- 100	Minimum Source to Object	39.000 "	Mat. Thickness	2.375
Film Class	II	(Source side of object to film distance	2.500 "	Weld Reinforcement	0.125 "
Film Size	7 X 17	at min. S.T.O)		Total Pene. Thickness	2.500 "

SS/G

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Densities	Discontinuity	Accept	Reject
1	G1	1 - 2	1		C	X														✓	
2		2 - 3																		✓	
3		3 - 4																		✓	
4		4 - 5																		✓	
5		5 - 6																		✓	
6		6 - 7																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETATION / ACCEPTANCE BY Lev. II Date: 4-27-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

AMERICAN PIPING INSPECTION

Code: ASME SEC VIII DIV 1
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-A
Date 4/26/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 19 **Rep. Film**

Source	Ir192 ☐ Co60 ■	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	115	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.212	Source to Film	41.500 "	Mat. Type	P1
Film Type	Fuji- 100	Minimum Source to Object	39.000 "	Mat. Thickness	2.375
Film Class	II	(Source side of object to film distance	2.500 "	Weld Reinforcement	0.125 "
Film Size	7 X 17	at min. S.T.O)		Total Pene. Thickness	2.500 "

SS/F

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Densities	Discontinuity	Accept	Reject
1	G2	1 - 2	1		C	X														✓	
2		2 - 3																		✓	
3		3 - 4																		✓	
4		4 - 5																		✓	
5		5 - 6																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETATION / ACCEPTANCE BY James Johnson Lev. II Date: 4-27-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

AMERICAN PIPING INSPECTION

Code: ASME SEC VIII DIV 1
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-A
Date 4/26/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 19 **Rep. Film**

Source	Ir192 ☐ Co60 ■	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	115	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.212	Source to Film	41.500 "	Mat. Type	P1
Film Type	Fuji- 100	Minimum Source to Object	39.000 "	Mat. Thickness	2.375
Film Class	II	(Source side of object to film distance	2.500 "	Weld Reinforcement	0.125 "
Film Size	7 X 17	at min. S.T.O)		Total Pene. Thickness	2.500 "

SS/N/F

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Densities	Discontinuity	Accept	Reject
1	G3	1 - 2	1		C	X														✓	
2		2 - 3																		✓	
3		3 - 4																		✓	
4		4 - 5																		✓	
5		5 - 6																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETATION / ACCEPTANCE BY [signature] Lev. II Date: 4-27-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

AMERICAN PIPING INSPECTION

Code: ASME SEC VIII DIV 1
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-A
Date 5/3/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 19 **Rep. Film**

Source	Ir192 ☐ Co60 ■	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	115	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.212	Source to Film	41.500 "	Mat. Type	P1
Film Type	Fuji- 100	Minimum Source to Object	39.000 "	Mat. Thickness	2.375
Film Class	II	(Source side of object to film distance	2.500 "	Weld Reinforcement	0.125 "
Film Size	4 1/2 X 17	at min. S.T.O)		Total Pene. Thickness	2.500 "

No. of film	Seam No. (SS/G)	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Densities	Discontinuity	Accept	Reject
1	G4	1 - 2	1		C	X														✓	
2		2 - 3																		✓	
3		3 - 4																		✓	
4		4 - 5																		✓	
5		5 - 6																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETATION / ACCEPTANCE BY James Johnson Lev. II Date: 5-4-17

BOARDMAN

JOB NO. 70699-A	Contract #	PO: 4500754152		DATE:	5/19/2017
INSPECTOR: BILLY SKILES		JOB NAME:	MOL SIEVE DEHYDRATOR		
Description of Work: BLAST AND PAINT		ITEM #	V-442	PROJECT: #	J447XX

SPECIFICATION: SSPC-SP10 1.5 - 3 MILS DFT

PREBLAST

INSPECT FOR WELD SPLATTER, SHARP EDGES					
INSPECT FOR SURFACE GREASE & OILS					

Testex PRESS-O-FILM™ HT X-Coarse
www.testextape.com
2.5 (C + XC) / 2
20 C 38 64 XC 115 µm
0.8 1.5 2.5 4.5 mil
1.5 to 4.5 mil
38 to 115 µm
Made in USA

BLASTING			PAINTING		
				PRIMER	
COMPRESSED AIR CLEANLINESS	ok		PAINT		
			type	zinc clad #2	
ANCHOR PATTERN	2.5		brand	sherwin williams	
			batch #	6303234	
SURFACE TEMPERATURE	53		pot life	8 hours	
AMBIENT TEMPERATURE	53		THINNER		
			type	n/a	
RELATIVE HUMIDITY	77%		brand	n/a	
WORKPLACE CLEANED OF SAND & DUST	ok		SURFACE TEMPERATURE	53	
DEW POINT	42		AMBIENT TEMPERATURE	53	
			RELATIVE HUMIDITY	77%	
			DRY FILM THICKNESS	2	
			DEW POINT	44	

Testex PRESS-O-FILM™ HT X-Coarse
www.testextape.com
2.5 (C + XC) / 2
20 C 38 64 XC 115 µm
0.8 1.5 2.5 4.5 mil
1.5 to 4.5 mil
38 to 115 µm
Made in USA

Testex PRESS-O-FILM™ HT X-Coarse
www.testextape.com
2.5 (C + XC) / 2
20 C 38 64 XC 115 µm
0.8 1.5 2.5 4.5 mil
1.5 to 4.5 mil
38 to 115 µm
Made in USA

Testex PRESS-O-FILM™ HT X-Coarse
www.testextape.com
2.0 (C + XC) / 2
20 C 38 64 XC 115 µm
0.8 1.5 2.5 4.5 mil
1.5 to 4.5 mil
38 to 115 µm
Made in USA

James Johnson
QC BOARDMAN, LLC.

BOARDMAN

JOB NO.	70699-A	Contract #	PO: 4500754152	DATE:	5/20/2017
INSPECTOR:	BILLY SKILES	JOB NAME:	MOL SIEVE DEHYDRATOR		
Description of Work:	TOP COAT	ITEM #	V-442	PROJECT: #	J447XX

SPECIFICATION: 2 - 4 MILS ZINC 1 - 2 MILS ALUMINUM

PREBLAST

INSPECT FOR WELD SPLATTER, SHARP EDGES		
INSPECT FOR SURFACE GREASE & OILS		

BLASTING		PAINTING	ZINC	ALUMINUM
COMPRESSED AIR CLEANLINESS	N/A	PAINT		
		type	hi-temp aluminum	
ANCHOR PATTERN	N/A	brand	sherwin williams	
		batch #	600201032	
SURFACE TEMPERATURE	N/A	pot life	8 hours	
AMBIENT TEMPERATURE	N/A	THINNER		
		type	n/a	
RELATIVE HUMIDITY	N/A	brand	n/a	
WORKPLACE CLEANED OF SAND & DUST	N/A	SURFACE TEMPERATURE		71
DEW POINT	N/A	AMBIENT TEMPERATURE		71
		RELATIVE HUMIDITY		42%
		DRY FILM THICKNESS		1.5
		DEW POINT		45

James Johnson
QC BOARDMAN, LLC.

Top and Bottom Heads MK 1-1

QM-System: Certification as per ISO 9001

DILLINGER HÜTTE

Erläuterungen siehe Rückseite/Explications voir au verso/See reverse for explanations (www.dillinger.de/certificate)

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004
INSPECTION CERTIFICATE 3.1 AS PER ISO 10474:2013
MATERIAL TEST REPORT (MTR)

A10 Advice of dispatch No./ Date of dispatch: 521853-17.02.15

A08/ Manufacturer's order/ A03 Certificate No.: 400961-001 Sheet: 1/...

A05 Established Inspecting body: DH

A06 Purchaser: EDMONTON STEEL, EDMON A07.1 No. ED10661-J1010ER

Final receiver: EDMONTON STEEL, EDMON A07.2 No.

B01 Product: HEAVY PLATES

19650

B02/ Steel design. SA516-70 SA20-S5

B03 Any suppl. requirements: ASME-IIA:2013
DIL-HUE-16:R23-2014-04-04

B01-B99 Description of the product

B14 Item No.	B08 Number of pieces	B09 Thickness	B10 Width	B11 Length	B12 Theoretical mass KG	B04 Product delivery condition	B07.2 Heat No.	B07.1 Rolled plate No./ Test No.	A09 Purchaser article number
			INCH						
01	1	2,5000 x	121,00000 x	482,00000	18756	N	417580	51027-01	
***	1				18756				

RECEIVED
FEB 13 2017
ZVS
Z. SEESE

B04 Product delivery condition

ITEM NO.: 01
N: HT: 1670 GR.F +36 -27 GR.F
SOAKING TIME TO ATTAIN THE TARGET TEMPERATURE OVER THE WHOLE SECTION: 1-1,75 MIN/MM (25-45 MIN/INCH)
COOLING IN STILL AIR

B06 Marking of the product

ITEM NO.: 01
STEEL DESIGNATION SA516 70 MTLTV SA516 60 MTLTV
HEAT NO. / TRADEMARK / ROLLED PLATE NO.-TEST NO. / INSPECTOR'S STAMP

B07-B99 Further information about the product

ITEM NO.: 01
THICKNESS REDUCTION RATIO >= 3,0 IS FULFILLED (CF. A/SA20 PAR. 5.3)

C10-C29 Tensile test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/ C01	C03 Temp. GR.F	C10	C11 KSI RP02	C12 RM	C13 A % L0=2IN	C14-C15
01	417580	51027		K1	QV	RT		45,0	73,1	35	

A04 D H Manufacturer's mark

Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

DR. CH. KÖNIG
Test House Manager

AHB Inspector's stamp

A01
AG der Dillinger Hüttenwerke
Postfach 1580, D-66748 Dillingen/Saar
Inspection department

Date 18.02.15 PP 1

1 of 3

QM-System: Certification as per ISO 9001

DILLINGER HÜTTE

Erläuterungen siehe Rückseite/Explications voir au verso/See reverse for explanations (www.dillinger.de/certificate)

A02	A10 Advice of dispatch No./ Date of dispatch	A08/ Manufacturer's order/ A03 Certificate No.	Sheet
INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1 AS PER ISO 10474:2013 MATERIAL TEST REPORT (MTR)	521853-17.02.15	400961-001	2/...

A05 Established Inspecting body	A06 Purchaser		A07.1 No.	B01 Product
DH	Final receiver	EDMONTON STEEL,EDMON EDMONTON STEEL,EDMON	ED10661-J1010ER A07.2 No.	HEAVY PLATES

B02/ Steel design. SA516-70 SA20-S5

B03 Any suppl. requirements ASME-IIA:2013
DIL-HUE-16:R23-2014-04-04

C30-C39 Hardness test

B14 Item. No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/C01	C03 Temp. GR.F	C30 Method of test	C35 C31 Individual values			C32 Mean value
01	417580	51027		K1	O	RT	HBW 10/3000	HB 135	136	136	136

C40-C49 Impact test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/ C01	C03 Temp. GR.F	C41 Width of test piece	C40 Type of test piece	C44 Testing method	C46 Energy	C45	C42 Individual values AV=FT.LBF			C43 Mean value
01	417580	51027		K1	LV	-51		CHP-V			AV 8	62	114	159	112

C70-C99 Chemical composition % - Heat analysis

B07.2 Heat	C70	C	SI	MN	P	S	N	CU	MO	NI	CR	V	NB	SN	TI
417580	Y	0,166	0,378	1,19	0,008	0,0004	0,0074	0,029	0,033	0,048	0,215	0,001	0,000	0,001	0,002

B07.2 Heat	C70	B	CA	AL-T
417580	Y	0,0000	0,0014	0,034

C94 Heat analysis Carbon equivalent / Alloying restrictions

B07.2 Heat									
417580	FO-02=	0,42	FO-51=	0,001	FO-55=	0,33	FO-78=	0,25	FO-91=	7,2

RECEIVED
FEB 13 2017
Z. SEESE

C95 Ladle treatment

ITEM NO.: 01
HEAT OF THE INDICATED ITEM: VACUUM DEGASSED / SULPHIDE SHAPE CONTROL

C95 Further information about ladle treatment

ITEM NO.: 01
CALCIUM TREATED

A04 Manufacturer's mark

Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

DR. CH. KÖNIG
Test House Manager

Inspector's stamp

A01
AG der Dillinger Hüttenwerke
Postfach 1580, D-66748 Dillingen/Saar
Inspection department

Date 18.02.15 PP 1

Top and Bottom Heads MK 1-1

QM-System: Certification as per ISO 9001

DILLINGER HÜTTE

Erläuterungen siehe Rückseite/Explications voir au verso/See reverse for explanations (www.dillinger.de/certificate)

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1 AS PER ISO 10474:2013 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 521853-17.02.15	A08/ Manufacturer's order/ A03 Certificate No. 400961-001 Sheet 3
A05 Established inspecting body DH	A06 Purchaser Final receiver	EDMONTON STEEL,EDMON A07.1 No. ED10661-J1010ER EDMONTON STEEL,EDMON A07.2 No.	B01 Product HEAVY PLATES
B02/ Steel design. SA516-70 SA20-S5 B03 Any suppl. requirements ASME-IIA:2013 DIL-HUE-16:R23-2014-04-04			

C70-C99 Chemical composition % - Product analysis

B07.2 Heat	B07.1 Test No.	C01	C	SI	MN	P	S	N	CU	MO	NI	CR	V	NB	SN	TI
417580	51027	K1	0,166	0,368	1,16	0,007	0,0008	0,0072	0,027	0,030	0,046	0,209	0,000	0,000	0,000	0,001

B07.2 Heat	B07.1 Test No.	C01	B	CA	AL-T
417580	51027	K1	0,0000	0,0014	0,032

C94 Product analysis Carbon equivalent / Alloying restrictions

B07.2 Heat	B07.1 Test No.	C01				
417580	51027	K1	FO-02=	0,41	FO-55=	0,31

C94 Carbon equivalent formula / Alloying restrictions

FO-02 = C+(MN/6)+(CR+MO+V)/5+(NI+CU)/15
FO-51 = V +NB
FO-55 = CU+MO+NI+CR
FO-78 = CR+MO
FO-91 = MN/C

AIR APPROVED EXCHANGER

D01 Marking and identification, surface appearance, shape and dimensional properties

ITEM NO.: 01
EXAMINATION OF MARKING, SURFACE, SHAPE AND DIMENSIONS: THE RESULTS MEET THE REQUIREMENTS.

SURFACE	AS PER ASME-SA20
THICKNESS	AS PER ASME-SA20
LENGTH AND WIDTH	AS PER ASME-SA20
FLATNESS	AS PER 1/2-ASME-SA20

A04 D H Manufacturer's mark

Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

DR. CH. KÖNIG
Test House Manager

AHB Inspector's stamp

A01 AG der Dillinger Hüttenwerke
Postfach 1580, D-66748 Dillingen/Saar
Inspection department

Date 18.02.15 PP 1

FORM U-2A MANUFACTURER'S PARTIAL DATA REPORT (ALTERNATIVE 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 P & M Industries, Inc. 4450 South Mingo Tulsa OK 74146-4703 USA
(Name and address of Manufacturer)

2. Manufactured for American Alloy Steel, Inc. 6350 North Erie Ave. Tulsa, OK 74117
(Name and address of Purchaser)

3. Location of installation Unknown
(Name and address)

4. Type Rolled & welded cylinder [Description of vessel part (shell, two-piece head, tube bundle)] | 1701033-1 thru 3 (Manufacturer's serial number) | N/A (CRN)

N/A (National Board number) | N/A (Drawing number) | P & M Industries, Inc. (Drawing prepared by) | 2017 (Year built)

5. ASME Code, Section VIII, Div. 1 2015 Edition [Edition and Addenda, if applicable (date)] | N/A (Code Case number) | None [Special service per UG-120(d)]

6. Shell: (a) Number of course(s) 1 (b) Overall length 8'-0"

Course(s)			Material	Thickness		Long. Joint (Cat. A)			Circum. Joint (Cat. A, B & C)			Heat Treatment	
No.	Diameter	Length	Spec./Grade or Type	Nom.	Corr.	Type	Full, Spot, None	Eff.	Type	Full, Spot, None	Eff.	Temp.	Time
1	78" ID	8'-0"	SA516-70NORM	2-3/8"	N/A	1	Full	*	-	-	-	None	None
2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-

Body Flanges on Shells

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

7. Heads: (a) None (Material spec. number, grade or type) (H. T. - time and temp.) (b) None (Material spec. number, grade or type) (H. T. - time and temp.)

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min.	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot, None	Eff.
(a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(b)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Body Flanges on Heads

									Bolting			
	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Num & Size	Bolting Material	Washer (OD, ID, thk)	Washer Material
(a)	-	-	-	-	-	-	None	-	-	-	-	-
(b)	-	-	-	-	-	-	-	-	-	-	-	-

8. MAWP - (Internal) - (External) at max. temp. - (Internal) - (External) . Min. design metal temp. - at - .

9. Impact test Yes [Indicate yes or no and the component(s) impact tested] at test temperature of -20 Deg F .

10. Hydro., ~~pneu.~~, ~~or comb.~~ test pressure - Proof test -

11. 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	
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-

12. Identification of part(s)

Name of Part	Quantity	Line No.	Mfr's. Identification No.	Mfr's. Drawing No.	CRN	National Board No.	Year Built
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

13. Supports: Skirt No (Yes or no) Lugs None (Number) Legs None (Number) Other None (Describe) Attached - (Where and how)

14. Remarks WPS Qualifed With & Without PWHT, No Design Calculations Performed

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. 25978 Expires 11/25/18

Date 3-29-17 Name P & M Industries, Inc. (Manufacturer) Signed [signature] (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 OneCIS Insurance Co. of Lynn, MA have inspected the pressure vessel part described in this Manufacturer's Data Report on 3-29-2017, 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 3-29-2017 Signed [signature] (Authorized Inspector) Commissions NB 11158 OK 646 [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 P & M Industries, Inc. 4450 South Mingo Tulsa OK 74146-4703 USA
(Name and address of Manufacturer)

2. Manufactured for American Alloy Steel, Inc. 6350 North Erie Ave. Tulsa, OK 74117
(Name and address of Purchaser)

3. Location of installation Unknown
(Name and address)

4. Type Rolled & Welded Cylinder (Horizontal, vertical, or sphere) | Unknown (Tank, separator, heat exch., etc.) | 1701033-1 thru 3 (Manufacturer's serial number)

N/A (CRN) | N/A (Drawing number) | N/A (National Board Number) | 2017 (Year built)

Data Report Item Number	Remarks
#14	Meets Requirements of ASME Section VIII Div 1, UG-79, UCS-79, UG-80
#14	*RT per UW-11(a)
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-

Certificate of Authorization: Type U No. 25978 Expires 11/25/18

Date 3-29-17 Name P & M Industries, Inc. (Manufacturer) Signed (Representative)

Date 3-29-2017 Name (Authorized Inspector) Commissions NB 11158 OIC 646 [National Board (incl. endorsements)]

P & M INDUSTRIES INC.
4450 S. MINGO TULSA, OK 74146-4703
P O BOX 471069 TULSA, OK 74147-1069

INSPECTION REPORT - SHELLS

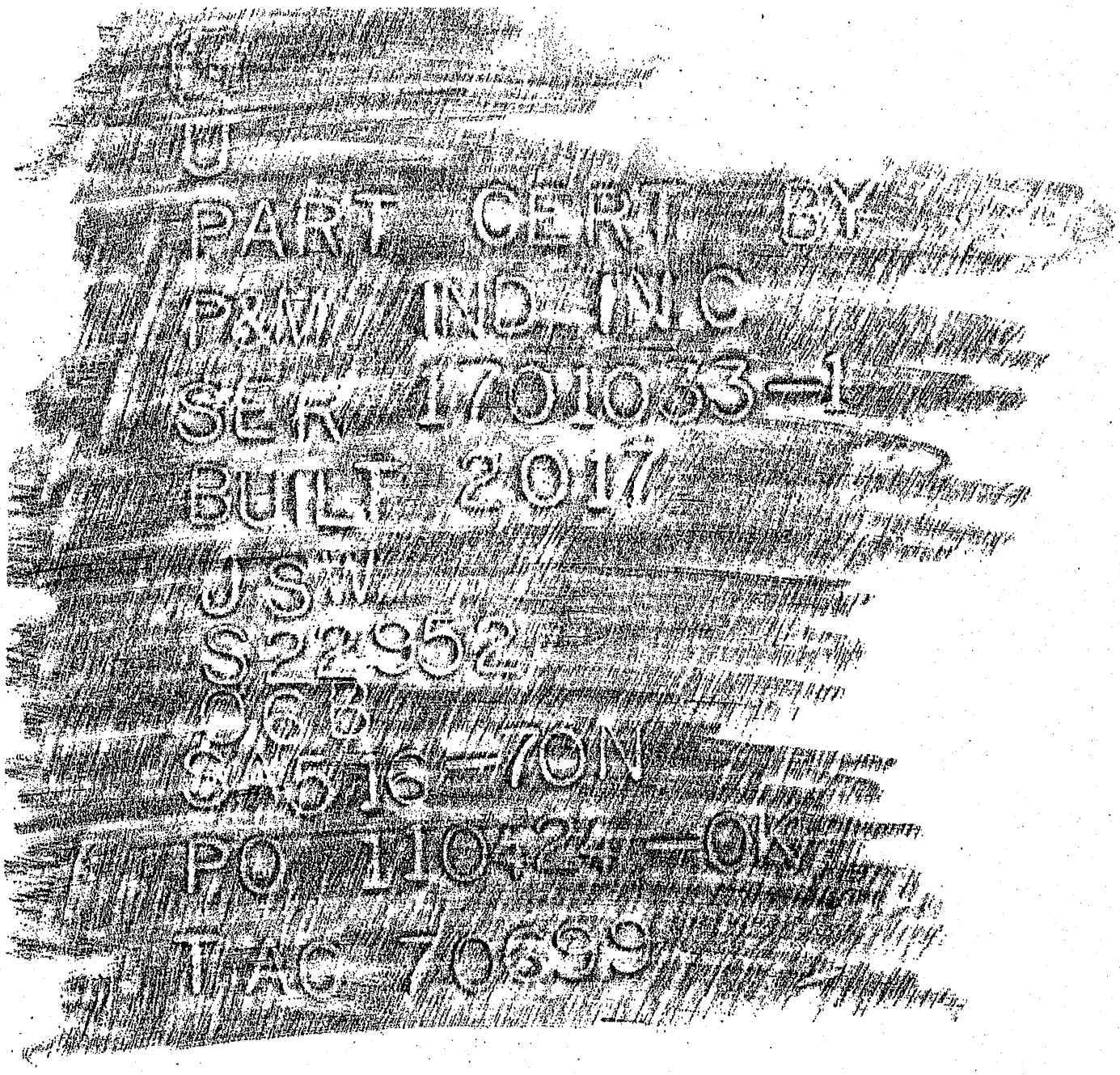
S/O# 1701033
DATE 1-1,2-3 3/29/17

CUSTOMER P.O.# Am Allow 110424-OK
~~JOB~~/TAG # 70699

DESCRIPTION	P&M PF U2A S/N	HEAT #	DIMENSIONS				ROUNDNESS
			CIRCUMFERENCE	ID/OD	THICKNESS	LENGTH	
2 3/8" x 78" ID x 96	1701033-1	522952 06B	21'-8 1/4"	78 1/16"		96"	W/N 1/8"
do	-2	522952 08B	21'-8 1/4"	78 1/16"		96 1/8"	
do	-3	522947 07C1	21'-8 1/8"	78"		96"	
do	-4						
do	-5						
do	-6						

IJ
PART CERT BY
P&M IND INC
SER-170103-5
BUILT-2017
JSW
S22-FIT
07C1
SA516-70N
PO-FOA-ZA-0K
TI-AS-70S9

PART CERT BY
P&M IND INC
SER 170103
BUILT 2017
J/S/N
S22952
108B
SA516-70N
PO 11042-OK
TAG 70929


PART CERT BY
PMI AMD INC
SER 170103=1
BUIL 2017
JSN
S2952
SB3
SN015-70N
PO 10-21-01
TAG 70399

METALLURGICAL SERVICES, L.L.C.
10982 W. 71st Street South
P.O. Box 908 • Sapulpa, OK 74067
Phone: 918-224-7221 •Fax: 918-224-7231

Lab No. 17-24010
Page 1 of 1
P.O.

Mechanical Test Report

Organization	P & M INDUSTRIES	**Contact**	MARK PARKER
Address	4450 S MINGO RD. TULSA, OK. 74146		
Base Metal Type	SA516-70N HT:	TO	SA516-70N
Coupon Thickness	2-1/4"	**PWHT**	3 HRS. @ 1150 DEG. F.
WPS No.	A1087 CIT REV. 2	**PQR No.**	N/A
Weld Process	SAW	**Filler**	N/A
Welder's Name	N/A	**I.D. No.**	N/A

Bends

Specimen Number	Bend Type	Results / Comments
1	NONE	
2		
3		
4		

Tensile Tests

Specimen Number	Specimen Size	Specimen Area sq. in.	Load at Failure PSI	Yield 2% offset PSI	Ultimate Tensile PSI	Break Location	Percent Elongation in 2 inches
1	NONE x						
2	x						
3	x						
4	x						

Hardness in BHN

Material 1			Heat Affected Zone			Weld Metal		
1	2	3	1	2	3	1	2	3
NONE								

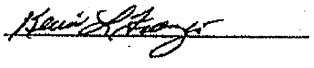
Material 2			Heat Affected Zone		
1	2	3	1	2	3

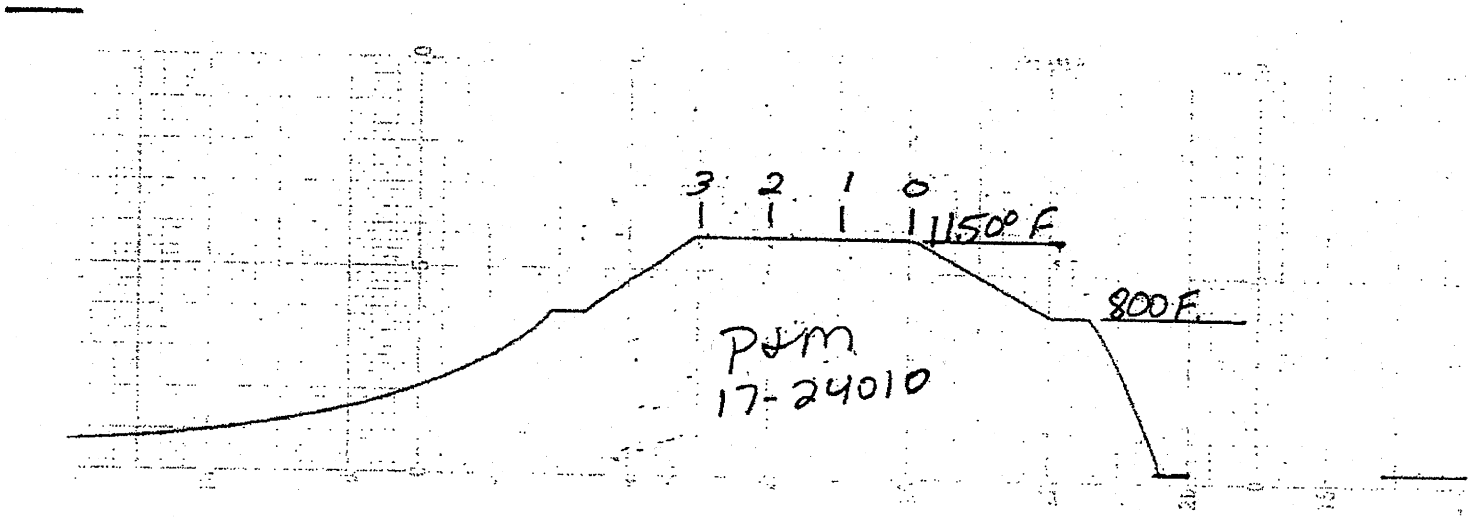
Charpy V-Notch Impact Testing

Specimen Number	Specimen Type	Specimen Size	Temp. F.	Value Ft./Lbs.	Lateral Expansion	Percent Shear
1	WM	10mm x 10mm	-20° F	50	44	20
2	WM	10mm x 10mm	-20° F	48	42	20
3	WM	10mm x 10mm	-20° F	54	49	20
4	CENTER WM	10mm x 10mm	-20° F	60	52	20
5	CENTER WM	10mm x 10mm	-20° F	56	46	20
6	CENTER WM	10mm x 10mm	-20° F	58	46	20
7	HAZ-CAP	10mm x 10mm	-20° F	80	67	40
8	HAZ-CAP	10mm x 10mm	-20° F	82	70	40
9	HAZ-CAP	10mm x 10mm	-20° F	79	65	40
10	HAZ-ROOT	10mm x 10mm	-20° F	85	73	40
11	HAZ-ROOT	10mm x 10mm	-20° F	81	69	40
12	HAZ-ROOT	10mm x 10mm	-20° F	83	70	40

OTHER TESTS PERFORMED: NONE

All tests performed in accordance to methods specified in ASME SA-370 & ASTM A-370.

Signature  Date 1/12/2017


3
2
1
0
1150° F
800 F
PVM
17-24010

P & M INDUSTRIES INC.
4450 S. MINGO TULSA, OK 74146-4703 918-660-0055
P.O. BOX 471069 TULSA, OK 74147-1069 FAX 918-660-0595

SERVICE IS OUR PRODUCT

RT DATE 3-27-17
ORIGINAL FILM X REPAIR
CUSTOMER Ameresco
CUSTOMER PO 110424-OK

RADIOGRAPHIC TESTING DATA AND REVIEW REPORT

SHOP ORDER NUMBER 1701033 | MATERIAL SA516-70 | THICKNESS-BM 2 3/8 | REINFORCEMENT 5/32 | WELD 2 11/32
RT QUALITY SPEC - ASME SECTION V, ARTICLE 2 | FILM MANUFACTURER Fuji | TYPE 100 | SIZE 7X17
RT REQUIREMENTS (RT 1) RT 2 RT 3 | #FILM PER CASSETTE 1
ACCEPTANCE CRITERIA ASME SECT VIII, DIV 1 (UW 51) UW 52 | FILTER | Pb BACKING
X-RAY MACHINE | ISOTOPE Co60
Kv Ma | CIS 70
EFF DIMENSION .218

SCREENS		PROCESSING		
FRONT	BACK	MAN-68F	AUTO	TEMP
.005	.010		X	30C

Seam Number	View #	# of Exposures SW= Single wall DW= Double Wall	Viewing SW= Single wall DW= Double Wall	Penetrameter Size (IQI Selection	Source to weld distance	Source side of weld to film	UG (if req'd)	Exposure time (if req'd)	Densities	Lack of Penetration	Gas Porosity	Lack of Fusion	Undercut	Slag Inclusion	Crack	Remarks	Acceptable	Reject
LS-1	1-2	1SW	1W	1C	22 3/8	2 11/32											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	
		"	"	"	"	"												
LS-2	1-2	"	"	"	"	"											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	
		"	"	"	"	"												
LS-3	1-2	"	"	"	"	"											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	
		"	"	"	"	"												
LS-4	1-2	"	"	"	"	"											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	
		"	"	"	"	"												

Capital X-Ray Tech Level: II Date 3-27-17
P & M Interpretation Level: II Date (1-2-3/3-29-17) (4/3-30-17)
Client Rep Date

03/30/2017 From: AMERICAN ALLOY STEEL, INC. To: BOARDMAN, INC
P.O.#: 00608303 S.O.#: 561259 AA PL#: 5180903
Item: 2 (2 PC) 2-3/8" X CYL 78" ID X 96" X 96" X 260"

Shell MK 1-2

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

METALLURGICAL TEST REPORT

AMERICAN ALLOY
PLATE #5180903

MET - 05
2/13/2017

Bulletin	Order Item	Heat	PO No.	Shipping Mode	Order Dimensions	Slab Origin	TC No.
T010844	JSW07233-01	S22947	110425-OK-SD	TRUCK	2.375x96x260		T010844-2947-1

This is to certify that JSW Steel (USA) Inc ,Baytown Texas does not do weld repair on plates unless agreed upon by the purchaser in accordance with ASTM Items, Clauses 9-2-1-2 and 9-4-1.

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

Sold To: AMERICAN ALLOY STEEL INC. 6230 NORTH HOUSTON - ROSSLYN HOUSTON, TX 77091
Ship To: AMERICAN ALLOY 4460 S MINGO TULSA, OK 74146

Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Nb	Ca	CE
LADLE	0.24	1.14	0.009	0.001	0.18	0.009	0.002	0.023	0.000	0.000	0.036	0.0029	0.004	0.0004	0.001	0.000	0.0028	0.44

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

Plate	Slab Identity	Gauge Tested	Test Cond	Test Dir.	Yield Point	Tensile Stgth.	Elong in 2"	YS/UTS Ratio	Yield Strenght Determind At	Charpy Impact Test (LCVN) Full Energy in Ft/Lb °F								
										Temp	Test1	Test2	Test3	Avg	Test1	Test2	Test3	Avg
1026581A	07C1	2.3750	PN	T	47	79	28.0%	0.59	0.2%	-20	40	42	40	41				

Plates Certified For The Above Tests

Material	Thick(IN)	Width (IN)	Len(IN)	Wgt(LB)
1026581A	2.3750	96.000	260.00	16812

Material	Thick(IN)	Width(IN)	Len (IN)	Wgt(LB)

Material	Thick(IN)	Width(IN)	Len(IN)	Wgt(LB)

RECEIVED
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L. Dawson

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
Date 3/30/17

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

Sandra Flores

Sandra Flores 832-840-4514 sandra.flores@jswsteelusa.com

03/30/2017 From:AMERICAN ALLOY STEEL, INC. To: BOARDMAN, INC
P.O.#: 00608303 S.O.#: 561259 AA PL#: 5180900
Item: 1 (1 PC) 2-3/8" X CYL 78" ID X 96" X 96" X 260"

Shell MK1-3

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

METALLURGICAL TEST REPORT

AMERICAN ALLOY
PLATE #5180900

MET - 05
2/13/2017

Bulletin	Order Item	Heat	PO No.	Shipping Mode		Order Dimensions	Slab Origin	TC No.
T010844	JSW07233-01	S22952	110425-OK-SD	TRUCK		2.375x96x260		T010844-2952-1

This is to certify that JSW Steel (USA) Inc ,Baytown Texas does not do weld repair on plates unless agreed upon by the purchaser in accordance with ASTM Items. Clauses 9-2-1-2 and 9-4-1.

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

Sold To:	AMERICAN ALLOY STEEL INC. 6230 NORTH HOUSTON - ROSSLYN HOUSTON, TX 77091
Ship To:	AMERICAN ALLOY 4450 S MINGO TULSA, OK 74146

Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Nb	Ca	CE
LADLE	0.24	1.12	0.008	0.001	0.19	0.003	0.002	0.021	0.000	0.000	0.032	0.0033	0.004	0.0000	0.001	0.000	0.0028	0.43

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

Plate	Slab Identity	Gauge Tested	Test Cond	Test Dir.	Yield Point	Tensile Stgth.	Elong In 2"	YS/UTS Ratio	Yield Strenght Determind At	Charpy Impact Test (LCVN) Full Energy in Ft/Lb °F								
										Temp	Test1	Test2	Test3	Avg	Test1	Test2	Test3	Avg
1026586A	08B	2.3750	PN	T	48	77	28.0%	0.60	0.2%	-20	50	50	50	50				

Plates Certified For The Above Tests

Material	Thick(IN)	Width (IN)	Len(IN)	Wgt(LB)
1026586A	2.3750	96.000	260.00	15812

Material	Thick(IN)	Width(IN)	Len (IN)	Wgt(LB)

Material	Thick(IN)	Width(IN)	Len(IN)	Wgt(LB)

RECEIVED
MAR 31 2017
L. Dawson

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
3/30/17

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

Sandra Flores

Sandra Flores 832-840-4514 sandra.flores@jswsteelusa.com

03/30/2017 From:AMERICAN ALLOY STEEL, INC. To: BOARDMAN, INC
P.O.#: 00608303 S.O.#: 561259 AA PL#: 5180901
Item: 1 (1 PC) 2-3/8" X CYL 78" ID X 96" X 96" X 260"

Shell MK1-4

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

METALLURGICAL TEST REPORT

AMERICAN ALLOY PLATE #5180901

MET - 05
2/14/2017

Bulletin	Order Item	Heat	PO No.	Shipping Mode	Order Dimensions	Slab Origin	TC No.
T010868	JSW07233-01	S22952	110425-OK-SD	TRUCK	2.375x96x260		T010868-2952-1

This is to certify that JSW Steel (USA) Inc ,Baytown Texas does not do weld repair on plates unless agreed upon by the purchaser in accordance with ASTM Items. Clauses 9-2-1-2 and 9-4-1.

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

Sold To: AMERICAN ALLOY STEEL INC. 6230 NORTH HOUSTON - ROSSLYN HOUSTON, TX 77091
Ship To: AMERICAN ALLOY 4450 S MINGO TULSA, OK 74146

Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Nb	Ca	CE
LADLE	0.24	1.12	0.008	0.001	0.19	0.003	0.002	0.021	0.000	0.000	0.032	0.0033	0.004	0.0000	0.001	0.000	0.0028	0.43

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

Plate	Slab Identity	Gauge Tested	Test Cond	Test Dir.	Yield Point	Tensile Stgth.	Elong In 2"	YS/UTS Ratio	Yield Strenght Determind At	Charpy Impact Test (LCVN) Full Energy in Ft/Lb °F								
										Temp	Test1	Test2	Test3	Avg	Test1	Test2	Test3	Avg
1026584A	06B	2.3750	PN	T	46	78	25.0%	0.59	0.2%	-20	50	71	59	60				

Plates Certified For The Above Tests

Material	Thick(IN)	Width (IN)	Len(IN)	Wgt(LB)
1026584A	2.3750	96.000	260.00	16812

Material	Thick(IN)	Width(IN)	Len (IN)	Wgt(LB)

Material	Thick(IN)	Width(IN)	Len(IN)	Wgt(LB)

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MAR 31 2017
L. Dawson

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

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

Sandra Flores 832-840-4514 sandra.flores@jswsteelusa.com

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CERTIFICATE OF INSPECTION & TEST (EN 10204 3.1)

ST&H CORPORATION
74, Jwadongsunhwan-ro, Haeundae-gu, Busan, Korea
Tel : +82.51.744-4680(5 line) Fax : +82.51.744-4670
E-mail :qm@stnhcorp.com

CE

Certificate No. MJW9095D-16/18 Date : OCT. 06. 2015
Customer INDUSTRIAL PIPING SPECIALISTS.
Contract No. TP476391-4TH
Certified to ISO9001:2008, ISO14001:2004,PED97/23/EC by LRQA
Spec. For Material ASTM/ASME A/SA350 LF2 CL1-14,NACE MR0175-2009/ISO15156-1:2015,NACE MR0103-2012
Heat Treatment 930℃ NORMALIZED & A.C
Dimensional inspection ASME B16.5 - 2013

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen D mm	Size of Test Specimen GL mm		Tension Test Y.S MPa	Tension Test T.S MPa	Tension Test E.L %	Tension Test R.A %	Hardness Test (HB)		Charpy Impact Test (10X10mm Specimen Size) Indiv.	Ave.	Notch	Temp.
						Max		655			197		16J	20J	V	-46℃
				12.5	50.0	Min	250	485	22.0	30.0			Test Result (J)			Ave.(J)
CA150WRSTD10	150LBS WN RF STD 10"	8	103343B	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA300WRSTD10	300LBS WN RF STD 10"	40	103343C	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA600WRXH10	600LBS WN RF XH 10"	60	103343D	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA600WRXH8	600LBS WN RF XH 8"	35	103343D	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA300WRSTD8	300LBS WN RF STD 8"	60	103343D	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA600WRXH8	600LBS WN RF XH 8"	52	103343E	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA600WRXH8	600LBS WN RF XH 8"	38	103343F	12.5	50.0		383	544	36	73	155	157	166	52	100	106
BLANK			BLANK				BLANK				BLANK					

Heat No./ Batch No.		Chemical Composition (%) C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	Nb						CE	NDE UT	MT	PT
	Max	0.300	0.300	1.350	0.035	0.040	0.400	0.300	0.120	0.400	0.080	0.020									
	Min		0.150	0.600																	
103343B		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			
103343C		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			
103343D		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			
103343E		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			
103343F		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			

REMARK * PRODUCT OF KOREA

We hereby certify that the material herein has been made and tested in accordance with the above specification and also with the requirements called for by the above order.

Witnessed by / H. J. LEE

Manager of Q.A Dept. / J. W. PARK

801-14-01

ST&H CORPORATION

No 2 off A and B Flange MK 1-7

| 00608321 | | 103343D | | LN: 7 | ER020791-2 | FK860RFWNXHL2 |

[| 00608321 | | | H8565] | [LN: 34] | ER020791-6 | *FLG |

FEDERAL FLANGE

MATERIAL TEST REPORT

FFI-QACON-F0003
Revision: 05, 01/19/2016

FID: H8565

INDUSTRIAL PIPING SPECIALISTS PO BOX 581270 TULSA, OK 74158	PO:	ELP48494X	SO:	023327 001	
	Item Code:	FFI-FGRFW-00903 0		Qty:	1
	Item Desc:	FLG REDWN RF 18X8 600 80			
	Supplier:	FORGED COMPONENTS INC	Supplier Heat:	Z581	
Material Grade:	A/SA 350 LF2 CL1		Country of Origin:	USA	

Element		Ladle	Element		Ladle
C	Carbon	0.1760	N	Nitrogen	0.0131
Mn	Manganese	1.1800	Mo	Molybdenum	0.0200
P	Phosphorous	0.0090	V	Vanadium	0.0530
S	Sulphur	0.0050	CbNb	Columbium/Niobium	0.0010
Si	Silicon	0.2000	Ti	Titanium	0.0032
Cu	Copper	0.1200	Al	Aluminum	0.0260
Ni	Nickel	0.0800	B	Boron	0.0001
Cr	Chromium	0.1000	Sn	Tin	0.0070

Melting Practice		Reduction Ratio	

Additional Chemicals
AS 0.004 ; SB 0.001

Mechanical Test Results				Heat Treatment Information	
Tensile (PSI)	76,200			NORMALIZING TEMPERATURE (°F)	1650
Yield (PSI)	49,000			NORMALIZING TIME (HRS)	1/2 HR/IN THK MIN
Elong (%)	33.70				
Red (%)	72.00				
CE	0.4210				
PCM					
HBW	156	to	156		
CVN Test Temperature			°F		
Ft/Lbs.					
Shear (%)					
MLE					
Tensile Test Size					
QTC Type & Size					

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FEB 14 2017
L. Dawson

Additional comments

Bradford, VA
YVETTE BRADFORD - Quality Representative

2/1/2017
Date

Unless other wise stated, yield stress is 0.2% offset, gauge length is 2" for 1/2" bars or 1" for 1/4" bars.
Unless other wise stated, charpy impact specimens are V-notch 10 x 10 mm

We certify this material meets the requirements of NACE MR-0175/ISO 15156-1 Dated Oct 15, 2009 and is EN 10204 Type 3.1 compliant
This product is free of mercury contamination and has had no weld repair.

4014 Pinemont Dr | Houston, TX 77018 | MTR Dept. Phone: (713) 600-2131 | Fax: (713) 681-3005

Nozzle A Reducing Flange MK1-15

[| 00608321 | | | C1069BN] | [LN: 4] | ER020791-7 | *FLG |

FVC
an AFGlobal Company

Material Test Report

Heat Code: C1069BN

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: ELP48435X	Sales Order: 157599	Line: 1
P.O. Box 581270	Item Code: V2N180600170A004A1	Qty Shipped: 2	
Tulsa, OK 74158-1270	Item Desc: V2N,SA350LF2,600#,18"x17",RF		
	Supplier: ARCELORMITTAL	Supplier Heat: 217A558	

Spec: ASTM A350(15)/ASME SA350(15)Section II Part A, - LF2 CL1

Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18			
Mn	Manganese	1.11		✓	7439-96-5
P	Phosphorous	0.010			
S	Sulphur	0.002			
Si	Silicon	0.23			
Cu	Copper	0.18		✓	7440-50-8
Ni	Nickel	0.10		✓	7440-02-0
Cr	Chromium	0.06		✓	7440-47-3
Mo	Molybdenum	0.031			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
V	Vanadium	0.02			
Cb	Columbium	0.00			
B	Boron	0.0002			
Ti	Titanium	0.002		✓	7440-02-0
Al	Aluminum	0.023			
C.E.		0.40			
CuNiCrMoV		0.39			
CrMo		0.09			

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Mechanical Testing

Test Lab	AFG
HBW	144 - 145
Elg (%)	36
RA (%)	66
Tensile Specimen Size (in)	.494
Tensile (ksi)	71.4
Yield (ksi)	45.1
Gauge Length (in)	2
Charpy Temp(F)	-50
Charpy (ft lbs)	77 - 55 - 62
Avg Energy 3 Specimens (ft-lbs)	65
Min Energy 1 Specimens (ft-lbs)	55
% Shear	30 - 20 - 20
Lat. Exp.(in)	.064 - .048 - .053

Heat Treat

Norm. Temp. (F)	1675
Norm. (Hrs)	4:45
Norm. Cooling Type	AIR
Norm. Location	FVC HT 300-16

Other

Country of Melt	USA
VD	Y
EF	Y
Fully Killed	Y
Made to Fine Grain Practice	Y

The recording of false, fictitious, or fraudulent statement or entries on this document may be punishable as a felony under federal statute.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1272780
Certification Date: 2/14/2017
Issued By: Angie Mendoza

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

Nozzle C MK 1-14 1 of 2

[| 00608321 | | | C1069BN] | [LN: 4] | ER020791-7 | *FLG |

Material Test Report

Heat Code: C1069BN

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: ELP48435X	Sales Order: 157599	Line: 1
P.O. Box 581270	Item Code: V2N180600170A004A1	Qty Shipped: 2	
Tulsa, OK 74158-1270	Item Desc: V2N,SA350LF2,600#,18"x17",RF		
	Supplier: ARCELORMITTAL	Supplier Heat: 217A558	
Spec: ASTM A350(15)/ASME SA350(15)Section II Part A, - LF2 CL1			

Product compliant with NACE MR0175/ISO 15156-2:2009 Annex A (A.2.1.2, A2.1.3).
Product compliant with NACE MR0103-2012, Section 2.1.2 and 2.1.4.

YIELD STRENGTH CALCULATED AT 0.2% OFFSET.
FVC STANDARD MANUFACTURING PRACTICES:
1) FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
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

The recording of false, ficititous, or fraudulent statement or entries on this document may be punishable as a felony under federal statute.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1272780
Certification Date: 2/14/2017
Issued By: Angie Mendoza

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

Rina Sane - Metallurgical Lab Manager

Nozzle C MK1-14

2 of 2

[| 00608321 | | | C1069BN] | [LN: 5] | ER020791-8 | *FLG |

FVC
an AFGlobal Company

Material Test Report

Heat Code: C1069BN

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: ELP48435X	Sales Order: 157599	Line: 2
P.O. Box 581270	Item Code: V3N180600161A004A9	Qty Shipped: 2	
Tulsa, OK 74158-1270	Item Desc: 18-600-16.1875-6R-1-4 RF V3N SA350LF2CL1		
	Supplier: ARCELORMITTAL	Supplier Heat: 217A558	
Spec: ASTM A350(15)/ASME SA350(15) Section II Part A, - LF2 CL1			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18			
Mn	Manganese	1.11		✓	7439-96-5
P	Phosphorous	0.010			
S	Sulphur	0.002			
Si	Silicon	0.23			
Cu	Copper	0.18		✓	7440-50-8
Ni	Nickel	0.10		✓	7440-02-0
Cr	Chromium	0.06		✓	7440-47-3
Mo	Molybdenum	0.031			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
V	Vanadium	0.02			
Cb	Columbium	0.00			
B	Boron	0.0002			
Ti	Titanium	0.002		✓	7440-02-0
Al	Aluminum	0.023			
C.E.		0.40			
CuNiCrMoV		0.39			
CrMo		0.09			

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Mechanical Testing	
Test Lab	AFG
HBW	144 - 145
Elg (%)	36
RA (%)	66
Tensile Specimen Size (in)	.494
Tensile (ksi)	71.4
Yield (ksi)	45.1
Gauge Length (in)	2
Charpy Temp(F)	-50
Charpy (ft lbs)	77 - 55 - 62
Avg Energy 3 Specimens (ft-lbs)	65
Min Energy 1 Specimens (ft-lbs)	55
% Shear	30 - 20 - 20
Lat. Exp.(in)	.064 - .048 - .053

Heat Treat	
Norm. Temp. (F)	1675
Norm. (Hrs)	4:45
Norm. Cooling Type	AIR
Norm. Location	FVC HT 300-16
Other	
VD	Y
EF	Y
Fully Killed	Y
Made to Fine Grain Practice	Y

The recording of false, fictitious, or fraudulent statement or entries on this document may be punishable as a felony under federal statute.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1273664
Certification Date: 2/21/2017
Issued By: John Sauceda

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

Nozzle D MK1-20 1 of 2

[| 00608321 | | | C1069BN] | [LN: 5] | ER020791-8 | *FLG |

Material Test Report

Heat Code: C1069BN

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: ELP48435X	Sales Order: 157599	Line: 2
P.O. Box 581270	Item Code: V3N180600161A004A9	Qty Shipped: 2	
Tulsa, OK 74158-1270	Item Desc: 18-600-16.1875-6R-1-4 RF V3N SA350LF2CL1		
	Supplier: ARCELORMITTAL	Supplier Heat: 217A558	
Spec: ASTM A350(15)/ASME SA350(15)Section II Part A, - LF2 CL1			

Product compliant with NACE MR0175/ISO 15156-2:2009 Annex A (A.2.1.2, A2.1.3).
Product compliant with NACE MR0103-2012, Section 2.1.2 and 2.1.4.

YIELD STRENGTH CALCULATED AT 0.2% OFFSET.
FVC STANDARD MANUFACTURING PRACTICES:
1) FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
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

The recording of false, fictitious, or fraudulent statement or entries on this document may be punishable as a felony under federal statute.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1273664
Certification Date: 2/21/2017
Issued By: John Sauceda

Rina Sane - Metallurgical Lab Manager

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

Nozzle D MK1-20 2 of 2

[| 00608321 | | | TL10010165] | [LN: 3] | ER020791-4 | *FLG |

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FEB 15 2017
L. Dawson

3

TRILAD Flanges and Fittings, Inc.
7260 MYKAWA RD.
HOUSTON, TX, USA 77033
(PHONE) 800-498-2136
(FAX) 888-727-7982
www.tri-lad.com

CERTIFIED MATERIAL TEST REPORT

Certificate No. 16237269	EN 10204 3.1	Date of Report 6/ 08/ 2016	
Customer: ALLIED HOUSTON, 7200 MYKAWA ROAD, HOUSTON TX 77033		Customer Order No. 60216-3STK	Quantity 12
		Tri-Lad Order No. 733156	Line No. 1

Specification A350-14 LF2 CL1 ✓	Heat Treatment NORMALI SED
Item Description 18 600 BL RF ✓ (886895)	Temperature Init 1925 F 1051 C
Shop Order/Trace No.	Time N=5HRS / Lot Definition
Lot No.	
Heat Code TL10010165 ✓	
C.E. .41 / Melt Practice EF	

Chemical Composition

	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V
Heat Product	.19 ✓	1.09 ✓	.020 ✓	.003 ✓	.23 ✓	.05 ✓	.11 ✓	.11 ✓	.01 ✓	.01 ✓
Heat Product	Nb .00									
Heat Product										

Mechanical Properties

Yield	Tensile	Elongation	Reduction of Area	Hardness	Impact Test Temperature	Impact Values	Shear Fracture
Ksi 43 ✓ / Mpa 293 ✓	Ksi 81 ✓ / Mpa 559	31 %	67 %	HBW 154 / HBW 156	M50 F / M46 C	Ft-lbs 56 50 40 / Joules 76 68 54	

Tensile Specimen	Lateral Expansion	Impact Type	Impact Orientation	Starting Material	Impact Specimen
STD RD		VNOTCH	TANGENTIAL		FULL SIZE

Notes

NACE MR0103 LATEST ED.
NACE MR0175/ISO15156-09

Material is in accordance with the applicable Standard to which it is ordered including: ASME Sect II, ASME B16.5, B16.9, B16.36, B16.47, CSA, MSS, AWWA C-207.
NO WELD REPAIR MERCURY FREE
Material conforms to both ASTM (A) and ASME (SA) applicable specifications.
We hereby certify that all information presented on this CMTR conforms to the above specification.
We hereby certify the results to be a true copy of the records of the company.

Troy Gorrell
Q.C. Inspector

Nozzle D Blind MK 1-21

[| 00608321 | | | A2S] | [LN: 9] | ER020791-3 | *MISC |

MST SEAMLESS TUBE & PIPE

TEST REPORT 1 3/4 X .467 SA105 A2S A4S 8-13-15

5315 MICHIGAN SEAMLESS TUBE SOUTH LYON, MICHIGAN 48178 SHIPMENT 001

ORDER NUMBER	CUSTOMER ORDER NUMBER	DATE	OPC	COM		DIV#	NET SLS	GR SLS	ACCOUNT NUMBER	US		PAGE
065176	214171	10/06/14	21	00		15	05	01	06587000000		2ME	1

SOLD TO: * SPECIAL METALS INC
P O BOX 94670
OKLAHOMA CITY OK USA 73143

SHIP TO: SPECIAL METALS INC
2009 SOUTH BROADWAY STREET
MOORE OK 71360

SN 2
TR 3
INV 3

CUTTING: COLL/O-T/TARPED/FOB S LYON MI/GBOYD@SPECIALMETALSINC.COM CUST PU

ANALYSIS	SHAPE	PRODUCT	FG	ANNEAL	REQUESTED
1026	ROUND	COLD DRAWN		NORMALIZED	10/31/14

	SPECIFICATION	CUST	DESCRIPTION	PROMISE
SEAMLESS	A105/A519		CD CARBON MECHANICAL	10/31/14

SPECIAL INSTRUCTIONS: DIL_S-0.020 MAX.CHEM/PHYS ASTM A105/ASME SA105.MUST MEET NACE MRO 175-97,NACE MRO 103-2010 SEC 2.1.1-2.1.7,ISO 15156-2 A.2 & EN 10204 SEC 3.1,3.2,4.1,4.2.MK W/MST,SIZE,GR,CUST NAME,PO#,SPEC & HTB. T/R TO INCL COMPLETE CHEM(INCL UNSPECIFIED ELEMENTS)PHYS, HBW & GRAIN SIZE. GUARANTEED FINISH BORE SIZE 0.921".

ITEM	QUANTITY	O.D.	I.D.	WALL	LENGTH	WT/FT	WEIGHT	
		1.750		.467 AVG		6.399		13:46:46 02/04/15

ITM NUM	BALE NUM	--BALE-- PCS	FTG	HEAT NO.		LENGTH	ITM STATUS	PART NUMBER
1	1 2	42	633	00A145044	RAND	12'-17'	COM	705787
1	5 2	42	636	00A145044	RAND	12'-17'	COM	705787
1	2 2	44	665	00A145042	RAND	12'-17'	COM	705787
1	3 2	44	667	00A145042	RAND	12'-17'	COM	705787
1	4 2	44	667	00A145042	RAND	12'-17'	COM	705787

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HEAT NO.	C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Al	REMARKS
00A145044	.240	.750	.007	.015	.210	.060	.140	.020	.120	.019	EF SDI GS 7
00A145042	.240	.750	.007	.017	.250	.060	.130	.030	.130	.017	EF SDI GS 7

HEAT NO.	ULT. STR. PSI	YIELD, PSI	% ELONG	HARDNESS	HYDRO TEST PSI	ULTRA SONIC %	EDDY CURRENT	EXPANSION
00A145044	73,266	45,942	34.4	HRB 78-81			OK	
00A145042	73,574	50,505	34.4	HRB 79-81				

BEND	FLATTEN	FLARE	REV. FLATTEN	FLANGE

	V	SN	NB	SB	AS
A145042	.002	.009	.000	.002	.004
A145044	.002	.009	.000	.002	.004

IPS TP530740X 3/4-6000#X4½" Full Coupling

MELTED AND MANUFACTURED IN USA HEAT CODE A2S, A4S

MTR REVISED 2/4/15

Reduction of area HT A145042 55.84%
" " " " A145044 57.69%

MTR Revised 8/12/2015

We hereby certify that the reported data are correct according to Michigan Seamless Tube tests and those of its suppliers.

6.2.P8.F9 Rev 2

Nozzles E1 and E2 MK1-22

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FEB 15 2017
L. Dawson

20,21,22,23,24,25,26

FSBOL8XH

HR056624

Nozzle Necks MK1-10, MK1-13, MK.5-95, MK5-97 MK 5-98, MK 5-110 and MK 5-111

[| 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

1 of 6

BOLY PIPE CO., LTD. MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng, Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

| | | |

Nozzle Necks MK1-10, MK1-13, MK5-95, MK5-97, MK5-98, MK5-110 and MK5-111

[| 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

2 of 6

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	NEW PRIME SEAMLESS STEEL PIPE		
PURCHASER		ORDER NO.	2014001-23		
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/	API Cert. NO.	5L-0956
Grade	X42/B PSL1	L/C NO.:	/	DATE	2014-6-25

Size	8"XH(0.500")			Length range		DRL		Total Length (FT)	55416.94	Total Bundles	445	Order Quantity (MT)	1112														
Total Joints	1321		Total Weight (MT)	1112.944		Delivery Condition		CHAMFER		Making Method		Hot Finished, Seamless															
No.	Heat No.	- 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000															Batch No.	Mechanical Properties				Impact Test (Temperature Do C)					Hardness	Quantity		Length	Weight
			- 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	3 Mo	3 V	3 Ti	3 Nb	3 Al		- 3	- 4	Y.S.	T.S.	E.L.%	Size (mm)	1	2	3	AVG	HB (AVG)	Bundle	Jts	FT	MT
	min																	min	Mpa	290	415	29.5						<225				
	max			28		130	30	30										max														
5	14E100692		H 16	25	106	12	1	35.8	2.3	5.1	6	20						YLJ11405045		365	545	32						152	32	96	4031.75	80.968
			P 15	23	105	10	1	35.2	2.3	4.8	5	18																				
			P 14	24	104	11	1	35.4	2.1	5.1	4	19																				
6	14E100693		H 17	26	109	11	2	34.6	2.3	4.9	5	20						YLJ11405038		375	550	33						153	30	88	3695.67	74.148
			P 15	23	106	9	2	34.2	2.1	4.6	4	18																				
			P 16	24	108	10	1	34.3	2.2	4.5	3	17																				
7	14E100693		H 17	26	109	11	2	34.6	2.3	4.9	5	20						YLJ21405053		360	560	31.5						166	3	8	334.56	6.746
			P 15	23	106	9	2	34.2	2.1	4.6	4	18																				
			P 16	24	108	10	1	34.3	2.2	4.5	3	17																				
8	14E100694		H 16	22	104	11	1	34.6	2.3	4.6	7	20						YLJ11405037		400	540	38						160	24	72	3025.34	60.69
			P 15	20	103	9	1	34.3	2.1	4.4	6	17																				
			P 14	21	102	10	1	34.2	2.2	4.3	5	19																				

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Cooling	PASS	Visual	PASS	Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/												
Expansion	/	Residual Magnetism Measurement	PASS	Flattening	/	Bending	/	Hydrostatic Test (20.5MPa/5s)	PASS	Chamfer Inspection (30÷5)°	PASS	Heat Treatment	/	O.D Size	PASS	I.D Size	PASS	W.T.Measure	PASS								

NOTES: G.L=Gauge Length "1 Process C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm

INSPECTORS TO: Shu xin Fan

WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.MEETS HARDNESS FOR NACE MR-0103.

Q.A Signature: He Tianliang

Nozzle Necks MK 1-10, MK 1-13, MK 5-95, MK 5-97, MK 5-98 MK 5-110 and MK 5-111

[| | 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

3 of 6

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	NEW PRIME SEAMLESS STEEL PIPE
PURCHASER		ORDER NO.	2014001-23
Standard	API spec. 5L 2012 :ASTM A106-GRADE B 2011:ASMESA106-GRADE B 2011: ASTM A53-GRADE B 2012:ASME SA53-GRADE B 2011:ASTM A530-12	S/C.NO:	/ — API Cert. NO. 5L-0956
Grade	X42/B PSL1	L/C NO.:	/ — DATE 2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55416.94	Total Bundles	445	Order Quantity (MT)	1112
Total Joints	1321	Total Weight (MT)	1112.944	Delivery Condition		CHAMFER		Making Method	Hot Finished, Seamless

No.	Heat No.	- 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000															Batch No.	Mechanical Properties				Impact Test (Temperature 0o C)					Hardness	Quantity		Length	Weight
			- 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	3 Mo	3 V	3 Ti	3 Nb	3 Al		- 3	- 4	Y.S.	T.S.	E.L.%	Size (mm)	1	2	3	AVG	HB	Bundle	Jts	FT	MT
	min																	min	Mpa	290	415	29.5						<225				
	max			28		130	30	30										max														
9	14E100694		H	16	22	104	11	1	34.6	2.3	4.6	7	20					YLJ21405054		380	564	31						165	5	15	624.48	12.572
			P	15	20	103	9	1	34.3	2.1	4.4	6	17																			
			P	14	21	102	10	1	34.2	2.2	4.3	5	19																			
10	14E100695		H	16	24	107	11	1	34.3	2.1	4.5	5	20					YLJ11405047		400	540	38						158	31	93	3906.02	78.028
			P	14	22	106	9	1	34.1	2.1	4.2	4	17																			
			P	15	23	104	10	1	34.2	1.9	4.3	3	19																			
11	14E100696		H	18	23	106	11	1	34.5	2.3	5.3	5	20					YLJ11405057		395	570	39						170	2	5	199.08	3.992
			P	16	21	106	9	1	34.4	2.1	5.1	4	18																			
			P	15	22	105	10	1	34.3	2.2	5.2	3	19																			
12	14E100696		H	18	23	106	11	1	34.5	2.3	5.3	5	20					YLJ21405046		375	585	38.5						175	31	93	3905.68	78.556
			P	16	21	106	9	1	34.4	2.1	5.1	4	18																			
			P	15	22	105	10	1	34.3	2.2	5.2	3	19																			

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS	Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30-5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES: G.L.=Gauge Length "1 Process C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm

INSPECTORS TO: WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT — Q.A Signature

Shen Xiu Feng

THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.MEETS HARDNESS FOR NACE MR-0103.

He Tianhong

Nozzle Necks MK 1-10, MK 1-13, MK 5-95, MK 5-97, MK 5-98, MK 5-110 and MK 5-111

1 | 00608321 | | 14E100695 | | [LN: 20] | ER020791-4 | FSBOL8XH |

4 of 6

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6. T.Mapyangpon A.Pluakdaeng,
Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	NEW PRIME SEAMLESS STEEL PIPE		
PURCHASER		ORDER NO.	2014001-23		
Standard	API Spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/	API Cert. NO.	5L-0956
Grade	X42/B PSL1	L/C NO.:	/	DATE	2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55416.94	Total Bundles	445	Order Quantity (MT)	1112		
Total Joints	1321	Total Weight (MT)	1112.944	Delivery Condition		CHAMFER		Making Method		Hot Finished, Seamless	

No.	Heat No.	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000															Batch No.	Mechanical Properties				Impact Test (Temperature 0o.C)					Hardness	Quantity		Length	Weight
		- 1	- 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	3 Mo	3 V	3 Ti	3 Nb	3 Al		- 3	- 4	Y.S.	T.S.	E.L.%	Size (mm)	1	2	3	AVG	HB	Bundle	Jts	FT	MT
	min																	min	Mpa	290	415	29.5						<225				
	max			28		130	30	30										max														
			H	17	26	107	15	1	34.4	1.9	3.5	7	20																		
13	14E100697		P	15	24	106	13	1	34.2	1.5	3.3	6	17				YLJ21405045			405	540	35.5						160	30	86	3696.27	74.45
			P	16	25	105	14	1	34.3	1.6	3.2	6	18																		
			H	17	26	107	15	1	34.4	1.9	3.5	7	20																		
14	14E100697		P	15	24	106	13	1	34.2	1.5	3.3	6	17				YLJ21405055			410	530	34						156	3	8	328.66	6.582
			P	16	25	105	14	1	34.3	1.6	3.2	6	18																		
			H	16	24	102	10	1	34	2	4.5	7	20																		
15	14E100698		P	15	22	100	8	1	32	2	4.2	6	17				YLJ11405044			410	550	38						165	30	88	3696.12	74.436
			P	14	23	101	9	1	33	1	4.3	5	19																		
			H	16	24	102	10	1	34	2	4.5	7	20																		
16	14E100698		P	15	22	100	8	1	32	2	4.2	6	17				YLJ21405056			405	555	39						165	3	8	332.35	6.694
			P	14	23	101	9	1	33	1	4.3	5	19																		

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS	Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30+5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES	G.L.=Gauge Length "1 Process C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm
INSPECTORS TO	WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.MEETS HARDNESS FOR NACE MR-0103.
Shm dil Fam	Q.A Signature: He Tianliang

Nozzle Necks MK1-10, MK1-13, MK5-95, MK5-97, MK5-98 MK5-110 and MK5-111

[| 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6. T.Mapyangpon A.Pluakdaeng.
Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER	:	PRODUCT	NEW PRIME SEAMLESS STEEL PIPE		
PURCHASER		ORDER NO.	2014001-23		
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/	API Cert. NO.	5L-0956
Grade	X42/B PSL1	L/C NO.:	/	DATE	2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55416.94	Total Bundles	445	Order Quantity (MT)	1112		
Total Joints	1321	Total Weight (MT)	1112.944	Delivery Condition		CHAMFER		Making Method		Hot Finished, Seamless	

No.	Heat No.	- 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000														Batch No.	Mechanical Properties			Impact Test (Temperature 0o C)					Hardness	Quantity		Length	Weight
			- 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	3 Mo	3 V	3 Ti	3 Nb	3 Al		- 3	- 4	Y.S.	T.S.	E.L.%	Size (mm)	1	2	3	AVG	HB (AVG)	Bundle	Jts	FT	MT
	min																min	Mpa		280	415	29.5						<225				
	max			28		130	30	30									max															
17	14E100699		H	17	23	105	14	1	34.5	2	4.9	7	20				YLJ11405043			410	555	38.5						163	38	113	4740.93	95.33
			P	15	21	103	12	1	34.4	2	4.6	6	17																			
			P	16	22	104	13	1	34.3	1	4.5	5	18																			
18	14E100700		H	18	24	105	10	1	34.7	2.2	5.1	7	20				YLJ11405041			430	560	38						166	47	141	5921.19	118.626
			P	16	23	103	8	1	34.5	2.1	4.9	6	18																			
			P	17	22	104	9	1	34.6	2.2	5.1	7	19																			
19	14E100701		H	17	22	104	12	2	34.9	2.2	5.1	8	20				YLJ21405040			395	535	38						157	16	48	2015.80	40.522
			P	16	20	103	10	2	34.5	2.1	4.7	7	17																			
			P	15	21	102	11	1	34.6	1.9	4.8	6	19																			
20	14E100702		H	17	25	104	15	1	33.3	2.2	5.4	5	20				YLJ21405039			405	545	38						162	26	77	3232.62	65.272
			P	15	23	103	13	1	33.1	2.2	5.2	4	19																			
			P	16	24	102	14	1	33.2	2.1	5.1	3	19																			

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Cooling	PASS	Visual	PASS
Pipe ends Land(1.6±0.8)mm	PASS	Drift Test									

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30+5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES	G.L=Gauge Length "1 Process C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm
INSPECTORS TO	WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT
Shu xin fang	THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009,MEETS HARDNESS FOR NACE MR-0103.

Q.A Signature

HR Tianliang

5 of 6

Nozzle Necks MK1-10, MK1-13, MK5-95, MK5-97, MK5-98, MK5-110 and MK5-111

[| 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

6 of 6

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong. 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	NEW PRIME SEAMLESS STEEL PIPE		
PURCHASER	\	ORDER NO.	2014001-23		
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/	API Cert. NO.	5L-0956
Grade	X42/B PSL1	L/C NO.:	/	DATE	2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55416.94	Total Bundles	445	Order Quantity (MT)	1112
Total Joints	1321	Total Weight (MT)	1112.944	Delivery Condition		CHAMFER		Making Method	Hot Finished, Seamless

No.	Heat No.	- 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000 - 2	C	Si	Mn	P	S	Cr	Ni	Cu	Mo	V	Ti	Nb	Al	Batch No.	Mechanical Properties - 3	- 4	Y.S.	T.S.	E.L.%	Impact Test (Temperature 0o C) Size (mm)	1	2	3	AVG	Hardness HB	Quantity Bundle	Jts	Length FT	Weight MT
	min																	min										(AVG)				
	max			28		130	30	30										max	Mpa	290	415	29.5						<225				
21	14E100702	H	H	17	25	104	15	1	33.3	2.2	5.4	5	20				YLJ21405052			400	550	39						164	2	6	248.31	4.988
		P	P	15	23	103	13	1	33.1	2.2	5.2	4	19																			
		P	P	16	24	102	14	1	33.2	2.1	5.1	3	19																			
		H	H																													
		P	P																													
		P	P																													
		H	H																													
		P	P																													
		P	P																													
		H	H																													
		P	P																													
		P	P																													

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS	Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30+5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES	G.L=Gauge Length "1 Process C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm
INSPECTORS TO	WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.MEETS HARDNESS FOR NACE MR-0103.
Shu xin Zong	Q.A Signature: He Tianfang

1, 2

RECEIVED
JAN 17 2017
L. Dawson

Nozzle B Elbow MK 1-12
Downcomer Elbow MK 5-96

[| 00608321 | | 51T94] | [LN: 1] | ER020791-1 | FA8XH90 |

erne fittings gmbh
A-6824 Schlins
Hauptstrasse 48
Austria/Europe
Telefon +43/5524 501-0
Telefax +43/5524 501-930
Reg. No. 12 100 3054

Abnahmeprüfzeugnis
Inspection Certificate
EN 10204 - 3.1

Zeugnis Nr. *[cert. no.]*	Rev.	Datum *[date]*
036271/16-PD		24/10/2016

Code-Nr. *[code no.]*: 51T94
Ident Nr. *[ident no.]*:
Unsere Auftrags.Nr./Art.Nr. *[our order no./item no.]*: 184223DM-0321 / 003337
Ihre Bestell Nr. *[your order no.]*: HP244020
Menge *[quantity]*: 200

Artikelbezeichnung *[designation]*
elbows
LR-90-S-WPB-8"-XS

Anforderungen der Bestellung *[requirements of the order]*
ASME B16.9-2012 LR, material:WPB, TR-fitting:ASTM A 234/A 234M-15, ASME SA-234/SA-234M-15, TR-addit fitting:NACE MR0175/ISO15156-2:2009A.2, NACE MR0103-2012 2.1 and 4, certificate:EN 10204/3.1, rust protection:Millstandard, execution:Seamless

Kunde *[customer]*
Industrial Piping Specialists

Box 581270
USA-74158-1270 Tulsa, OK

Vormaterial *[base material]*: seamless pipe

Analyse *[analysis]* | Schmelze Nr. [heat no.] | Erschmelzungsart *[melting process]* | **1 = Schmelzanalyse** *[heat analysis]*

J-Faktor *[J-Factor]*: (Si + Mn) * (P + Sn) * 10000
CEQ *[CEQ]*: C + (Mn / 6) + (Cr + Mo + V) / 5 + (Cu + Ni) / 15

Index		C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	Nb	Al	B	Ti	N	Ceq	Ca		
1	410921	0.15	0.23	1.08	0.013	0.003	0.04	0.01	0.03	0.07	<0.01	<0.01	0.031	<0.0005	<0.01	0.0077	<0.35	0.0024		

Mech.-technologische Prüfung *[mech. technological test]*

Proben Nr. *[test no.]*	Zugversuch *[tensile test]*						Kerbschlagbiegeversuch *[notched bar impact test]* Form:			
	Pr.-Lage *[pos. of sample]*	Temp.	Dehngr. *[yield str.]* ReH	Dehngr. *[yield str.]* Rp 0,2	Zugfestigkeit [tensile str.] Rm (MPa)	Dehnung *[elongation]* 2" (%)	PR-Lage *[pos. of sample]*	Temp.	Querschnitt *[cross sec.]* (mm²)	Kerbschlagarbeit *[impact values]* (J)
502_12	L	+20 °C	363	339	503	32				

Härteprüfung *[hardness test]*: 140-149 HB

Wärmebehandlung *[heat treatment]*:
formed under normalizing cond.
temperature 840 °C - 890 °C
Cooling in still air

Kennzeichnung *[marking]*: CE QS AUSTRIA / A / SA234 / WPB / 51T94 / 8" / XS

Besichtigung und Ausmessung *[visual inspection and dimensional check]*: o.B./o.K.

Bemerkungen *[remarks]*
hot formed over mandrel

Zusatzmarkierung *[add. mark.]*

Die gelieferten Produkte erfüllen die in der Bestellung festgelegten Anforderungen.
[The products supplied are in compliance with the requirements of the order].
The products were manufactured, sampled, tested and inspected in accordance with the specifications and were found to meet the requirements.

Abnahmebeauftragter *[inspection representative]*
24/10/16 Pape Dijana ☎ - 323

Dieses Dokument wurde elektronisch erstellt und ist ohne Unterschrift gültig. *[The certificate is issued by the computerized system and is valid without signature.]*

Zertifiziert nach DGRL 2014/68/EU Anhang I - Absatz 4.3 durch TÜV SÜD Industrie Service, Benannte Stelle 0036,Zertifikat Nr. DGR-0036-QS-W 129/2002/MUC *[Certified acc. to PED 2014/68/EU Annex I, Paragraph 4.3 by TÜV SÜD Industrie Service. Notified Body 0036. Certificate No. DGR-0036-QS-W 129/2002/MUC]*

6

RECEIVED
JAN 17 2017
L. Dawson

CERTIFICATE OF INSPECTION & TEST (EN 10204 3.1)

ST&H CORPORATION
74, Jwadongsunhwan-ro, Haeundae-gu, Busan, Korea
Tel : +82.51.744-4680(5 line) Fax : +82.51.744-4670
E-mail :qm@stnhcorp.com

CE
RPS 0160308 / 01

Certificate No. MJW8896B Date : MAY. 26. 2015
Customer INDUSTRIAL PIPING SPECIALISTS,
Contract No. TP455658-2ND
Spec. For Material ASTM A105N-14/ASME SA105N-13/NACE MR0175 & NACE MR0103/ISO 15156-1:2001
Heat Treatment 910℃ NORMALIZED & A.C

Certified to ISO9001:2008, ISO14001:2004,PED97/23/EC by LRQA
Dimensional inspection ASME B16.5 - 2013

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen D mm	Size of Test Specimen GL mm	Tension Test	Y.S MPa	T.S MPa	E.L %	R.A %	Hardness Test (HB)		Charpy Impact Test (10X10mm Specimen Size) Indiv.	Ave.	Notch	Temp.
						Max					187		Test Result (J)			Ave.(J)
						Min	250	485	22.0	30.0						
BA600BR1	600LBS BL RF 1"	55	5A756H	12.5	50.0		313	549	36	73	143	143				
BA600KR1601	600LBS SW RF S160 1"	45	5A756H	12.5	50.0		313	549	36	73	143	143				
BA600KRXH1	600LBS SW RF XH 1"	40	5A756H	12.5	50.0		313	549	36	73	143	143				
BA600KRXH0.75 .	600LBS SW RF XH 3/4"	30	5A756H	12.5	50.0		313	549	36	73	143	143				
BA600WR1602	600LBS WN RF S160 2"	750	5A756K	12.5	50.0		339	528	33	75	143	144				
BA600WRXH2	600LBS WN RF XH 2"	105	5A756L	12.5	50.0		304	527	32	71	141	143				
BA600BR2	600LBS BL RF 2"	150	5A756M	12.5	50.0		306	508	31	66	143	144				
BA900WRXH4	900LBS WN RF XH 4"	150	103997B	12.5	50.0		285	529	34	73	141	143				
	BLANK		BLANK				BLANK				BLANK					

Heat No./ Batch No.		Chemical Composition (%) C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	CE	NDE UT	MT	PT
	Max	0.350	0.350	1.050	0.035	0.040	0.400	0.300	0.120	0.400	0.080				
	Min		0.100	0.600											
5A756H		0.204	0.312	0.930	0.013	0.004	0.007	0.022	0.003	0.010	0.004	0.365			
5A756K		0.204	0.312	0.930	0.013	0.004	0.007	0.022	0.003	0.010	0.004	0.365			
5A756L		0.204	0.312	0.930	0.013	0.004	0.007	0.022	0.003	0.010	0.004	0.365			
5A756M		0.204	0.312	0.930	0.013	0.004	0.007	0.022	0.003	0.010	0.004	0.365			
103997B		0.200	0.269	0.980	0.020	0.004	0.013	0.119	0.002	0.014	0.002	0.389			

REMARK * PRODUCT OF KOREA

We hereby certify that the material herein has been made and tested in accordance with the above specification and also with the requirements called for by the above order.

Witnessed by / H. J. LEE

Manager of Q.A Dept. / J. W. PARK

T-801-14-01

ST&H CORPORATION

Downcomer Flange MK 5-100

| 00608321 | | 5A756K | | LN: 6 | ER020791-1 | FK260RFWN160 |

8

RECEIVED
JAN 17 2017
L. Dawson

CERTIFICATE OF INSPECTION & TEST (EN 10204 3.1)

ST&H CORPORATION
74, Jwadongsunhwan-ro, Haeundae-gu, Busan, Korea
Tel : +82.51.744-4680(5 line) Fax : +82.51.744-4670
E-mail :qm@stnhcorp.com

CE
KPS 0160308 F01

Dowcomer Flange MK 5-91

Certificate No. MJW9095D-04/18 Date : OCT. 06. 2015
Customer INDUSTRIAL PIPING SPECIALISTS.
Contract No. TP476391-4TH
Spec. For Material ASTM/ASME A/SA105N-14,NACE MR0175-2009/ISO15156-1:2015,NACE MR0103-2012
Heat Treatment 930℃ NORMALIZED & A.C

Certified to ISO9001:2008, ISO14001:2004,PED97/23/EC by LRQA
Dimensional inspection ASME B16.5 - 2013

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen D mm	Size of Test Specimen GL mm	Tension Test	Y.S MPa	T.S MPa	E.L %	R.A %	Hardness Test (HB)	Charpy Impact Test (10X10mm Specimen Size) Indiv.	Ave.	Notch	Temp.
						Max					187				
						Min	250	485	22.0	30.0		Test Result (J)			Ave.(J)
BA600WRXH8	600LBS WN RF XH 8"	200	108305A	12.5	50.0		371	550	30	70	158 159				
BA600WRXH8	600LBS WN RF XH 8"	100	108305B	12.5	50.0		371	550	30	70	158 159				
BA600WRXH8	600LBS WN RF XH 8"	100	108305C	12.5	50.0		371	550	30	70	158 159				
BA600WRXH8	600LBS WN RF XH 8"	130	108305D	12.5	50.0		371	550	30	70	158 159				
BA600WRXH8	600LBS WN RF XH 8"	230	108305E	12.5	50.0		371	550	30	70	158 159				
	BLANK		BLANK				BLANK				BLANK				

Heat No./ Batch No.		Chemical Composition (%) C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	CE	NDE UT	MT	PT
	Max	0.350	0.350	1.050	0.035	0.040	0.400	0.300	0.120	0.400	0.080				
	Min		0.100	0.600											
108305A		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			
108305B		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			
108305C		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			
108305D		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			
108305E		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			

REMARK * PRODUCT OF KOREA

We hereby certify that the material herein has been made and tested in accordance with the above specification and also with the requirements called for by the above order.

Witnessed by / H. J. LEE

Manager of Q.A Dept. / J. W. PARK

-801-14-01

ST&H CORPORATION

| 00608321 | | 108305B | | IN: 8 | ER020791-1 | FK860RFWNXH |

[| 00608321 | | | 59667] | [LN: 29] | ER020791-1 | D2X8-6160WOL |

CERTIFIED MILL TEST REPORT

The Best Value - Price, Quality, Service All The Time.

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LOG NO. F00000000065756 Page 1 of 3

BONNEY FORGE CORPORATION
P.O. BOX 330 • 14496 CROGHAN PIKE • MOUNT UNION, PA 17066-0330
(814) 542-2545 • (800) 345-7546 • FAX (814) 542-4906
www.bonneyforge.com

CUSTOMER: INDUSTRIAL PIPING SPECIALISTS

DATE 11/12/2014

CUSTOMER ORDER NO.: ELP12623

BONNEY ORDER NO. B000177601

SHIP TO: INDUSTRIAL PIPING SPECIALISTS (EL RENO)
1301 TRAIL BLVD
EL RENO OK 73036
United States

RECEIVED JAN 17 2017 L. Dawson

ITEM	QUANTITY	LOT NO.	GRADE OR SPECIFICATION NO. CHEMICAL ANALYSIS, PHYSICAL PROPERTIES, REMARKS:
1	20	59577	36-8X2 XS A105 FLEX B SA/A105 Al 0.027 C 0.210 Cb 0.000 Co 0.004 Cr 0.040 Cu 0.050 Mn 1.020 Mo 0.006 Nb 0.014 Ni 0.013 P 0.006 S 0.021 Si 0.210 V 0.004 CE(Long Formula) = 0.39 T/S(PSI) 74,222 Y/S(PSI) 51,763 EL(%) 34.45 RA(%) 63.23 Brinell 137 BHN 135 BHN
2	25	59667	8 -6 X 2 S160 A105 WELD B SA/A105 Al 0.030 C 0.210 Co 0.000 Cr 0.040 Cu 0.050 Mn 1.020 Mo 0.006 N 0.003 Nb 0.013 Ni 0.030 P 0.006 S 0.022 Si 0.210 V 0.003 CE(Long Formula) = 0.40 T/S(PSI) 76,479 Y/S(PSI) 48,362 EL(%) 32.90 RA(%) 61.19 Brinell 139 BHN 139 BHN
3	500	6678 MALE	1 3000 A105 UNAR T SA/A105 Al 0.028 C 0.200 Co 0.004 Cr 0.040 Cu 0.060 Mn 1.000 Mo 0.006 N 0.004 Nb 0.012 Ni 0.020 P 0.006 S 0.019 Si 0.220 V 0.004 CE(Long Formula) = 0.38 T/S(PSI) 75,600 Y/S(PSI) 43,700 EL(%) 26.00 RA(%) 51.60 Brinell 163 BHN 163 BHN
		6881 FEMALE	1 3000 A105 UNAR T SA/A105 Al 0.033 C 0.200 Co 0.003 Cr 0.030 Cu 0.020 Mn 1.040 Mo 0.004 N 0.002 Nb 0.015 Ni 0.020 P 0.004 S 0.018 Si 0.220 V 0.003 CE(Long Formula) = 0.38 T/S(PSI) 76,200 Y/S(PSI) 48,700 EL(%) 27.00 RA(%) 52.30 Brinell 152 BHN 151 BHN

/e certify that the data on this sheet is a true copy taken from our records of material rnished us by the production mill, or as obtained by additional laboratory checks.

by Kenzie Grove

Kenzie Grove
QUALITY PROCESS MANAGER

MTR: REV2

Downcomer Weldolet MK 5-99

[| 00608321 | | | 10/K] | [LN: 28] | ER020791-3 | *MISC |

06Feb15 9:59

TEST CERTIFICATE

No: 1 113287

2-10-15

KREHER STEEL COMPANY, LLC.
1550 NORTH 25TH AVENUE
MELROSE PARK, IL 60160
Tel: 708-345-8180 Fax: 708-345-8293

P/O No 3269
Rel
S/O No 1 272541-001
B/L No 1 221072-001
Inv No

Shp 06Feb15
Inv

Sold To: (7811)
PRODUCTION MANUFACTURING CO., INC.
5909 EAST 13TH STREET
TULSA OK 74112

Ship To: (1)
PRODUCTION MANUFACTURING CO., INC.
5909 EAST 13TH STREET
TULSA OK 74112

Tel: 918-836-3585 Fax: 918-835-9681

CERTIFICATE of ANALYSIS and TESTS

Cert. No: 1 113287
06Feb15

Part No
TURN & POLISH ROUNDS A105
1.3750 X 16'R/L

1 3/8" Ø SA105
10/K

0

ASTM A105-
ASME SA105
HEAT NUMBER 145020
Cu .21 , V .034 AND Cb/Nb .001
LOT NUMBER 71494 WEIGHT 14524
TENSILE 89,400
YIELD 62,900
ELONGATION 24 %
REDUCTION OF AREA 45 %
HARDNESS 176 - AT SURFACE
MADE IN THE USA

RECEIVED
JAN 23 2017
ZVS
SEESE

Heat Number
145020

*** Chemical Analysis ***
C=0.2200 Mn=0.9300 P=0.0140 S=0.0310 Si=0.2300 Cu=0.2100
Ni=0.0860 Cr=0.1430 Mo=0.0300 Al=0.0030 Cb=0.0010 V=0.0340
Sn=<.007> B=<.0003> Ti=<.0002> N=<.0124> Ca=<.0021>

I hereby certify that this data is correct as contained in the records of this company.
I hereby certify that no mercury came in contact with or no weld repair was done to this product while in our possession.

BQapp

PRODUCTION MFG, TULSA, OKLA.
CUSTOMER IPS
P.O.# TP530740X
ITEM 3/4"-3000# x 3 1/2" Full Couplg
HEAT CODE 10/K

Page: 1 .... Last

Downcomer Coupling mk 5-101

5501549 01 ID#3207

3

NUCOR
PLATE MILL

P.O.Box 279
Winton, NC 27986
(252) 356-3700

Mill Test Report

Page 6

NUCOR
It's Our Nature

Issuing Date : 03/20/2015 B/L No. : 411932 Load No. : 417535 Our Order No. : 125433/12 Cust. Order No. : 143884-9

Vehicle No: ALY 91710

Specification: 2.0000" x 120.000" x 480.000"
ASTM A516 70/65/60-10/ASME SA516-70/65/60 PVQ 2010/2011a
Addenda, 2013 Normalized Plate NACE MR0175 Annex 2.1.2, MR0103
Section 2.1.2 Compliant

Marking :

Sold To: SUPERIOR SUPPLY AND STEEL
PO BOX 2388
SULPHUR ,LA 70664

Ship To: SUPERIOR SUPPY AND STEEL (CATOOSA)
C/O PTCATOOSA
TULSA PORT AUTHORITY
TULSA PORT AUTHORIT,OK 74016

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
5501549	0.22	1.06	0.013	0.002	0.22	0.20	0.07	0.07	0.01	0.023	0.005	0.002	0.002	0.0075	0.0000	0.0000	0.010	0.43	0.30

			Tensile Test					Heat Treat			Charpy Impacts											
											Absorbed Energy (Ft-lbs)					Shear (%)						
Plate Serial No	Pieces	Tons	Dir.	Yield (psi)	Tensile (psi)	Elong. % in 2"	Elong. % in 8"	Norm °F	Time (min)	Temper °F	Time (min)	Dir.	1	2	3	Ave	Min	1	2	3	Ave	Min	Temp °F	Size
5501549-01	2	32.67	T	46,400	76,900	55.0		1650	76			H-L	87.3	70.1	116.0	91.1	15						-40	10mm

ELITE TOWERS	HT#5501549
PO#5242109	SL#01
SO#320749	ITEM#1 1PCS

FEB 0 1 2017
L. Dawson

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast discrete plate, unless otherwise noted in Specification. For Mexico shipments: nhc-SalesMX@Nucor.com
Yield by 0.5EUL method unless otherwise specified. Ceq = C+(Mn/6)+((Cr+Mo+V)/5)+((Cu+Ni)/15)
Pcm = C+(Si/30)+(Mn/20)+(Cu/20)+(Ni/60)+(Cr/20)+(Mo/15)+(V/10)+5B
Melted and Manufactured in the USA. ISO 9001:2008 certified (#010940) by SRI Quality System Registrar (#0985-09). PED 97/23/EC 7/2 Annex 1, Para. 4.3 Compliant. DIN 50049 3.1.B/EN 10204 3.1B(2004), DIN EN 10204 3.1(2005) compliant. For ABS grades only, Quality Assurance certificate 14-MMPQA-723.

We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications, including customer specifications.

T. A. Deprets, Metallurgist

3/20/2015 8:01:45 AM

Q.A. APPROVED
By _____ Date 5/18/2015

Nozzle B Repad MK 1-11

17

AMERICAN ALLOY
PLATE # 5176513

NUCOR
PLATE MILL
P.O.Box 279
Wilson, NC 27986
(252) 358-3700

Mill Test Report

Page 1

1505 River Rd
Cofield, NC 27922
(252) 356-3700
NUCOR
It's Our Nature.

Issuing Date : 07/07/2016 B/L No. : 448664 Load No. : 456646 Our Order No. : 138090/24 Cust. Order No. : 108415-OK

Vehicle No: NOKL 725193

Specification: 1.5000" x 120.000" x 480.000"
ASTM A516 70-10(2015)/ASME SA516 70 PVQ 2013/2015 Cu .15 Max, Sn .020 Max Normalized Test Coupons at 1650 F NACE MR0175 Annex 2.1.2, MR0103 (2010) Section 2.1.2 (2015) 13.1.1, 13.1.2)Compliant .

Marking : 108415-OK

Sold To: AMERICAN ALLOY STEEL INC
6230 N HOUSTON ROSSLYN RD
PO BOX 40469
NORTH HOUSTON,TX 77091

Ship To: AMERICAN ALLOY STEEL
6350 N ERIE AVE
C/O SKOL TRACK #21
OWASSO,OK 74055

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
6504179	0.19	1.03	0.011	0.004	0.20	0.12	0.13	0.08	0.01	0.029	0.005	0.002	0.004		0.0019	0.0002	0.007	0.39	0.26

Tensile Test								Charpy Impacts										
Plate Serial No	Pieces	Tons	Dir.	(psi) Yield	(psi) Tensile	Elongation % in 2"	Elongation % in 8"	Dir.	1	(%) shear	2	(%) shear	3	(%) shear	Ave.	(%) shear	Size	Temp	Min Ave.
6504179-01	1	12.25	T	51,200	87,400		27.2												
			T	44,600	70,900		29.3	N											

ELITE TOWERS	HT#6504179
PO#5242109	SL#01
SO#320749	ITEM#2 1PCS

RECEIVED
FEB 0 1 2017
L. Dawson

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

HOT ROLLED CARBON STEEL PLATE
Test coupons only, normalized 30 minutes per inch of thickness at 1650 F ± 25 F. Hold 30 minutes minimum. ;

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast discrete plate as-rolled, unless otherwise noted in Specification. For Mexico shipments: nhc-SalesMX@Nucor.com
Yield by 0.5EUL method unless otherwise specified. Ceq = C+[(Mn/6)+((Cr+Mo+V)/5)+((Cu+Ni)/15)
Pcm = C+(Si/30)+(Mn/20)+(Cu/20)+(Ni/60)+(Cr/20)+(Mo/15)+(V/10)+5B
Melted and Manufactured in the USA. ISO 9001:2008 certified (#010640) by SFI Quality System Registrar (#0565-09). PED 97/23/EC 7/2 Annex 1, Para. 4.3 Compliant. DIN 50049 3.1.B/EN 10204 3.1B(2004), DIN EN 10204 3.1(2005) compliant. For ABS grades only, Quality Assurance certificate 14-IMPQA-723

We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications, including customer specifications.

T. A. Depretis, Metallurgist

7/7/2016 8:10:28 AM

Q.A. APPROVED
By: Date 12/2/2016

12/02/2016 From: AMERICAN ALLOY STEEL, INC. To: PORT CITY METAL SERVICES
P.O.#: 101403 S.O.#: 559272 AA PL#: 5176513
Item: 2 (1 PC) 1-1/2" X 120" X 480"

Lifting Lug Plate MK 2-32

02/14/2017 From: AMERICAN ALLOY STEEL, INC. To: BOARDMAN, INC
P.O.#: 00608356 S.O.#: 561564 AA PL#: 5180482
Item: 1 (1 PC) 3/8" X 62" X 258-13/16", PER BEVEL DTL #
TAG: 70699

ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

US HWY 12 Burns Harbor, Indiana

SHIPMENT NO. 804-06100 | DATE SHIPPED 01-23-17 | CAR OR VEHICLE NO. CSS-CHGO-BNSF BVRY 062134 | PAGE 1

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

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

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

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC, ASTM A516-06 GR 65 PVQ, ASME SA516 GR 70 PVQ 2015 EDITION, ASME SA516 GR 65 PVQ 2015 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL --- TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# 110190 GH 354-5373C

→ E540856	821V11050	4	.375	96	360	14700	56200	78400	8	25
							51100	74800	8	28
(M55)MFST REF#:4										
E540857	821V11050	4	.375	96	360	14700	56700	79000	8	24
							52800	75700	8	24
(M55)MFST REF#:4										

RECEIVED
FEB 17 2017
L. Dawson

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

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

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
J.F 2.9.2017

HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MO/AD GRAIN SIZE
821V11050	.17	1.12	.014	.006	.32	7.019	.01	.13	.082	.002	.002	.033	.0002	.002	.005	.004	

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

BHPLTRPT.TIF

R. SPANGLER II PER LSS
SUPV. QUALITY ASSURANCE

AMERICAN ALLOY PLATE #5180482

Miscellaneous Skirt Plate MK 1-6.

ELITE TOWERS	HT#821U02690
PO#5242109	SL#C051159
SO#320749	ITEM#5 1PCS

2, 5, 6, 8, 12, 13, 15, 18, 19

659700 Burns Harbor Plate
Quality Department
250 West US Highway 12
Burns Harbor, IN 46304

Report of tests and analyses

ArcelorMittal

Shipment no.	Date shipped	Car or vehicle no.	
803-00267	09-16-16	AMERICAN COMMERCIAL	PAGE 3

Sold to
SENTRY SUPPLY INC
DBA SUPERIOR SUPPLY & STEEL CO
PO BOX 2388
SULPHUR LA 70664

Ship to
SUPERIOR SUPPLY & STEEL CO
C/O RICHWAY STEVEDORING
CITY DOCKS PORT OF HOUSTON
111 E LOOP NORTH
HOUSTON TX 77092

Serial number	Pat no.	Heat no.	Size and quantity: No pcs	Thickness INCHES	Width or dia. INCHES	Length INCHES	Weight POUNDS	Yield point PSI	Tensile strength PSI	Elong. in/2" IN	Elong. %	Red. %

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.

PLATES - ASTM A516-06 GR 70 PVQ KLD FINE
GRAIN PRAC, ASME SA516 GR 70 PVQ
2015 EDITION, FIRST TST AS
ROLLED-ADD'L TENSION PER TST PC
HEAT TREATMENT --- MILL TEST PCS
NORM 1650F FOR 1HR/IN AIRCL
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# PO170744-04 GH 816-S811L

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

C051159	821U02690	1	1/2	120	480	8168	47500	73800	8	26
							50000	71600	8	26
(M55)MFST REF#:LN 14										
C051160	821U02690	1	1/2	120	480	8168	50500	75800	8	28
							50000	72000	8	28
(M55)MFST REF#:LN 14										

RECEIVED
FEB 0 1 2017
L. Dawson

Q - quench temperature T - temper temperature 1100 N - normalize temperature

Serial number	Pat no.	Heat number	Hard	Bend	Thickness INCHES	Type	Size	Dir	Test temp. F	Charpy impact Energy FT. LBS. 1	2	3	Shear % 1	2	3	Lat. exp. MILS 1	2	3

SUBSCRIBED AND SWORN TO BEFORE ME
THIS 19TH DAY OF JAN YR 2017
NOTARY PUBLIC RYAN D. NEWBERN
PORTER COUNTY, INDIANA
MY COMMISSION EXPIRES DECEMBER 7, 2023
COUNTY OF RESIDENCE, PORTER

Heat number	Chemical analysis C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	Austenitic grain size
821U02690	.17	1.06	.011	.006	.333	.223	.17	.03	.005	.002	.002	.037	.0002	.002			

Q.A. APPROVED
By _____ Date 11/22/2016

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

Robert K Youngblood Quality manager per

Miscellanius Plate MK2-31, MK2-40, MK3-51, MK3-52 MK3-53, MK3-64, MK3-70, MK3-74, MK4-81, MK4-82, and MK4-86

Cust: ELITE TOWERS INC. ORD#: 35-45198-03 Date: 12192016 Time: 141023 To: OCJWM Page 1 of 1

Miscellaneous Plate MK 5-103 and MK 5-112

SSAB 7,14

Test Certificate

Form TC1: Revision 2: Date 23 Apr 2014

12400 Highway 43 North, Axis, Alabama 36505, US

Customer: RYERSON INC. P.O. BOX 91602 LUBBOCK TX 79490-1601	Customer P.O. No.: M3574934	Mill Order No.: 41-427710-01	Shipping Manifest : AT204219
	Product Description: ASTM A516-70(10)/ASME SA516-70(13) AS-ROLLED, TENSILE COUPON NORMALIZED 1650F+/-25F/1HR/"	Ship Date: 28 Apr 15 Cert Date: 28 Apr 15	Cert No: 081504877 (Page 1 of 1)
	Size: 0.375 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
5D157	E06	0.371 (DISCRT)	L	54	79		24		T													
5D157	E06*	0.371 (DISCRT)	L	54	78		26		T													

Heat Id	Chemical Analysis C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	ORGN
D157	.20	1.12	.009	.001	.25	.025	.023	.31	.16	.11	.05	.001	.004	.008	.0008	USA

KILLED STEEL
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE
RESULTS OF TESTS PERFORMED ON NORMALIZED TEST COUPONS ARE LABELED ABOVE WITH *
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
PRODUCTS SHIPPED:
E5D157 E06 PCES: 9, LBS: 44109

(U) Cust Part # : 35852

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

Justin Ward
SENIOR METALLURGIST - PRODUCT

ELITE TOWERS	HT#821T02570
PO#5242109	SL#B060377
SO#320749	ITEM#4 1PCS

1

ArcelorMittal Burns Harbor Plate — US HWY 12 Burns Harbor, Indiana

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.		PAGE
803-05823	05-13-16	CSB-CHGO-UP	UP 262080	7

SOLD TO:
SENTRY SUPPLY INC
DBA SUPERIOR SUPPLY & STEEL CO
PO BOX 2388
SULPHUR LA 70664-2388

SHIP TO:
SUPERIOR SUPPLY & STEEL CO
C/O RICHARDSON STEEL YARD
PTRA 20-702
8615 CLINTON DR
HOUSTON TX 77029

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

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ KLD FINE
GRAIN PRAC, ASME SA516 GR 70 PVQ
2015 EDITION, FIRST TST AS
ROLLED-ADD'L TENSION PER TST PC
HEAT TREATMENT --- MILL TEST PCS
NORM 1650F FOR 1HR/IN AIRCL
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

CO# P0165743-04 GH 816-5624G
TEST SPECIMENS LABORATORY HEAT TREATED AND YIELD STRENGTH @ .5% E.U.L.

B060377	821T02570	1	1	120	480	16335	46900	77500	8	26
							51000	75900	8	28

(M55)MFST REF#:LN#8

PLATES - ASTM A709-15 GR 50 MOD SI.04 MAX AL
KLD FINE GRAIN PRAC TYPE 3, ASTM
A572-15 GR 50, CH-V A673 FREQ (H) L
26/18 FTLBS AT -22F

CO# P0165743-04 GH 816-5624H

812837150	2	1/4	120	480	8168	85000	88300	8	15

(M55)MFST REF#:LN#9

SUBSCRIBED AND SWORN TO BEFORE ME
THIS 16 DAY OF May YR 16

NOTARY PUBLIC: [illegible]
LA PORTE COUNTY INDIANA
MY COMMISSION EXPIRES DECEMBER 20, 2017
COUNTY OF RESIDENCE, LA PORTE

Q-QUENCH TEMPERATURE — T-TEMPER TEMPERATURE

FEB 07 2017
16
L. Dawson

SERIAL NUMBER	PAT NO.	HEAT NUMBER	HARD BHN	BEND	THICKNESS INCHES	TYPE	SIZE	DIR	TEST TEMP F	CHARPY IMPACT ENERGY FT LBS 1	2	3	SHEAR(%) 1	2	3	LAT. EXP MILS 1	2	3
		812837150			.250	V	1/2	L	-22	43	79	46						

CHEMICAL ANALYSIS

HEAT NUMBER	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MOLVD GRAIN SIZE
821T02570	.18	1.15	.017	.004	.31	5.012	.01	.13	.082	.003	.002	.029	.0002	.003	.004	.002	
812837150	.09	1.25	.012	.005	.01	1.026	.02	.04	.006	.048	.017	.030	.0002	.032	.007	.005	

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

Robert K Spangler II
R. SPANGLER II PER LSS
SUPV. QUALITY ASSURANCE

BHPLTRPT.TIF

KMG	HT#821T02570
PO#174-5	SL#B060377
SO#319857	ITEM#7 2PCS
	19 2PCS
	28 2PCS
	29 2PCS

Q.A. APPROVED
By [illegible] Date 11/7/2016

Miscellanius Plate MK4-84

22Dec16 11:38 T E S T C E R T I F I C A T E No: TU 279030

4, 10

Sold To: (24222)
BOYD METALS OF OKLAHOMA CITY INC
ATTN SHELIA HARRINGTON
PO BOX 819
FORT SMITH AR 72902

Ship To: (1)
BOYD METALS OF OKLAHOMA CITY INC
6060 SOUTHWEST 44TH ST
OKLAHOMA CITY OK 73179

CERTIFICATE of ANALYSIS and TESTS Cert. No: TU 279030
22Dec16

Part No	Pcs	Wgt
HR SHEET COMM. STEEL TYPE B		
10 GA. X 96.0000" X 242.0000"	3	2,723

ASTM A1011-12

Heat Number	Tag No	Pcs	Wgt
1378C4	951780	3	2,723

YIELD=41/TENS=56/ELONG=36/MILL=<ESSAR>/VESSL=<CN136929>
CNTRY=<USA>/MELT=<CANADA>/MFG=<CANADA>

Heat Number *** Chemical Analysis ***
1378C4 *=0.0000 C=0.0900 Mn=0.3500 P=0.0070 S=0.0080 Si=0.0300
Cu=0.0100 Al=0.0380 Ti=0.0020 V=0.0000 Nb=0.0000 Ca=0.0021
Mo=0.0000 Cr=0.0100 Ni=0.0100 Sn=0.0000 N=0.0039

ELEMENTS NOT LISTED TEST BELOW DETECTABLE LEVELS
ALL ASTM PLATE PRODUCTS ARE PRODUCED FROM COIL

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS SAMPLED AND TESTED IN ACCORDANCE WITH THE SPECIFICATION, TO OUR KNOWLEDGE, AND FULFILLS REQUIREMENTS IN SUCH RESPECT.
ALL PRODUCT IS PRODUCED FROM COIL. ELONGATION IS MEASURED FROM A TWO INCH GAGE LENGTH UNLESS OTHERWISE NOTED.

FEB 0 1 2017
L. Dawson

Miscellanious Plate MK1-29 and MK1-27

01/13/2017 From: AMERICAN ALLOY STEEL, INC. To: ELITE TOWERS INC.
P.O.#: 5242097 S.O.#: 561746 AA PL#: 5177802
Item: 12 (1 PC) 1/4" X 72 X 96

9

ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

US HWY 12 Burns Harbor, Indiana

SHIPMENT NO. 803-08502 | DATE SHIPPED 07-20-16 | CAR OR VENICLE NO. CSS-CHGO-BNSF CSS 019001 | PAGE 8

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

SHIPPED TO
AMERICAN ALLOY STEEL INC
C/O SKOL TRACK #21
6350 N ERIE AVE
OWASSO OK

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

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC, A516-06 GR 65 PVQ, ASME SA516 GR 70 PVQ 2015 EDITION, ASME SA516 GR PVQ 2015 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTE MIN), AIRCOOL --- TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1 CORD WITH PROCEDURES OUTLINED EN
10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# 108591-OK GH 354-5169F

C041704	813T72930	1	.25	96	360	2450	57800	82700	8	21
							56300	77200	8	26
(M55)MFST REF#:1										
C041697	823T69840	2	.25	96	360	4900	53700	82900	8	21
							61600	79200	8	23
(M55)MFST REF#:1										
→ C041698	823T69840	2	.25	96	360	4900	52500	82300	8	20
							56700	78000	8	23
(M55)MFST REF#:1										

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

RECEIVED FEB 01 2017 L. Dawson

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

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
J.P. 8/3/2016

HEAT NUMBER	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MIXAID GRAIN SIZE
813T72930	.18	1.13	.013	.005	.320	.021	.01	.13	.082	.003	.002	.030	.0002	.003	.006	.002	
823T69840	.18	1.16	.016	.005	.328	.020	.01	.13	.083	.003	.002	.032	.0002	.002	.006	.004	

AMERICAN ALLOY PLATE #5177802

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

BHPLTRPT.TIF

R. SPANGLER II PER LSS
SUPV. QUALITY ASSURANCE

Miscellanius Plate MK 1-28

01/06/2017 From: AMERICAN ALLOY STEEL, INC.	ELITE TOWERS	HT#813U73010
P.O.#: 101458 S.O.#:	PO#5242109	SL#C061564
Item: 6' (1 PC) 1-1/4" X 96" X 480"	SO#320749	ITEM#3 1PCS

20

ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE
REPORT OF TEST AND ANALYSES

US HWY 12 Burns Harbor, Indiana

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.		PAGE
803-12431	10-21-16	CSS-CHGO-BNSF	LMIC 066050	4

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

SHIP TO:
AMERICAN ALLOY STEEL INC
C/O SKOL TRACK #21
6350 N ERIE AVE
OWASSO OK

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

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC, ASTM A516-06 GR 65 PVQ, ASME SA516 GR 70 PVQ 2015 EDITION, ASME SA516 GR 65 PVQ 2015 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL --- TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# 109611-OK GH 354-5293B

C061560	811U09890	1	1.25	96	480	16335	44100	72600	8	28
							47600	73100	8	29
(M55)MFST REF#:3										
C061563	813U73010	1	1.25	96	480	16335	46400	75100	8	28
							48800	74000	8	29
(M55)MFST REF#:3										
→ C061564	813U73010	1	1.25	96	480	16335	45000	74500	8	28
							48800	73600	8	30
(M55)MFST REF#:3										

RECEIVED
FEB 01 2017
L. Dawe

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

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

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
JP 12·1·2016

HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MOLDS GRAIN SIZE
811U09890	.17	1.07	.015	.006	.310	.020	.01	.12	.078	.002	.002	.031	.0002	.002	.007	.003	
813U73010	.17	1.12	.014	.004	.354	.026	.01	.12	.086	.002	.002	.038	.0002	.003	.007	.005	

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

R. SPANGLER II PER LSS

SHPLTRPT.TIF

SUPV. QUALITY ASSURANCE

Q.A. APPROVED
By _____ Date 1/6/2017

AMERICAN ALLOY
PLATE #D1718933

Miscellanius Plate MK 2-38

[| 00608321 | | | 232AA] | [LN: 11] | ER020791-4 | D.75HXPLUG |

Capitol Manufacturing
1125 Capitol Avenue
Crowley, LA 70526

10, 11

Commanding a Higher Standard℠

Phoenix * Capitol * Camco

CapProducts

Certified Mill Test Report

Printed: 2/25/2016
Customer
INDUSTRIAL PIPING SPECIALISTS
P.O. BOX 581270
TULSA, OK 74158

Certified: 02/18/2016
P.O. ELP32345
Tag

Heat No 144343
Heat Code 232AA
Phoenix Order # 1186190

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

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Part Number
12203407

Description
3/4" FS HEX HD PLUG

Chemical Properties

C	Mn	P	S	Si	Cu	Ni	Cr
0.2000	0.9400	0.0060	0.0240	0.2300	0.1900	0.0660	0.1060

C Eq. Long
0.4055

Mo	V	Co	Al	Cb	N	Pb	Sn	Ta	Ti
0.0160	0.0370								

Additional Chemical Properties

Cr + Cu + Ni
0.3620

Mechanical Properties

Tensile (PSI)	Yield (PSI)	Elong. % in 2 in. or 4D	R of A	HBW	HBW2
87,000	58,500	26.0%	60.0%	179	167

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 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.

Miscellanius Plugs MK1-23 and MK5-102

[| 00608321 | | | 30303K] | [LN: 12] | ER020791-4 | FSNH1.5STD |

12 FSNH 1.5STD

TÜV CERT EN ISO 9001:2008 / EN ISO 14001:2004 Certificate Reg. No. DE 100 036041-004, DE 104 990140-004

ArcelorMittal

A02 **Inspection certificate "3.1" (EN 10 204)**

A03 Document No.: **01879/11**

A07	Customer's Order (P.O.) No./Item No.: **HR033045/10078223 IPS**	A08	Manufacturer's Works Order No.: **40874/0/11**
A11	Supplier's Order No.: **NH 3150035991**	A10	Advice - Note No.: **503781, 503783, 503870.**
B08, B12/13	Quantity delivered: pcs / bdls: **1164**; mtrs / feet: **24550.525**; B13 Actual mass kgs / lbs: **31144**	A06	Customer / Consignee: **ARCELORMITTAL INTERNATIONAL AMERICA 1 S.DEARBORN STREET 60603-9888 CHICAGO USA**
B09-11	Dimensions: **1.1/2" x 3.70 mm (1.1/2" x 0.145")**		
B02	Steel designation: **B / X42**		

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B01, B03, B04 Product, conditions and terms of delivery:
Seamless steel pipes acc. to API 5L 44th edit. 2007 PSL-1 / ASTM A 53/A53M-07 / ASME SA 53/SA 53M-10 / ASTM A 106/A 106M-08 / ASME SA 106-10 / NACE MR 0175-03 / NACE MR 0103-05, GRADE B / X42, in lengths SRL, with square cut ends, ends protected with plastic caps, lacquered as finished, certified acc. to EN 10204/3.1-2004. Hot finished as rolled.

A04, B06 Marking: Manufacturer's mark, mill inspector's stamp

AMTP OSTRAVA (2) (1)

C71-92 Heat (H) and product (P) chemical analyses (%) — C70 Steel made by basic oxygen process, fully killed, strand cast.

B07 Heat No.:		C	MN	P	S	V	NB	TI	SI	CU	NI	CR	MO	CEQ
30303K	H	0.17	0.70	0.010	0.007	<0.003	<0.003	<0.003	0.193	0.05	0.03	0.04	0.005	0.30
	P	0.16	0.68	0.007	0.004	<0.003	<0.003	<0.003	0.204	0.04	0.02	0.04	0.005	0.28
	P	0.16	0.69	0.007	0.005	<0.003	<0.003	<0.003	0.209	0.04	0.02	0.04	0.005	0.29

Z99 continues on appendix

B07 Heat No. / C04 Requirements:	C00 Specimen No.	C11 Yield Point psi	C12 Tensile Strength psi	C13 Elongation % 2"	C40-43 Impact test J °C Ø / min	C30-32 Hardness HRB
	B	min. 35500	min. 60200	min. 21		max. 99
	X42	min. 42100	min. 60200	min. 21		
		Longitudinal strip specimen 3/4"				
30303K		52504	74114	26.2		68.7
		52939	74259	27.8		
		50328	73534	28.0		

Z99 continues on appendix

D01	Visual and dimensional inspection with satisfactory results	X	D51	Hydraulic test - min. test pressure psi / sec.	2970 / 6
C50	Flattening test - satisfactory		D02	The pipes tested on tightness by NDT in acc. to	
C51	Expanding test - satisfactory				
C52	Bending test - satisfactory	X			
C53	Ring expanding test (DIN EN 10236) - satisfactory		D03	Nondestructive Elektromagnetic Testing	
C54	Ring tensile test (DIN EN 10237) - satisfactory				

22 HRC = 99 HRB max.
MSNA Order No.: HR033045/10078223 Customer name : IPS Vessel name : JANA

Z01 All pipes conform to the above mentioned standards and ordering requirements and agreements.

Z02 Date of issue 31.12.2011/Vo

ArcelorMittal
ArcelorMittal Tubular Products Ostrava a.s.
Vratimovská 689, 707 02 Ostrava 7
Řízení jakosti
36

Tel.:++420 595683644 / Fax:++420 595682062

A01 ArcelorMittal Tubular Products Ostrava a.s.
A05 QA Department
Vratimovská 689
707 02 Ostrava-Kunčice
Czech Republic

Dipl. Ing. Pekař
Work's Inspector
Z02 Validation

E.z. 2575/16/15/P

Miscellanius Pipe MK 2-35

13

[| 00608321 | | | 860399] | [LN: 13] | ER020791-4 | FSHB18STD |

FSHB18 STD

HUTA BATORY
Sp. z o.o.
UL. Dyrekcyjna 6
41-506 Chorzów
POLAND

ŚWIADECTWO ODBIORU No 3548/EXP/R/12

CERTYFICAT DE RECEPTION INSPECTION CERTIFICATE
ABNAHMEPRÜFZEUGNIS СЕРТИФИКАТ
Acc. to EN 10204:2006 type 3.1
/nr normy/

Zamawiający ALCHEMIA S.A. 00 - 842 WARSZAWA UL.ŁUCKA 7/9
Le client-Ordered by-Besteller-Заказчик

Adres wysyłkowy COUTINHO & FERROSTAAL HOUSTON, TX 77060
Adresse-Address-Versandadresse-Адрес получателя

Nr i data zamówienia klienta No et date la commande Order No and date No und Datum der Bestellung No и число заказа	Nr zlecenia Ordre No Manuf. Order No Auftrag No No наряда	Nr awiza Avis No Advice No Versandanzeige No No извещения	Nr wagonu Wagen No Car No Wagon No No вагона
PL/ABR/12/00701 1040325300	4249046/12		

Wyszczególnienie zamówienia:
Specyfication de la commande-Order Specification-Spizifikation der Bestellung-Спецификация заказа

Przedmiot i wykonanie (stan obr. Termicz.,mech. Itp.) L'objet et l'execution (traitement thermique et l'usinage) Item and specification (Heat and mechanical treatment etc.) Gagenstand und Ausführung (therm und mechan. Bearbeitung usw.) Предмет и исполиение (состояние терм. и механобраб. и пр.)	Wymiar lub rysunek Dimensions ou dessin Dimesions or drawing Abmessung order Zeichnung Размер чертеж	Marka Marque Steel type Marke Марка	Wytop Coulée Heat Abstich Плавка	Sztuk Piéces Pieces Stück Штук	mb. ft (c. mtr.) c. mtr. 1. M. пог. м	Kg lb (kg) кг
Seamless steel pipes acc. to ASTM A106/A106M/10/A53/A53M/10/ ASME SA106/SA53/ SEC.II.P.A/10. Outside diameter tolerances +/- 1 %. Tolerances wall of thicknes +22,5/-12,5%. Outside surface double lacquered. Bevelled ends. Pipes hot finished > 850 degree C and cooled in still air. Melting proces: Electric furnace-Fully killed. No Mercury, Mercury compounds or Mercury bearing instruments and or equipment have been used in any manner which might cause contamination in manufacture, assembly or test of material. No weld repair. Fine grain practice.Country of melt and manufacture: Poland.	18" x 0,375" (457 x 9,53 mm) 37 - 44 ft (11,28 - 13,41 m)	B/C	860399	10	412,2 (125,70)	30996 (14061)

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Kontrolę techniczną powyższego zamówienia przeprowadził Oddział Technicznej Kontroli. Wyniki badań podano niżej.
Le controle technique de la été exécute par le Service de Controle. Les resultats des essais sont indiqués ci-aprés.
The technical investigation of this order has been executed by the Works Control. Results of tests are as follows.
Die technische Prüfung obiger Bestellung wurde von der Fabrikationskontrolle durchgeführt. Die Ergebnisse der Proben sind nachstehend angeführt.
Технический контроль вышеупомянугого заказа произвел Отдел Технического Контроля. Результат испытания представлен ниже.

1. **SKŁAD CHEMICZNY** - ANALYSE CHIMIQUE – CHEMICAL COMPOSITION – CHEMISCHE ZUSAMMENSETZUNG ХИМИЧЕСКИЙ СОСТАВ

Wytop Coulée Heat Abstich Плавка	C	Mn	Si	P	S	Cr	Ni	Cu
860399	0,17	0,98	0,23	0,010	0,009	0,09	0,08	0,16
control anal.	0,20	0,99	0,23	0,010	0,012	0,10	0,08	0,17
	0,19	0,97	0,23	0,009	0,009	0,10	0,08	0,17
	Mo	V	Ceq					
	0,02	0,00	0,37					
	0,02	0,00	0,41					
	0,02	0,00	0,39					

Miscellanius Pipe MK 2-37

2. BADANIA MECHANICZNE – ESSAIS MECANIQUES – MECHANICAL TESTS – MECHANISCHE UNTERSUCHUNGEN
МЕХАНИЧЕСКИЕ ИСПЫТАНИЯ

Nr wytopu lub próby No de la coulée ou De l'eprouvette Heat No Or. Tests No Abstich Oder Probe No No плавки или пробы	Stan obróbki Termicznej Traitement thermique Heat treatement Therm. Bearbeitung Термич. обработка	Yield Re PSI MPa min 275	Tensile Rm PSI MPa min 485	A 2" % min 30,0	Z %	U	Twardość Dureté Hardness Härte Твердость
Test size:$1^1/_2$" longitudinal 860399/20496		53083 (366)	77595 (535)	33,9			Hardness guarantee - max 22 HRC. Pipes in accordance with NACE MR 0175/ ISO - 15156-2/03 AN.A.p.A 2.1.2 and NACE MR 0103/2005 P.2.1

3.BADANIA TECHNOLOGICZNE – ESSAIS TECHNOLOGIQUES – TECHNOLOGICAL TESTS – TECHNOLOGISCHE PRÜFUNGEN
Flattening test - positive results

4. INNE BADANIA – AUTRES ESSAIS – OTHER TESTS – ANDERE UNTERSUCHUNGEN – ДРУГИЕ ИСПЫТАНИЯ

Each pipes has been hydrostatically tested by pressure 1015 PSI - positive results time 5 s

5. UWAGI DODATKOWE – ADDITIONAL REMARKS – AUTRESOBSERVATIONS – ANDERE BEMERUNGEN
Huta Batory Sp.z o.o. has Quality Management System accordance with Directive 97/23/EC (PED) – Annex I – par. 4.3 –cert.TÜV no 07-202-3537 WP/WZ 0888/10.

Powierzchnię i wymiary zbadano w 100% - Surface et dimensions ont éte controlés et 100% - Surface and dimensions tested at 100%
Oberfläche und Abmessungen geprüft zu 100% - Наружный осмотр и проверка измерений произведены в 100% - **positive results**

Niniejszym potwierdzam, że wyżej wymieniony materiał zostal zbadany i spelnia warunki potwierdzenia zamówienia - Par la presente je confirme que le materiel susmentionne a ete examine et il remplit les conditions de la confirmation de commande.- We hereby certify, that the material described above has been tested and complies with the terms of the order.- Es wird bestaetigt, dass das oben genannte Material geprueft wurde und den Bedingungen der Bestellung entspricht.- Подтверждаем, что вышеуказанный материал был протестирован и соответствует условиям подтверждения договора.

Material oznaczono – La material est marqué – Material marked – Das Material wurde bezeichnet – Материал обозначен
Acc.to A106/A53/SA106/SA53/B/C.

B

Na podstawie wyżej przeprowadzonych prób material zwolniono – Sur la base des essais si-dessus le material est dliv-According to the carried out tests the material released – Untersuchungen wurde das Material freigegeben – На основании вушенменованных Испытаний признан годным.

Kontrola Jakości Contróle de Fabrication Control of Manufacture Fabrikationskontrolle Технический контроль	Dyrekcja Huty Direction de l'Usine Works Management Hütten - Direktion Дирекция Завода	
SPECJALISTA Z ZAKRESU KONTROLI JAKOŚCI *mgr Barbara Czyż*	Kierownik Działu Kontroli Jakości i Technologii inż. Jerzy Nowaczyk	dn. 30.08. 2012 r.

KJ 21/631

Miscellanius Pipe MK 2-37

voestalpine Tubulars GmbH & Co KG

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

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

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

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FSVAT 4120

INSPECTION - CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

No. 105797

Hersteller: Manufacturer: Producteur:	voestalpine Tubulars GmbH & Co KG, Austria
Besteller: Purchaser: Archeteur:	VOEST-ALPINE TUBULAR CORPORATION USA-77042 HOUSTON TEXAS INDUSTRIAL PIPING SPEC., TULSA OK 74158-1270, US
Pruefgegenstand: Object of tests: Eprouvette:	**Line Pipe** **LP-USA-02** **LINEPIPE-01.0** **non upset ends (API 5 D + 5 L) - non upset** **UV coating**
Werkstoff: Material: Matières:	GRADE B / GRADE X42/ GRADE C
Anforderungen: Requirements: Exigence:	Gr B acc. ASTM A 106 / A 106 M -ASME SA 106 - 2014 Gr B acc. ASTM A 53 / A 53 M - ASME SA 53 - 2012 Gr B / X42 acc. API SPEC 5 L (PSL1)-45.edition - 2012 NACE MR 0175 / ISO 15156-2009 NACE MR0103-2012 (latest edition) LINEPIPE-01.0
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE, BOTH ENDS BEVELLED ACC. TO API/ASTM (30°)
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" 11/14 4.500" x 0.438" B/X42 PSL1 SMLS 2970 PSI length ft heat no A/SA 53 Grade B S A/SA 106 Grade B Sched 120 PO# MIP00080 MADE IN AUSTRIA
Colour coding:	Fully painted: Bands: Purple
Label:	PO No.: MIP00080, DAT QUAY Port of Houston, TX
Remarks:	*) Grade C without marking on tubes SI units have been converted to US customary units

Auftrags-Nr.: Our works order No.: No usine:	17500 / 16
Bestellnr.: Your order No.: No de la commande:	MIP00080/VATC PO#410606
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, 18.11.2014

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

voestalpine
ONE STEP AHEAD.

No. 105797

Miscellanius Pipe MK 4-83

1 of 5

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:
	16	4.500 In x 0.438 In 19,01 lbs/ft	1-53	511	21 367.703ft	184 889.00kg		

Volume of delivery

Heat	Lot			Remark
1014364396	193480	--	01	
1014364397	193481	--	01	
1014364398	193482	--	01	
1014364399	193483	--	01	

Test results

1 Dimensionskontrolle/ Dimensional Inspection: bestanden/passed

2 Ringfaltversuch/Flattening test: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: 2970 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, 18.11.2014

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

voestalpine
ONE STEP AHEAD.

No. 105797

Miscellanius Pipe MK 4-83

2 of 5

voestalpine Tubulars GmbH & Co KG

Tensile testing

Lot No	Test Type	Heat treatment	Temp	Specimen			Yield Strength	Tensile Strength	Elong.	Reduct. in area	Rt/Rm
			[°C]	No.	Type	Dimension [mm]	[PSI]	[PSI]	[%]	[%]	
						Requ. from	42 061	60 190	26.50		
						Requ. to					
193480 -- 01	Standard	as rolled	20	1	Strip	25.32 x 11.30 Rt0.50	48 442	72 808	35.30		0.67
193481 -- 01	Standard	as rolled	20	1	Strip	25.35 x 11.39 Rt0.50	48 297	72 226	36.00		0.67
193482 -- 01	Standard	as rolled	20	1	Strip	25.40 x 11.38 Rt0.50	52 213	74 984	35.50		0.70
193483 -- 01	Standard	as rolled	20	1	Strip	25.39 x 11.20 Rt0.50	48 587	73 679	34.30		0.66

yield strength:
Gr B: 35500 PSI
X42: 42100 PSI
Gr C: 40000 PSI
tensile strength:
Gr B: 60200 PSI
X42: 60200 PSI
Gr C: 70000 PSI

Hardness testing

Lot No	Test Type	Heat treatment	Specimen No.	Location	Test Method	Hardness Number from	to	Mean Hardness Number from	to	Variation
					Requ.:				99.50	
193480 -- 01	Standard	as rolled	1	Body	HRB	80.90	82.00	81.27	81.80	0.53
193481 -- 01	Standard	as rolled	1	Body	HRB	80.50	81.40	80.80	80.97	0.17
193482 -- 01	Standard	as rolled	1	Body	HRB	81.50	82.20	81.83	81.93	0.10
193483 -- 01	Standard	as rolled	1	Body	HRB	81.60	82.30	81.83	82.10	0.27

Kindberg, 18.11.2014

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

voestalpine
ONE STEP AHEAD.

No. 105797

Miscellanius Pipe MK 4-83

3 of 5

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															
1014364396	0.1753	0.2596	0.9553	0.0145	0.0071	0.0503	0.0234	0.0237	0.0294	0.0015	0.0062	0.0033	0.0012	0.0002	0.0047	0.0411	0.0023	0.3496
1014364397	0.1748	0.2610	0.9646	0.0141	0.0056	0.0374	0.0135	0.0180	0.0312	0.0015	0.0048	0.0032	0.0002	0.0000	0.0049	0.0379	0.0028	0.3467
1014364398	0.1782	0.2652	0.9486	0.0151	0.0048	0.0339	0.0142	0.0184	0.0295	0.0016	0.0031	0.0031	0.0007	0.0002	0.0056	0.0380	0.0028	0.3465
1014364399	0.1741	0.2647	0.9644	0.0137	0.0072	0.0434	0.0405	0.0194	0.0307	0.0015	0.0095	0.0031	0.0009	0.0002	0.0071	0.0396	0.0026	0.3500

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. 193480 -- 01 1 Standard Heat No. 1014364396	0.1742	0.2407	0.9369	0.0145	0.0077	0.0457	0.0300	0.0207	0.0255	0.0020	0.0086	0.0048	0.0016	0.0004	0.0000	0.0382	0.0000	0.3456
Lot No. 193480 -- 01 2 Standard Heat No. 1014364396	0.1702	0.2361	0.9281	0.0144	0.0073	0.0458	0.0279	0.0214	0.0251	0.0019	0.0080	0.0046	0.0015	0.0004	0.0000	0.0371	0.0000	0.3399
Lot No. 193481 -- 01 1 Standard Heat No. 1014364397	0.1735	0.2452	0.9250	0.0151	0.0068	0.0324	0.0139	0.0173	0.0254	0.0019	0.0048	0.0040	0.0015	0.0004	0.0000	0.0330	0.0000	0.3380
Lot No. 193481 -- 01 2 Standard Heat No. 1014364397	0.1675	0.2416	0.9131	0.0150	0.0066	0.0322	0.0143	0.0172	0.0251	0.0018	0.0046	0.0038	0.0015	0.0004	0.0000	0.0314	0.0000	0.3299
Lot No. 193482 -- 01 1 Standard Heat No. 1014364398	0.1721	0.2399	0.9063	0.0141	0.0051	0.0303	0.0133	0.0166	0.0242	0.0017	0.0032	0.0042	0.0014	0.0003	0.0000	0.0324	0.0000	0.3327
Lot No. 193482 -- 01 2 Standard Heat No. 1014364398	0.1732	0.2360	0.8982	0.0151	0.0061	0.0298	0.0138	0.0167	0.0239	0.0017	0.0033	0.0040	0.0009	0.0004	0.0000	0.0321	0.0000	0.3324

Kindberg, 18.11.2014

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

voestalpine
ONE STEP AHEAD.

No. 105797

Miscellanius Pipe MK 4-83

4 of 5

voestalpine Tubulars GmbH & Co KG

Chemical test results

Product analysis

Lot No.	193483	--	01	1	Standard	Heat No. 1014364399											
0.1759	0.2496	0.9512	0.0143	0.0088	0.0412	0.0406	0.0182	0.0270	0.0019	0.0108	0.0048	0.0015	0.0004	0.0000	0.0371	0.0000	0.3497

Lot No.	193483	--	01	2	Standard	Heat No. 1014364399											
0.1763	0.2474	0.9507	0.0142	0.0089	0.0409	0.0401	0.0188	0.0264	0.0019	0.0107	0.0048	0.0018	0.0004	0.0000	0.0374	0.0000	0.3500

Kindberg, 18.11.2014

No. 105797

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

voestalpine
ONE STEP AHEAD.

Miscellaneous Pipe MK 4-83 5 of 5

[| 00608321 | | 14010239-1] | [LN: 18] | ER020791-4 | FSBOL6XH |

Miscellaneous Pipe MK 3-71 and MK 3-73

18, 19

FSBOL6XH

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FEB 15 2017
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HR056624

BOLY PIPE CO., LTD. MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, Thailand/21140
Phone Number:+66-33-010-907,+66-33-010-909

| | | |

[| 00608321 | | 14010239-1] | [LN: 18] | ER020791-4 | FSBOL6XH |

miscellanius Pipe MK3-71 and MK 3-73 2pc3

BOLY PIPE CO., LTD.

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, Thailand/21140
Phone Number:+66-33-010-907,+66-33-010-909

MILL TEST CERTIFICATES

EN10204/3.1

| | | |

miscellanius Pipe MK 3-71 and MK 3-73 3 of 3

[| 00608321 | | | 14010239-1] | [LN: 18] | ER020791-4 | FSBOL6XH |

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, Thailand/21140
Phone Number:+66-33-010-907,+66-33-010-909

| | | |

[| 00608321 | | | 870603] | [LN: 16] | ER020791-1 | FSHB20STD |

16

alchemia

ALCHEMIA S.A.
Oddział Walcownia Rur Batory
w Chorzowie
ul. Dyrekcyjna 6
41-506Chorzów
POLAND
(A01)(A04)

(A03)

ŚWIADECTWO ODBIORU No 4044/EXP/R/15

CERTYFICAT DE RECEPTION INSPECTION CERTIFICATE
ABNAHMEPRÜFZEUGNIS СЕРТИФИКАТ

(A02) Acc. to EN 10204:2006 type 3.1
/nr normy/ Strona Page Page Seite Страница 1/2

FSHB20STD HRD61899

(A06) **Zamawiający** STEEL & COMMODITIES MC 98000 MONACO
Acheteur-Customer-Besteller-Заказчик

(A05) **Adres wysyłkowy**
Adresse-Address-Versandadresse-Адрес получателя

(A07) Nr zamówienia klienta Numéro de la commande du client Purchaser's order No Kundenbestellnummer No заказа	(A08,09) Nr potwierdzenia No de la commande Manuf. Order No Werksauftragsnummer Приказ №
PL/ABR/15/00711 2381	4239244/15

Wyszczególnienie zamówienia:
Specyfication de la commande-Order Specification-Spizifikation der Bestellung-Спецификация заказа

Wyrób i wymagania dodatkowe (stan obr. termicz.,mech. itp.) Produit et prescriptions supplémentaires (traitement thermique et l'usinage) Product and any supplementary requirements (Heat and mechanical treatment etc.) Erzeugnis und Zusätzliche Anforderungen (therm und mechan. Bearbeitung usw.) Продукта и дополнительные требования (состояние терм. и механобраб. и пр.)	Wymiar wyrobu Dimensions du produit Product dimensions Masse des Erzeugnisses Размер продукта	Oznaczenie stali Désignation del'acier Steel designation Stahlbezeichnung Марка стали	Wytop Coulée Heat Abstich Плавка	Sztuk Pièces Pieces Stück Штук	mb ft (c. mtr.) c. mtr. l. M. пог. м	kg lb (kg) кг
(B01,B03) Seamless steel pipes acc. to ASTM A106/ A106M/14/A53/A53M/12/ ASME SA106/ SA53/SEC.II.Part.A/13. Outside diameter tolerances +/- 1 %. Tolerances of wall thickness +22,5/-12,5% Outside surface double lacquered. Bevelled ends. Pipes hot finished > 850 °C and cooled in still air. Melting proces Electric furnace-Fully killed.No Mercury, Mercury compounds or Mercury bearing instruments and or equipment have been used in any manner which might cause contamination in manufacture, assembly or test of material. No weld repair. Fine grain practice. ***Country of melt and manufacture: Poland.***	(B09) 20" x 0,375" (508 x 9,53 mm) 37 - 45 ft (11,28 - 13,72 m)	(B02) B/C	(B07) 870603	(B08) 2	(B15) 75,20 (22,91)	(B13) 6234 (2828)

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JAN 17 2017
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Kontrolę techniczną powyższego zamówienia przeprowadził Oddział Technicznej Kontroli. Wyniki badań podano niżej.
Le controle technique de la été exécute par le Service de Controle. Les resultats des essais sont indiqués ci-aprés.
The technical investigation of this order has been executed by the Works Control. Results of tests are as follows.
Die technische Prüfung obiger Bestellung wurde von der Fabrikationskontrolle durchgeführt. Die Ergebnisse der Proben sind nachstehend angeführt.
Технический контроль вышеупомянутого заказа произвел Отдел Технического Контроля. Результат испытания представлен ниже.

1. SKŁAD CHEMICZNY - COMPOSITIO CHIMIQUE – CHEMICAL COMPOSITION – CHEMISCHE ZUSAMMENSETZUNG
(C71-C92) ХИМИЧЕСКИЙ СОСТАВ

Wytop Coulée Heat Abstich Плавка	C	Mn	Si	P	S	Cr	Ni	Cu
(B07) 870603 control anal. control anal.	0,14 0,14 0,14	1,12 1,12 1,13	0,20 0,20 0,21	0,007 0,007 0,006	0,004 0,003 0,003	0,07 0,07 0,07	0,07 0,07 0,07	0,13 0,13 0,13
	Mo	V	Ceq					
	0,04 0,04 0,04	0,04 0,04 0,04	0,37 0,37 0,37					

Miscellanius Pipe MK 2-36

2. BADANIA MECHANICZNE – ESSAIS MECANIQUES – MECHANICAL TESTS – MECHANISCHE UNTERSUCHUNGEN – МЕХАНИЧЕСКИЕ ИСПЫТАНИЯ

Nr wytopu lub próby No de la coulée ou De l'eprouvette Heat No Or. Tests No Abstich Oder Probe No No плавки или пробы	Yield Re PSI MPa min	Tensile Rm PSI MPa min	A 2" % min	Z %	Badanie udarności Impact Impact test Kerbschlagprobe Испытание на удар (C40,C41,C02) Wartość pojedyncza Valeurs individuelles Individual values Einzelwerte Единственный результат	Średnia Moyenne Mean Mittel Средний	Twardość Dureté Hardness Härte Твердость (C30)	^{0}C MPa min
(B07,C02,C00)	(C11)	(C12)	(C13)	(C50-69)	(C42)	(C43)	(C31)	(C50-C69)
Test size: 1½" 870603/19597 L	51488 (355)	71068 (490)	41,9				Hardness quarantee - acc.to NACE MR 0175/ISO 15156-2/03 AN.A.P.A.2.1.2 and NACE MR 0103/05 P.2.1 MAX 22HRC/237HB	

3. INNE BADANIA – AUTRES ESSAIS – OTHER TESTS – ANDERE UNTERSUCHUNGEN – ДРУГИЕ ИСПЫТАНИЯ (D51-D99)

(Z04)

BADANIA TECHNOLOGICZNE – ESSAIS TECHNOLOGIQUES – TECHNOLOGICAL TESTS – TECHNOLOGISCHE PRÜFUNGEN ТЕХНОЛОГИЯ ИССЛЕДОВАНИЯ

Flattening test - positive results

Each pipes has been hydrostatically tested by pressure 870 PSI - positive results time 5 s

4. BADANIA NIENISZCZĄCE - Essais Non Destuctifs – Non Destructive Tests – Zerstörungsfreie Prüfungen - Неразрушающий Контроль (D02-D50)

Numery rur - Le nombre de tubes - Numbers of tubes - Nummern von Röhren - Номера трубок

5. UWAGI DODATKOWE – Additional Remarks – Autresobservations – Andere Bemerungen- Дополнительные примечания (Z05-Z99)

Manufacturer has Quality Management System accordance with Directive 97/23/EC (PED) – Annex I – par. 4.3 –TÜV Nord, Certificate No 07-203-9120 WZ-0888/13 and Certificate No 07-202-9120 WZ-0888/13 and ISO 9001/TUV Certificate No 04100 950250.

(Z01)Powierzchnię i wymiary zbadano w 100% - Surface et dimensions ont été controlés et 100% - Surface and dimensions tested at 100%
Oberfläche und Abmessungen geprüft zu 100% - Наружный осмотр и проверка измерений произведены в 100% - positive results

(Z01)Niniejszym potwierdzam, że wyżej wymieniony material został zbadany i spełnia warunki potwierdzenia zamówienia - Par la presente je confirme que le materiel susmentionne a ete examine et il remplit les conditions de la confirmation de commande.- We hereby certify, that the material described above has been tested and complies with the terms of the order.- Es wird bestaetigt, dass das oben genannte Material geprueft wurde und den Bedingungen der Bestellung entspricht.- Подтверждаем, что вышеуказанный материал был протестирован и соответствует условиям подтверждения договора.

(D01)Cechowanie – Marquage – Marking –Kennzeichnung – Обозначен
Acc.to A106/B/C/A53/B/ SA106/B/C/SA53/B.

(D51-D99)Na podstawie wyżej przeprowadzonych prób material zwolniono – Sur la base des essais si-dessus le material est dliv-According to the carried out tests the material released – Untersuchungen wurde das Material freigegeben – На основании вышеименованных Испытаний признан годным.

Kontrola Jakości Contrôle de Fabrication Control of Manufacture Fabrikationskontrolle Технический контроль (Z03)	Dyrekcja Direction Management Direktion Дирекция (Z05)	(Z02)
SPECJALISTA DS. ZARZĄDZANIA JAKOŚCIĄ Halina Kemmer	KIEROWNIK Działu Kontroli Jakości i Nadzoru Technologicznego Grzegorz Datta	dn. 20.08. 2015 r.

4044/EXP/R/15

Miscellanius Pipe MK 2-36

[| 00608321 | | | 1016382797] | [LN: 14] | ER020791-5 | FSVAT2.5STDPSL2 |

voestalpine Tubulars GmbH & Co KG

14, 15

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FEB 09 2017
L. Dawson

Alpinestrasse 17
8652 Kindberg-Aumuehl
T. +43/050304/23-0
F. +43/050304/63-532
www.voestalpine.com/tubulars

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

FSVAT2.5STD

MILL TEST CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

No. 122503 Rev.: 0

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-02-PSL2** **LINEPIPE-01.0** **non upset ends (API 5 D + 5 L) - non upset** **UV coating**
Werkstoff: Material: Matières:	GRADE B / GRADE BN /GRADE X42N / GRADE C
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 BN/X42N acc. to API 5 L, 45.edt.-2012 (PSL2) NACE MR 0175 / ISO 15156-2015 NACE MR 0103-2015 LINEPIPE-01.0; LP-USA-02-PSL2
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE, both ends bevelled acc. to API/ASTM (30°)
Wärmebehandlung: Heat treatment: Traitment de chaleur:	NORMALIZED ROLLED
Coupl.die stamped:	
Coupl.paint stencilling:	
Coupl.Colour coding:	Fully painted: Bands:
Tube die stamped:	
Tube paint stencilling:	va SPEC 5L-0033 "API" 07.2016 2.875" x 0.203" BN X42N PSL2 SMLS 2970 PSI Length FT Heat No. Lot No. A/SA 53 Grade B S A/SA 106 Grade B Sched.40 PO# HR068855 MADE IN AUSTRIA
Tube Colour coding:	Fully painted: Bands: purple
Label:	PO No.: HR068855, DAT Port of Houston TX
Remarks:	*) Grade C without marking on tubes *) SI units have been converted to US customary units *) (Nb+V) <= 0,06%

Auftrags-Nr.: 21600 / 5
Our works order No.:
No usine:

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

No de la commande:

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

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

Kindberg, 12.08.2016

No. 122503

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
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du controle

voestalpine
ONE STEP AHEAD.

Miscellanius Pipe MK2-41 and MK2-44

1 of 8

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:
	5	2,875 in x 0,203 in; 5,80 lbs/ft	1-4	117	4661,096 ft	12456,50 kg	

Volume of delivery

Heat	Lot	Remark
1016382797	208020 -- 01	

Kindberg, 12.08.2016

No. 122503

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Miscellanius Pipe MK 2-41 and MK 2-44

2 of 8

voestalpine Tubulars GmbH & Co KG

Additional tests and inspections performed on pipe

1 Dimensionskontrolle/ Dimensional Inspection: bestanden/passed

2 Ringfaltversuch/Flattening test:bestanden/passed

3 Streuflusspruefung gem. ASTM E 570 / Flux Leakage testing acc. ASTM E 570: bestanden/passed

4 Ultraschallpruefung gem. Norm (Wanddicke - 100 % Umfang)/Ultrasonic inspection acc. to standard (wallthickness - 100 % circumference): bestanden/passed

5 Visuelle Inspektion/ Visual Inspection: bestanden/passed

6 Wasserinnendruckversuch/Hydrostatic test: bestanden/passed, Mindestpruefdruck/min test pressure: 2970 PSI, min.Haltezeit/min duration: 5 sec

7 Streuflusspruefung/Diverted flux acc. API 5 L (old version - SR 4) OD + ID, longitudinal 12.5 %: 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, 12.08.2016

No. 122503

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SCHNEIDHOFER
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voestalpine
ONE STEP AHEAD.

Miscellanious Pipe MK2-41 and MK 2-44

3 of 8

voestalpine Tubulars GmbH & Co KG

Tensile testing

Lot No	Test Type	Heat treatment	Loc.	Temp	Specimen				Yield Strength	Tensile Strength	Elong.	gage-length	Reduct. in area	Rt/Rm
				[°F]	No.	Type	Dimension[inch]		[PSI]	[PSI]	[%]	[inch]	[%]	
								Requ. from	42061	60190	21.50			
								Requ. to	71793	94999				0.93
208020 -- 01	Standard	normalized rolled	Rear	68	1	Strip-long	0.74 x 0.22	Rt0.50	54679	73679	33.00	2		0.74

yield strength: Requ. from - to
GR B/ BN / X42N: 42100 PSI - 71800 PSI
Gr C: 40000 PSI

tensile strength: Requ. from - to
GR B/ BN / X42N: 60200 PSI - 95000 PSI
Gr C: 70000 PSI

Kindberg, 12.08.2016

No. 122503

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Qualitätsstelle / Quality Department
SCHNEIDHOFER
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représentant autorisé du controle

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Miscellanius Pipe MK2-41 and MK2-44

4 of 8

voestalpine Tubulars GmbH & Co KG

Hardness testing

Lot No	Test Type	Heat treatment	Specimen Loc.	No.	Test Location	Method	Hardness Number from	to	Mean Hardness Number from	to	Variation
						Requ.:				99.50	
208020	-- 01	Standard	normalized rolled	Rear	1	Body	HRB	80.70	82.00	81.13	81.60	0.47

Kindberg, 12.08.2016

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ONE STEP AHEAD.

miscellanius Pipe MK2-41 and MK2-44

5 of 8

voestalpine Tubulars GmbH & Co KG

Impact testing

Requirement:	Length [inch]	Wide [inch]	Height [inch]	Specimen Orientation	Type	Temp. [°F]	[	Single ft-lbs	]	[	Average ft-lbs	Factor]
	2.165	.394	.13	long.	CH-V	- 20					-1	

Lot No	Test Type	Heat Treatment	Loc.	No.			Single1	Single2	Single3	Average	Unit
208020 – 01	Standard	normalized rolled	Rear	1	long.	Imp. Values:	33	32	31	32	ft-lbs
Werte informativ!						Including Factor:					
						Shear-Area [%]:					
						Lateral Expansion (un-/broken):					
						Lateral Expansion: [inch]				H: .13	[inch]

Kindberg, 12.08.2016

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ONE STEP AHEAD.

Miscellanius Pipe MK 2-41 and MK 2-44

6 of 8

voestalpine Tubulars GmbH & Co KG

Chemical testing

Heat analysis

C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
min. Requ.																	
0.0000	0.1000	0.2900															
max. Requ.																	
0.2300	0.4000	1.0600	0.0250	0.0150	0.3000	0.3000	0.4000		0.0400	0.1500	0.0600		0.0010		0.0500		0.4000
1016382797																	
0.1751	0.2493	0.9599	0.0121	0.0056	0.0468	0.0203	0.0197	0.0265	0.0019	0.0040	0.0016	0.0009	0.0003	0.0072	0.0393	0.0023	0.3482

Kindberg, 12.08.2016

No. 122503

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voestalpine
ONE STEP AHEAD.

Miscellanious Pipe MK2-41 and MK2-44

7 of 8

voestalpine Tubulars GmbH & Co KG

Chemical testing

Product analysis

C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
Lot No. 208020 -- 01 1 Standard Heat No. 1016382797																	
0.1790	0.2372	0.9429	0.0103	0.0054	0.0328	0.0167	0.0218	0.0279	0.0022	0.0036	0.0038	0.0020	0.0003	0.0050	0.0385	0.0000	0.3468
Lot No. 208020 -- 01 2 Standard Heat No. 1016382797																	
0.1797	0.2526	0.9582	0.0095	0.0065	0.0324	0.0160	0.0211	0.0294	0.0023	0.0033	0.0043	0.0019	0.0004	0.0037	0.0385	0.0000	0.3499

Kindberg, 12.08.2016

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voestalpine
ONE STEP AHEAD.

Miscellaneous Pipe MK2-41 and MK2-44

8 of 8

[| 16C77718 | | | 1013444472] | [LN: 1] | T0378778-1 | FSVAT2XXH |

voestalpine Tubulars GmbH & Co KG

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

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

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

INSPECTION - CERTIFICATE 3.1 Rev.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1 Rev.1 — No. 86939

(gem. EN 10204)

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

Hersteller: Manufacturer: Producteur:	voestalpine Tubulars GmbH & Co KG, Austria
Besteller: Purchaser: Acheteur:	VOEST-ALPINE TUBULAR CORPORATION USA-77042 HOUSTON TEXAS INDUSTRIAL PIPING SPEC. INC., TULSA OK 74158-1270
Pruefgegenstand: Object of tests: Eprouvette:	SEAMLESS STEEL TUBES, LINE PIPE
Werkstoff: Material: Matières:	GRADE B / GRADE X42 / GRADE C
Anforderungen: Requirements: Exigence:	Gr B acc. ASTM A 106 / A 106 M - ASME SA 106-2011 Gr B acc. ASTM A 53 / A 53 M - ASME SA 53-2012 Gr B acc. API SPEC 5 L (PSL1)-2007 X42 acc. API SPEC 5 L (PSL1)-2007 NACE MR 0175 / ISO 15156-2009 NACE MR0103-2010 (latest edition) LINEPIPE-01.0
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE, BOTH ENDS BEVELLED ACC. TO API/ASTM (30°)
Wärmebehandlung: Heat treatment: Traitment de chaleur:	AS ROLLED
Coupl.die stamped:	
Coupl.paint stencilling:	
Colour coding:	Fully painted: Bands:
Tube die stamped:	
Tube paint stencilling:	heat no va SPEC 5L-0033 "API" 02/13 API 5L B/API 5L X42 PSL1 A/SA 53 GRADE B/() S A/SA 106 GRADE B 2.375" x 0.436" SMLS 2970 PSI length ft heat no PO# MIP00004 MADE IN AUSTRIA/().
Colour coding:	Fully painted: Bands: Purple
Label:	PO No.: MIP00004 DAT Port of Houston TX
Remarks:	*) Grade C without marking on tubes

Auftrags-Nr.: 12408 / 2
Our works order No.:
No usine:

Bestellnr.: MIP00004/VATC
Your order No.: PO#211633

No de la commande:

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

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

RECEIVED
MAR 24 2017
L. Dawson

Kindberg, 12.12.2013

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

voestalpine
ONE STEP AHEAD.

No. 86939

Miscellanius Pipe MK2-43

1 of 4

[| 16C77718 | | | 1013444472] | [LN: 1] | T0378778-1 | FSVAT2XXH |

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	2,375 in x 0,436 in; 9,02 lbs/ft	1-18	375	16 099.178ft	65 642.20kg		

Volume of delivery

Heat	Lot		Remark
1013444472	170071	AD 01	
1013445000	170072	AD 01	

Test results

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

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

3 Wasserinnendruckversuch/Hydrostatic test:2970 PSI (duration min. 5 sec.)o.B./satisfactory

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

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

Test remarks

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

Kindberg, 12.12.2013

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

voestalpine
ONE STEP AHEAD.

No. 86939

Miscellanius Pipe MK 2-43

2 of 4

[| 16C77718 | | | 1013444472] | [LN: 1] | T0378778-1 | FSVAT2XXH |

voestalpine Tubulars GmbH & Co KG

Tensile testing

Lot No		Test Type	Heat treatment	Temp [°C]	Specimen No.	Type	Dimension [mm]	Yield Strength [PSI]	Tensile Strength [PSI]	Elong. [%]	Reducl. In area [%]	Rt/Rm
								Requ. from 42 061	60 190	25.00		
								Requ. to				
170071	AD 01	Standard	as rolled	20	1	Strip	19.00 x 11.29 Rt0.50	54 969	75 564	36.60		0.73
170072	AD 01	Standard	as rolled	20	1	Strip	18.95 x 11.10 Rt0.50	53 954	73 389	35.90		0.74

yield strength:
Gr B: 35500 PSI
X42: 42100 PSI
Gr C: 40000 PSI
tensile strength:
Gr B: 60200 PSI
X42: 60200 PSI
Gr C: 70000 PSI

Hardness testing

Lot No		Test Type	Heat treatment	Specimen No.	Location	Test Method	Hardness Number from	to	Mean Hardness Number from	to	Variation
						Requ.:				99.50	
170071	AD01	Standard	naturhart	1	Body	HRB	80.90	82.60	81.60	82.20	0.60
170072	AD01	Standard	naturhart	1	Body	HRB	80.80	82.90	81.03	81.97	0.93

Kindberg, 12.12.2013

Page 3 of 4

No. 86939

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

voestalpine
ONE STEP AHEAD.

Miscellanius Pipe MK 2-43

3 of 4

[| 16C77718 | | | 1013444472] | [LN: 1] | T0378778-1 | FSVAT2XXH |

voestalpine Tubulars GmbH & Co KG

Chemical test results

Heat analysis

C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
max																	
0.2300		1.0600	0.0300	0.0300	0.4000	0.4000	0.4000			0.1500	0.0800						0.4000
min																	
	0.1000	0.2900															
1013444472																	
0.1681	0.2558	0.9744	0.0094	0.0045	0.0314	0.0194	0.0288	0.0311	0.0019	0.0034	0.0018	0.0025	0.0000	0.0043	0.0371	0.0020	0.3410
1013445000																	
0.1646	0.2251	0.9469	0.0127	0.0049	0.0333	0.0252	0.0338	0.0226	0.0015	0.0071	0.0014	0.0031	0.0001	0.0047	0.0339	0.0016	0.3347

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. 170071 AD 01 1 Standard Heat No. 1013444472																	
0.1651	0.2236	0.9219	0.0081	0.0041	0.0262	0.0198	0.0302	0.0278	0.0019	0.0036	0.0029	0.0024	0.0004	0.0000	0.0330	0.0000	0.3286
Lot No. 170071 AD 01 2 Standard Heat No. 1013444472																	
0.1655	0.2132	0.9003	0.0053	0.0012	0.0250	0.0193	0.0265	0.0262	0.0017	0.0030	0.0024	0.0019	0.0003	0.0000	0.0316	0.0000	0.3247
Lot No. 170072 AD 01 1 Standard Heat No. 1013445000																	
0.1617	0.1938	0.9131	0.0100	0.0044	0.0296	0.0261	0.0337	0.0195	0.0016	0.0067	0.0027	0.0040	0.0004	0.0000	0.0323	0.0000	0.3257
Lot No. 170072 AD 01 2 Standard Heat No. 1013445000																	
0.1637	0.1976	0.9285	0.0092	0.0034	0.0284	0.0265	0.0346	0.0200	0.0016	0.0070	0.0031	0.0038	0.0004	0.0000	0.0329	0.0000	0.3302

Kindberg, 12.12.2013

Page 4 of 4

No. 86939

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

voestalpine
ONE STEP AHEAD.

Miscellanius Pipe MK 2-43

4 of 4

PRECISION SCREEN MANUFACTURING

CERTIFICATE OF CONFORMANCE

February 15, 2017

Precision Screen Manufacturing
PO Box 1234
Oologah, OK 74053

BOARDMAN Purchase Order # 00608413
PSM Sales Order # 016220
Product: 2-1/4" X 3/16" BB 19W4 MILL FINISH SMOOTH GRATING

This document certifies that the MILL FINISH SMOOTH GRATING products listed below were manufactured from CARBON STEEL ASTM A 1011, and meet or exceed the performance standards of ANSI/NAAMM-MBG531-09.

Alejandra Sanchez-PSM QC

Miscellanius Mesh Screen MK 3-60
MK 3-61, MK 3-62, MK 3-63 and MK 3-75

PRECISION SCREEN MANUFACTURING

Phone: (866)596-7537• Fax: (866)896-7537
SAN ANTONIO, TX/TULSA, OK
www.psm-mfg.com

MATERIAL TEST REPORT

February 15, 2017

BOARDMAN, INC.

PO # 00608413
Heat # V11218
3 MESH X .080" 304SS

CHEMICAL COMPOSITION

C	Mn	Si	P	S	Cr	Mo	V
.024	1.5		.036	.006	18.16		
Ti	**Cu**	**Al**	**Ca**	**B**	**W**	**Ni**	**Pb**
						8.04	
Sn	**Nb**	**N**	**Mg**	**As**	**Zn**	**Co**	**Ta**
		.054					

MECHANICAL PROPERTIES

Tensile-(psi)	Yield	Elongation-%	Reduction of Area %
12400			

Material is free from mercury contamination

Surface Condition Good

I hereby certify that this data is correct as contained in the records of this company.

Alejandra Sanchez - PSM QC

Misscellanius Mesh Screen MK3-60, MK 3-61 and MK 3-62

PRECISION SCREEN MANUFACTURING

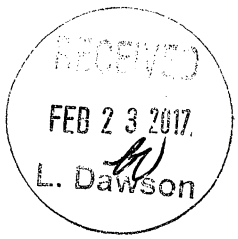
Phone: (866)596-7537• Fax: (866)896-7537
SAN ANTONIO, TX/TULSA, OK
www.psm-mfg.com

MATERIAL TEST REPORT

February 15, 2017

BOARDMAN, INC.

PO # 00608413
Heat # J71998
20 MESH X .016" 304SS



CHEMICAL COMPOSITION

C	Mn	Si	P	S	Cr	Mo	V
0.055	1.53	0.42	0.017	0.010	18.12		
Ti	**Cu**	**Al**	**Ca**	**B**	**W**	**Ni**	**Pb**
						8.09	
Sn	**Nb**	**N**	**Mg**	**As**	**Zn**	**Co**	**Ta**

Material is free from mercury contamination

Surface Condition Good

I hereby certify that this data is correct as contained in the records of this company.

Alejandra Sanchez - PSM QC

Miscellanius Mesh Screen MK 3-63

PRECISION SCREEN MANUFACTURING

Phone: (866)596-7537• Fax: (866)896-7537
SAN ANTONIO, TX/TULSA, OK
www.psm-mfg.com

MATERIAL TEST REPORT

February 15, 2017

BOARDMAN, INC.

PO # 00608413
Heat # SL-C26887
20 MESH X .016" 316SS

CHEMICAL COMPOSITION

C	Mn	Si	P	S	Cr	Mo	V
0.027	1.11	0.40	0.014	0.010	16.24	2.14	
Ti	**Cu**	**Al**	**Ca**	**B**	**W**	**Ni**	**Pb**
						10.16	
Sn	**Nb**	**N**	**Mg**	**As**	**Zn**	**Co**	**Ta**
		0.034					

MECHANICAL PROPERTIES

Tensile-(N/mm2)	Yield-(KG/MM2)	Elongation-%	Reduction of Area %
69		39	

This material meets the chemistry specifications for: ASTM A580/A580M-06

Material is free from mercury contamination

Surface Condition Good

I hereby certify that this data is correct as contained in the records of this company.

Alejandra Sanchez - PSM QC

Miscellanius Mesh Screen MK 3.75

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

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USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A193	14	Threaded Rod	3080627	90096-2

Heat Number	Grade	Size	TPI	Length	Finish
3105305	B7	1.5/8	8	12FT	Plain

C	Si	S	P	Mn	Mo	Cr	Ni	Al	V	Fe	Ti	Cu
0.39	0.23	0.005	0.018	0.87	0.18	0.98	0	0	0	0	0	0

Yield		Scale	Tensile		Scale
114000	0	psi	131000	0	psi

Elong %		R.A %		Hardness		Scale
20	0	60	0	28	0	HRC

Charpy Set 1			Scale	Temp	Macro Etch			Wedge Tensile	Proof Load
0	0	0			R	C	S		
Charpy Set 2					Pass	Pass	Pass		
0	0	0							

Quenched			Tempered		Stress Relieved	
@	0 °	In	@	1166 ° F	@	0 °

Remarks:

Memo:
1-5/8-8 X 12 AT STUD A193-B7 CAD

RECEIVED
APR 20 2017
L. Dawson

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Stud MK 1-16

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

Material Test Report

9

USA FASTENER GROUP, INC.
USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	96149-4

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	1.5/8	8	Plain	JU1293-02		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.230	0.012	0.012	0.700	0.000	0.110	0.040	0.090

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
29	0	HRC	92	0	HRB

First Charpy Set			Charpy Scale	Charpy Temp	Macro Etch			Proofload
0	0	0			S	C	R	311,500 lbf
Second Charpy Set					2	2	2	
0	0	0						

Quenching	Tempering
80min @ 850 ° C in	120min @ 520 ° C

RECEIVED
APR 20 2017
L. Dawson

Remarks:

Memos:
1-5/8-8 HVY HEX NUT A194-2H S.KOREA ONLY CAD

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 1-17

USA FASTENER GROUP, INC.

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

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Material Test Report

USA FASTENER GROUP, INC.

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	12	Heavy Hex Nuts	3080627	113994-00

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	3/8	16	Plain	W25875		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.400	0.230	0.007	0.004	0.770	0.000	0.000	0.000	

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
27	28	HRC	0	0	

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R

Proofload
13,900 lbs

Quenching	Tempering
@ 0 ° in	1 hr @ 1000 ° F

Remarks
Heat treated @ 1620 F @ 1 hr
Oil quenched

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APR 17 2017
L. Taylor

Memos:
3/8-16 HVY HEX NUT A194-2H DOMESTIC PLAIN

COUNTRY OF ORIGIN: CANADA

USA FASTENER GROUP INC.

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 2-39

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

7

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
USS	15	FLAT WASHER	3080627	101538-2

Heat Number	Grade	Size	TPI	Length	Finish
288522	8	3/4			

C	Si	S	P	Mn	Mo	Cr	Ni	Al	V	Fe	Ti	Cu
0.33	0	0.004	0.008	0.85	0	0	0	0	0	0	0	

Yield		Scale	Tensile		Scale
0	0		0	0	

Elong %		R.A %	
0	0	0	0

Hardness		Scale
38	45	HRC

Charpy Set 1			Scale	Temp	Macro Etch			Wedge Tensile	Proof Load
0	0	0			R	C	S		
Charpy Set 2									
0	0	0							

Quenched	Tempered	Stress Relieved
@ 0 ° in	@ 0 °	@ 0 °

Remarks:

RECEIVED
APR 17 2017
L. Dawson

Memo:
3/4 USS FLAT WASHER GR.8 PLAIN

COUNTRY OF ORIGIN: USA

USA FASTENER GROUP INC

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Washer MK 2-46

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

USA FASTENER GROUP, INC.

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	16	Heavy Hex Nuts	3080627	114079-A

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	3/4	10	Plain	692415		2H,DAL,TSI

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.450	0.170	0.014	0.018	0.660	0.000	0.000	0.000	0.000

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	29	0	HRC

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
1	1	1

Proofload
58450 lbf

Quenching	Tempering
@ 0 ° in	@ 1030 ° F

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Remarks

Memos:
3/4-10 HVY HEX NUT A194-2H S.KOREA ONLY PLAIN

COUNTRY OF ORIGIN: S.KOREA

USA FASTENER GROUP
USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 2-47

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SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

CERTIFICATE OF CONFORMANCE

TO: Boardman, Inc.
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-20-17
Customer Part #: ✓
Description 3/4-10 X 2-1/4 A307 HEX HD M/B PLAIN
Quantity Shipped: 16
LOT#: 00605379
SBS Order #: 5735156
Customer P.O.#: 00608689

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APR 2 0 2017
L. Dawson

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

Miscellaneous Bolt MK 3-54

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

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Material Test Report

USA FASTENER GROUP INC.
USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	16	Heavy Hex Nuts	3080627	114079-A

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	3/4	10	Plain	692415		2H,DAL,TSI

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.450	0.170	0.014	0.018	0.660	0.000	0.000	0.000	0.000

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	29	0	HRC

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
1	1	1

Proofload
58450 lbf

Quenching	Tempering
@ 0 ° in	@ 1030 ° F

Remarks

RECEIVED
APR 17 2017
L. Dawson

Memos:
3/4-10 HVY HEX NUT A194-2H S.KOREA ONLY PLAIN

COUNTRY OF ORIGIN: KOREA

USA FASTENER GROUP
USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 3-55

SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

CERTIFICATE
OF
CONFORMANCE

TO: Boardman, Inc.
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-13-17
Customer Part #:
Description 5/8-11 X 3 A307A HEX HD M/B PLN
Quantity Shipped: 24
LOT#: 753441
SBS Order #: 5735156
Customer P.O.#: 00608689

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

Miscellanius Bolt MK 3-67

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

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Material Test Report

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	102295-8

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	5/8	11	Plain	JU4397-01		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.180	0.019	0.016	0.680	0.000	0.130	0.050	0.120

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	92	0	HRB

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
2	2	2

Proofload
39550 lbf

Quenching	Tempering
60min @ 850 ° C in	120 min @ 520 ° C

Remarks
MEETS ASTM A194-2H AND ASME SA194-2H (REV 15)

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APR 12 2007
L. DAWSON

Memos:
5/8-11 HVY HEX NUT A194-2H S.KOREA

COUNTRY OF ORIGIN: KOREA

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 3-68

SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

15

CERTIFICATE OF CONFORMANCE

TO: Boardman, Inc.
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-13-17
Customer Part #:
Description 5/8-11 X 1-3/4 A307 ALL THREAD STUD PLAIN
Quantity Shipped: 8
LOT#: 753443
SBS Order #: 5735156
Customer P.O.#: 00608689

RECEIVED APR 17 2017 L. Dawson

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

miscellanius stud MK3-79

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

2

Material Test Report

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	99725-23

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	1	8	Plain	JU1777-04		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.190	0.012	0.011	0.680		0.110	0.040	0.080

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
29	0	HRC	93	0	HRB

First Charpy Set		
Second Charpy Set		

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
2	2	2

Proofload
106000 lbf

Quenching	Tempering
70 MIN @ 850 ° C in	120 MIN@ 520 ° C

Remarks
MEETS ASTM A194-2H AND ASME SA194-2H (REV 15)

RECEIVED
APR 17 2017
L. DAWSON

Memos:
1-8 HVY HEX NUT A194-2H S.KOREA ONLY PLAIN

COUNTRY OF ORIGIN: S.KOREA

USA FASTENER GROUP
USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 4-85

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

16

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A320	2015	Threaded Rod	3080627	104150

Heat Number	Grade	Size	TPI	Length	Finish
A163519	L7/B7	1 1/8	8	12FT	Plain

C	Si	S	P	Mn	Mo	Cr	Ni	Al	V	Fe	Ti	Cu
0.4	0.26	0.015	0.009	0.86	0.21	1.03	0.11	0.035	0.005	0	0.001	0.22

Yield		Scale	Tensile		Scale
121	0	ksi	135	0	ksi

Elong %		R.A %		Hardness		Scale
21	0	64	0	29	0	HRC

Charpy Set 1			Scale	Temp	Macro Etch			Wedge Tensile	Proof Load
38	34	43	Ft Lbs	-150 °F	R	C	S		
					1	2	1		

Charpy Set 2		
0	0	0

Quenched			Tempered		Stress Relieved	
@	0 °	In	@	1332 ° F	@	0 °

Remarks:
Sn=.011; N=.0080; B=.0004; Ca=.0006; As=.004; Sb=.003
Conforms to ASTM A193 B7 Rev. 2016; ASME SA-193/SA-193M B7 Rev.2013

Memo:
1-1/8-8 X 8-3/4 AT STUD A193-B7 CAD
MFG FROM ABOVE

RECEIVED
APR 20 2017
Dawson

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Stud MK 5-92

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

Material Test Report

17

USA FASTENER GROUP, INC.
USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	96149-1

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	1.1/8	8	Plain	JU1777-04		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.190	0.012	0.011	0.680	0.000	0.110	0.040	0.080

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	93	0	HRB

First Charpy Set			Charpy Scale	Charpy Temp	Macro Etch			Proofload
0	0	0			S	C	R	138,200 lbf
Second Charpy Set					2	2	2	
0	0	0						

Quenching	Tempering
70min @ 850 ° C in	120min @ 520 ° C

RECEIVED
APR 20 2017
L. Dawson

Remarks:
MEETS ASTM A194-2H AND ASME SA194-2H (REV 15)

Memos:
1-1/8-8 HVY HEX NUT A194-2H S.KOREA ONLY CAD

Quality Assurance
Laura Taylor

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Miscellanius Nut MK5-93

USA FASTENER GROUP, INC.

SBS INDUSTRIES, INC.

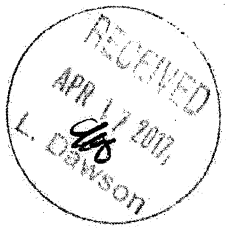
1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

3

CERTIFICATE OF CONFORMANCE

TO: Boardman, Inc.
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-13-17
Customer Part #:
Description 5/8-11 X 2 A307A HEX HD M/B PLN
Quantity Shipped: 8
LOT#: 753433
SBS Order #: 5735156
Customer P.O.#: 00608689



The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

Miscellanius Bolt MK 5-104

SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

CERTIFICATE
OF
CONFORMANCE

TO: Boardman, Inc.
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-20-17
Customer Part #:
Description 5/8 REG LOCKWASHER PLAIN
Quantity Shipped: 8
LOT#: 751907
SBS Order #: 5735156
Customer P.O.#: 00608689

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein

Approved Signature
BERRY HEINLEIN

Miscellanius Washer MK 5-105

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

5

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
		USS Flat Washer	3080627	104731-7

Heat Number	Grade	Size	TPI	Length	Finish
299155		5/8			Plain

C	Si	S	P	Mn	Mo	Cr	Ni	Al	V	Fe	Ti	Cu
0.34	0	0	0.007	0.83	0	0	0	0	0	0	0	0

Yield		Scale	Tensile		Scale
0	0		0	0	

Elong %		R.A %		Hardness		Scale
0	0	0	0	38	45	HRC

Charpy Set 1			Scale	Temp	Macro Etch			Wedge Tensile	Proof Load
0	0	0			R	C	S		
Charpy Set 2									
0	0	0							

Quenched	Tempered	Stress Relieved
@ 0 ° in	@ 0 °	@ 0 °

Remarks:

RECEIVED
APR 17 2017
L. Dawson

Memo:
5/8 USS FLAT WASHER GR.8 PLAIN

COUNTRY OF ORIGIN: USA

USA FASTENER GROUP INC.

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Washer MK 5-106

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513 4

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	102295-8

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	5/8	11	Plain	JU4397-01		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.180	0.019	0.016	0.680	0.000	0.130	0.050	0.120

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	92	0	HRB

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
2	2	2

Proofload
39550 lbf

Quenching	Tempering
60min @ 850 ° C in	120 min @ 520 ° C

Remarks
MEETS ASTM A194-2H AND ASME SA194-2H (REV 15)

RECEIVED
APR 17 2017
L. Lawson

Memos:
5/8-11 HVY HEX NUT A194-2H S.KOREA ONLY PLAIN

COUNTRY OF ORIGIN: S.KOREA

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 5-107

USA FASTENER GROUP INC.

Since 1910
BOARDMAN
1135 South McKinley Ave * Oklahoma City, Oklahoma 73108
(405) 634-5434 * Fax (405) 632-6948
STEEL & ALLOY PLATE FABRICATION * PRESSURE VESSELS AND FCCU COMPONENTS

CUSTOMER:	UOP RUSSELL LLC
P.O. NO.:	4500754152
PROJECT:	J447XX
VESSEL:	78" I.D. x 24'-4" TAN/TAN – MOL SIEVE DEHYDRATOR
ITEM NO:	V-442 & 443
JOB NO.:	70699
DATE:	01/05/17
ENGINEER:	R. WOLF
DIR/FILE:	E:\DWG\JOBS\70600-70699\70699\70699.CW7 Rev.: 0

DESIGN DATA

DESIGN PRESSURE: Int.: 1,095 psi @ 600 deg. F. Ext.: n/a

CORROSION ALLOW: 0.0625"

X-RAY: **RT-1**

Cat. A, Long. Seams	FULL per UW-11(a) TYPE 1
Cat. B, Girth Seams	FULL per UW-11(a) TYPE 1
Head to Shell Seams	FULL per UW-11(a) TYPE 1
Heads, Cat. A Seams	Seamless or FULL X-ray

WIND: ASCE 7-10
Speed = 120 mph
Exposure = C
Risk Category = III

SEISMIC: ASCE 7-10
Soil Profile = D
Spectral Response Ss = 100%
Spectral Response S_1 = 40%
Importance Factor = 1.25

PWHT: Required per Code

MAWP: 1,095 psi @ 600 deg. F. - Limited by Design

MDMT (design): (-)20 deg. F. @ 1,095 psi, Impacts required on heads, shells, and repad per UG-84. SA350-LF2 nozzles tested per UCS-66(g). SA105 nozzles exempt per UCS-66(b)(3). SA106-B piping exempt per Fig. UCS-66, Curve B.

MAP, N&C: 1,095 psi @ 60 deg. F. - Limited by Design

HYDROTEST: Shop, (Utilizing MAWP) = 1,424 psi. Horizontal position.
Field, (Utilizing MAWP) = 1,424 psi. Vertical position.
(See Hydrostatic Test report)

Design is based on the 2015 ASME Code, Section VIII, Division 1, No Addenda.

Nozzles 2" and under are exempt from reinforcement calculations per paragraph UG-36(c)(3)(a).

Nozzles without reinforcing elements are exempt from weld strength calculations per paragraph UW-15(b)(2).

CERTIFIED Randy Wolf DATE: 01/11/2017

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3. Settings Summary
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14. Bottom Head
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16. Wind Code
17. Seismic Code
18. Skirt Course
19. Base Ring
20. Outlet (B)
21. Fill / Manway (C)
22. Dump (D)
23. Lifting Lugs (From Horiz. - Empty)
24. Lifting Lugs (Vertical Lift Loaded)

Deficiencies Summary

No deficiencies found.

Pressure Summary

Component Summary						
Identifier	**P Design (psi)**	**T Design (°F)**	**MDMT (°F)**	**MDMT Exemption**		**Impact Tested**
Top Head	1 095	600	-24.4	Note 1		Yes
Straight Flange on Top Head	1 095	600	-24.4	Note 2		Yes
Shell Course #3	1 095	600	-24.4	Note 2		Yes
Shell Course #2	1 095	600	-24.4	Note 2		Yes
Shell Course #1	1 095	600	-24.4	Note 2		Yes
Straight Flange on Bottom Head	1 095	600	-24.4	Note 2		Yes
Bottom Head	1 095	600	-24.4	Note 3		Yes
Outlet (B)	1 095	600	-32.7	Nozzle	Note 4	No
				Pad	Note 5	Yes
Fill / Manway (C)	1 095	600	-55	Note 6		No
Dump (D)	1 095	600	-55	Note 7		No
TI (E1)	1 095	600	-155	Note 8		No
TI (E2)	1 095	600	-155	Note 8		No

Chamber Summary	
Design MDMT	-20 °F
Rated MDMT	-24.4 °F @ 1 095 psi
MAWP hot & corroded	1 095 psi
(1) This pressure chamber is not designed for external pressure.	

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

Notes for MDMT Rating		
Note #	**Exemption**	**Details**
1.	Straight Flange governs MDMT	
2.	Material is impact tested per UG-84 to -20°F.	UCS-66(i) reduction of 4.4°F applied (ratio = 0.9562).
3.	Straight Flange governs MDMT	
4.	Nozzle impact test exemption temperature from Fig UCS-66 Curve B = -13°F Fig UCS-66.1 MDMT reduction = 31.2°F, (coincident ratio = 0.6881)	UCS-66 governing thickness = 0.4375 in.
5.	Pad is impact tested per UG-84 to -20°F.	UCS-66(i) reduction of 12.7°F applied (ratio = 0.8733).
6.	Flange rating governs: Flange rated MDMT = -76°F Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	UCS-66(i) reduction of 26°F applied (ratio = 0.7399).

	Flange is impact tested per material specification to -50°F.	
7.	Nozzle is impact tested per material specification to -50°F with an additional 5°F reduction per UCS-66(g)	UCS-66 governing thickness = 2.375 in.
8.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1157).	

Settings Summary

COMPRESS 2017 Build 7700	
ASME Section VIII Division 1, 2015 Edition	
Units	U.S. Customary
Datum Line Location	0.00" from bottom seam
Vessel Design Mode	Design Mode
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	1.2000
Skirt/legs stress increase	1.0
Minimum nozzle projection	2"
Juncture calculations for d > 30 only	Yes
Preheat P-No 1 Materials > 1.2500" and <= 1.5000" thick	Yes
UG-37(a) shell tr calculation considers longitudinal stress	No
Cylindrical shells made from pipe are entered as minimum thickness	No
Nozzles made from pipe are entered as minimum thickness	No
ASME B16.9 fittings are entered as minimum thickness	No
Butt welds	Tapered per Figure UCS-66.3 (a)
Disallow Appendix 1-5, 1-8 calculations under 15 psi	No
Hydro/Pneumatic Test	
Shop Hydrotest Pressure	1.3 times vessel MAWP
Test liquid specific gravity	1.0000
Field Hydrotest Pressure	1.3 times vessel MAWP
Wind load present @ field	33% of design
Maximum stress during test	90% of yield
Required Marking - UG-116	
UG-116(e) Radiography	RT1
UG-116(f) Postweld heat treatment	HT
Code Cases\Interpretations	
Use Code Case 2547	No
Use Code Case 2695	No
Apply interpretation VIII-1-83-66	Yes

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:	No
Note: UG-22(b),(c) and (f) loads only considered when supports are present.	

License Information	
Company Name	Boardman
License	Commercial
License Key ID	20125
Support Expires	January 25, 2018

Hydrostatic Test

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

Gauge pressure at 60°F = 1.3*MAWP*LSR
= 1.3*1 095*1
= 1 423.5 psi

Horizontal shop hydrostatic test				
Identifier	**Local test pressure (psi)**	**Test liquid static head (psi)**	**UG-99(b) stress ratio**	**UG-99(b) pressure factor**
Top Head	1 426.798	3.298	1.0309	1.30
Straight Flange on Top Head	1 426.798	3.298	1.0309	1.30
Shell Course #3	1 426.798	3.298	1.0309	1.30
Shell Course #2	1 426.798	3.298	1.0309	1.30
Shell Course #1	1 426.798	3.298	1.0309	1.30
Straight Flange on Bottom Head	1 426.798	3.298	1.0309	1.30
Bottom Head	1 426.798	3.298	1.0309	1.30
Dump (D)	1 423.897	0.397	1.087	1.30
Fill / Manway (C)	1 425.716	2.216	1.087	1.30
Outlet (B) (1)	1 425.528	2.028	1	1.30
TI (E1)	1 425.41	1.91	1.087	1.30
TI (E2)	1 425.41	1.91	1.087	1.30
(1) Outlet (B) limits the UG-99(b) stress ratio. (2) The zero degree angular position is assumed to be up, and the test liquid height is assumed to the top-most flange.				

The test temperature of 60 °F is warmer than the minimum recommended temperature of 5.6 °F so the brittle fracture provision of UG-99(h) has been met.

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

Gauge pressure at 60°F = 1.3*MAWP*LSR
= 1.3*1 095*1
= 1 423.5 psi

Vertical field hydrostatic test				
Identifier	**Local test pressure (psi)**	**Test liquid static head (psi)**	**UG-99(b) stress ratio**	**UG-99(b) pressure factor**
Top Head	1 424.8	1.3	1.0309	1.30
Straight Flange on Top Head	1 424.8	1.3	1.0309	1.30
Shell Course #3	1 428.265	4.765	1.0309	1.30
Shell Course #2	1 431.73	8.23	1.0309	1.30
Shell Course #1	1 435.196	11.696	1.0309	1.30
Straight Flange on Bottom Head	1 435.268	11.768	1.0309	1.30
Bottom Head	1 435.972	12.472	1.0309	1.30
Dump (D)	1 434.437	10.937	1.087	1.30
Fill / Manway (C)	1 423.941	0.441	1.087	1.30
Outlet (B) (1)	1 436.712	13.212	1	1.30
TI (E1)	1 433.734	10.234	1.087	1.30
TI (E2)	1 430.089	6.589	1.087	1.30
(1) Outlet (B) limits the UG-99(b) stress ratio.				

The test temperature of 60 °F is warmer than the minimum recommended temperature of 5.6 °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**
Top Head	SA-516 70	78 ID	21.7752	2.2752*	2.2752	0.0625	1.00	Internal
Straight Flange on Top Head	SA-516 70	78 ID	2	2.375	2.3447	0.0625	1.00	Internal
Shell Course #3	SA-516 70	78 ID	96	2.375	2.3447	0.0625	1.00	Internal
Shell Course #2	SA-516 70	78 ID	96	2.375	2.3447	0.0625	1.00	Internal
Shell Course #1	SA-516 70	78 ID	96	2.375	2.3447	0.0625	1.00	Internal
Straight Flange on Bottom Head	SA-516 70	78 ID	2	2.375	2.3447	0.0625	1.00	Internal
Bottom Head	SA-516 70	78 ID	21.7752	2.2752*	2.2752	0.0625	1.00	Internal
Skirt Course	SA-516 70	82.75 OD	61.4797	0.375	0.1691	0	0.55	Seismic
*Head minimum thickness after forming								

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

Weight Summary

Weight (lb) Contributed by Vessel Elements										
Component	Metal New*	Metal Corroded	Insulation	Insulation Supports	Lining	Piping + Liquid	Operating Liquid		Test Liquid	
							New	Corroded	New	Corroded
Top Head	4 840.2	4 716.9	254.2	0	0	0	0	0	2 642	2 658.3
Shell Course #3	16 292.7	15 876.2	757	0	0	0	0	0	16 558.6	16 611.7
Shell Course #2	16 291	15 874.7	757	0	0	0	0	0	16 558.7	16 611.9
Shell Course #1	15 884.5	15 478.9	757	0	0	0	0	0	16 598.2	16 651.9
Bottom Head	5 151	5 019.2	254.2	0	0	0	0	0	2 608.2	2 624.5
Skirt Course	1 654.1	1 654.1	0	0	0	0	0	0	0	0
Base Ring	512	512	0	0	0	0	0	0	0	0
TOTAL:	**60 625.7**	**59 132**	**2 779.5**	**0**	**0**	**0**	**0**	**0**	**54 965.8**	**55 158.2**
*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						
Top Head	0	0	2 252.2	2 232.9	0	1 550.8	0	0	0	0
Shell Course #3	0	0	0	0	8 328	160	0	0	696.7	0
Shell Course #2	0	0	2	1.7	12 212.8	160	0	0	0	0
Shell Course #1	0	0	2 259	2 240.3	11 347.5	1 810.8	0	0	0	1 115
Bottom Head	0	0	250.1	243.4	0	220	0	0	0	0
Skirt Course	0	0	0	0	0	0	0	0	73.9	0
TOTAL:	**0**	**0**	**4 763.2**	**4 718.2**	**31 888.4**	**3 901.6**	**0**	**0**	**770.6**	**1 115***

Vessel Totals		
	New	Corroded
Operating Weight (lb)	105 844	104 305
Empty Weight (lb)	105 844	104 305
Test Weight (lb)	160 810	159 464
Capacity** (US gal)	6 578	6 601
**The vessel capacity does not include volume of nozzle, piping or other attachments.		

Vessel Lift Condition	
Vessel Lift Weight, New (lb)	73 956
Center of Gravity from Datum (in)	138.8077

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)		
B	8.625	0.5	0.3934	Yes	Yes	2.2752*	2.055		3.5	2	0.0625	105.7
C	26.25	4.125	0.6218	Yes	Yes	2.2752*	2.055		N/A	N/A	0.0625	110.4
D	27.75	4.875	0.6218	Yes	Yes	2.375	2.3446		N/A	N/A	0.0625	103.0
E1	1.75	0.35	0.125	Yes	Yes	2.375	N/A		N/A	N/A	0.0625	Exempt
E2	1.75	0.35	0.125	Yes	Yes	2.375	N/A		N/A	N/A	0.0625	Exempt
*Head minimum thickness after forming												

Definitions	
t_n	Nozzle thickness
Req t_n	Nozzle thickness required per UG-45/UG-16 Increased for pipe to account for 12.5% pipe thickness tolerance
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**
B	Outlet	NPS 8 Sch 80 (XS)	Nozzle	SA-106 B Smls pipe	No	No	No	NPS 8 Class 600 WN A350 LF2	No
			Pad	SA-516 70	Yes	Yes	No		
C	Fill / Manway	26.25 OD x 4.125	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 18 Class 600 V2 (or equiv.) A350 LF2 Cl.1	NPS 18 Class 600 A350 LF2 Cl.1
D	Dump	27.75 OD x 4.875	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 18 Class 600 V3 (or equiv.) A350 LF2 Cl.1	NPS 18 Class 600 A350 LF2 Cl.1
E1	TI	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
E2	TI	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No

Top Head

ASME Section VIII Division 1, 2015 Edition				
Component		Ellipsoidal Head		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Attached To		Shell Course #3		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		1.23	34	1
Dimensions				
Inner Diameter		78"		
Head Ratio		2		
Minimum Thickness		2.2752"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Length L_{sf}		2"		
Nominal Thickness t_{sf}		2.375"		
Weight and Capacity				
		Weight (lb)[1]		**Capacity (US gal)[1]**
New		4 840.21		310.28
Corroded		4 716.9		312.14
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	254.17
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Category A joints		Seamless No RT		
Head to shell seam		Full UW-11(a) Type 1		

[1] includes straight flange

Results Summary	
Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2752"
Straight Flange governs MDMT	-24.4°F

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

Design thickness for internal pressure, (Corroded at 600 °F) Appendix 1-4(c)

t = P*D*K / (2*S*E - 0.2*P) + Corrosion
= 1 095*78.125*0.997872 / (2*19 400*1 - 0.2*1 095) + 0.0625
= 2.2751"

% Extreme fiber elongation - UCS-79(d)

EFE = $(75*t / R_f)*(1 - R_f / R_o)$
= (75*2.375 / 14.4475)*(1 - 14.4475 / ¤)
= 12.3291%

Straight Flange on Top Head

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		1.3	36	1
Dimensions				
Inner Diameter		78"		
Length		2"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		339.43		41.37
Corroded		330.76		41.5
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	0
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Seamless No RT		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.3447"

Design thickness due to combined loadings + corrosion	0.9723"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9094	0.9083
						Seismic	0.9098	0.9079
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.9079	0.9068
						Seismic	0.9084	0.9064
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0011	0.0028
						Seismic	0.0004	0.0035
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.0011	0.0028
						Seismic	0.0005	0.0035
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0008	0.0021
						Seismic	0.0003	0.0025
Empty, New	0	20 000	17 289	70	0	Wind	0.0008	0.0021
						Seismic	0.0003	0.0026
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	19 400	12 641	600	0.0625	Weight	0.0029	0.0029

Shell Course #3

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		4.76	132	1
Dimensions				
Inner Diameter		78"		
Length		96"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		16 292.67		1 985.81
Corroded		15 876.25		1 992.18
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	757.04
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Full UW-11(a) Type 1		
Top Circumferential seam		Full UW-11(a) Type 1		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"

Design thickness due to internal pressure (t)	2.3447"
Design thickness due to combined loadings + corrosion	0.9766"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9086	0.9035
						Seismic	0.9141	0.898
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.9071	0.902
						Seismic	0.9127	0.8963
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0024	0.0101
						Seismic	0.004	0.0186
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.0025	0.0102
						Seismic	0.004	0.0188
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0017	0.0074
						Seismic	0.0039	0.0136
Empty, New	0	20 000	17 289	70	0	Wind	0.0018	0.0075
						Seismic	0.0039	0.0138
Hot Shut Down, Corroded, Weight &	0	19 400	12 641	600	0.0625	Weight	0.0094	0.0094

Eccentric Moments Only								

Shell Course #2

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		8.23	228	1
Dimensions				
Inner Diameter		78"		
Length		96"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		16 291.05		1 985.81
Corroded		15 874.67		1 992.18
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	757.04
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Full UW-11(a) Type 1		
Top Circumferential seam		Full UW-11(a) Type 1		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"

Design thickness due to internal pressure (t)	2.3447"
Design thickness due to combined loadings + corrosion	0.9874"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9089	0.8987
						Seismic	0.9249	0.8827
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.9073	0.8971
						Seismic	0.9237	0.8807
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0019	0.0175
						Seismic	0.0148	0.0421
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.0021	0.0177
						Seismic	0.015	0.0427
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0014	0.0128
						Seismic	0.0143	0.0308
Empty, New	0	20 000	17 289	70	0	Wind	0.0015	0.013
						Seismic	0.0146	0.0314
Hot Shut Down, Corroded, Weight &	0	19 400	12 641	600	0.0625	Weight	0.0146	0.0146

Eccentric Moments Only								

Shell Course #1

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		11.7	324	1
Dimensions				
Inner Diameter		78"		
Length		96"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		15 884.54		1 985.81
Corroded		15 478.87		1 992.18
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	757.04
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Full UW-11(a) Type 1		
Top Circumferential seam		Full UW-11(a) Type 1		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"

Design thickness due to internal pressure (t)	2.3447"
Design thickness due to combined loadings + corrosion	1.0006"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9076	0.8868
						Seismic	0.9381	0.8563
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.906	0.8851
						Seismic	0.9371	0.854
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0038	0.0357
						Seismic	0.028	0.0825
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.004	0.036
						Seismic	0.0285	0.0835
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0028	0.0261
						Seismic	0.0272	0.0604
Empty, New	0	20 000	17 289	70	0	Wind	0.003	0.0264
						Seismic	0.0276	0.0613
Hot Shut Down, Corroded, Weight &	0	19 400	12 641	600	0.0625	Weight	0.0278	0.0315

Eccentric Moments Only								

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 Course #1		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		12.47	345.5	1
Dimensions				
Inner Diameter		78"		
Head Ratio		2		
Minimum Thickness		2.2752"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Length L_{sf}		2"		
Nominal Thickness t_{sf}		2.375"		
Weight and Capacity				
		Weight (lb)[1]		**Capacity (US gal)[1]**
New		5 151.05		310.28
Corroded		5 019.2		312.14
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	254.17
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Category A joints		Seamless No RT		
Head to shell seam		Full UW-11(a) Type 1		

[1] includes straight flange

Results Summary	
Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2752"
Straight Flange governs MDMT	-24.4°F

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

Design thickness for internal pressure, (Corroded at 600 °F) Appendix 1-4(c)

t = P*D*K / (2*S*E - 0.2*P) + Corrosion
= 1 095*78.125*0.997872 / (2*19 400*1 - 0.2*1 095) + 0.0625
= 2.2751"

% Extreme fiber elongation - UCS-79(d)

EFE = $(75*t / R_f)*(1 - R_f / R_o)$
= (75*2.375 / 14.4475)*(1 - 14.4475 / ¤)
= 12.3291%

Straight Flange on Bottom Head

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		11.77	326	1
Dimensions				
Inner Diameter		78"		
Length		2"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		339.43		41.37
Corroded		330.76		41.5
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	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		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.3447"

Design thickness due to combined loadings + corrosion	1.0016"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9083	0.8861
						Seismic	0.9391	0.8553
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.9067	0.8844
						Seismic	0.9381	0.8529
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0028	0.0369
						Seismic	0.029	0.0842
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.003	0.0372
						Seismic	0.0295	0.0852
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0021	0.027
						Seismic	0.0281	0.0616
Empty, New	0	20 000	17 289	70	0	Wind	0.0022	0.0273
						Seismic	0.0286	0.0625
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	19 400	12 641	600	0.0625	Weight	0.0268	0.0327

Wind Code

Building Code: ASCE 7-10		
Elevation of base above grade		1.00 ft
Increase effective outer diameter by		1.50 ft
Wind Force Coefficient, Cf		0.7000
Risk Category (Table 1.5-1)		III
Basic Wind Speed, V		120.00 mph
Exposure Category		C
Wind Directionality Factor, Kd		0.9500
Top Deflection Limit		6.00 in. per 100 ft.
Topographic Factor, Kzt		1.0000
Enforce min. loading of 16 psf		Yes
Hazardous, toxic, or explosive contents		No
Vessel Characteristics		
Height, h		31.4813 ft
Minimum Diameter, b	Operating, Corroded	7.5625 ft
	Empty, Corroded	7.5625 ft
	Hydrotest, New, Field	7.5625 ft
Fundamental Frequency, n_1	Operating, Corroded	8.5274 Hz
	Empty, Corroded	8.9819 Hz
	Hydrotest, New, Field	7.2181 Hz
Damping coefficient, e	Operating, Corroded	0.0201
	Empty, Corroded	0.0210
	Hydrotest, New, Field	0.0260

Table Lookup Values

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

Wind Deflection Reports:

Operating, Corroded
Empty, Corroded

Hydrotest, New, field

Wind Pressure Calculations

Wind Deflection Report: Operating, Corroded								
Component	**Elevation of Bottom above Base (in)**	**Effective OD (ft)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Platform Wind Shear at Bottom (lb_f)**	**Total Wind Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**	**Deflection at Top (in)**
Top Head	354	9.05	26.5	*	883	1 092	2 431	0.0124
Shell Course #3	258	9.06	26.5	22.81	883	2 020	14 817	0.0115
Shell Course #2	162	9.06	26.5	22.81	883	2 888	34 500	0.0079
Shell Course #1	66	9.06	26.5	22.81	883	3 696	70 600	0.0043
Bottom Head (top)	61.4797	9.05	26.5	*	1 634	4 485	78 357	0.0011
Skirt Course	0	8.40	26.5	3.97	1 634	4 965	102 564	0.001
*Moment of Inertia I varies over the length of the component								

Wind Deflection Report: Empty, Corroded								
Component	**Elevation of Bottom above Base (in)**	**Effective OD (ft)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Platform Wind Shear at Bottom (lb_f)**	**Total Wind Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**	**Deflection at Top (in)**
Top Head	354	9.05	29.4	*	883	1 092	2 431	0.0112
Shell Course #3	258	9.06	29.4	22.81	883	2 020	14 817	0.0104
Shell Course #2	162	9.06	29.4	22.81	883	2 888	34 500	0.0071
Shell Course #1	66	9.06	29.4	22.81	883	3 696	70 600	0.0039
Bottom Head (top)	61.4797	9.05	29.4	*	1 634	4 485	78 357	0.001
Skirt Course	0	8.40	29.4	3.97	1 634	4 965	102 564	0.0009
*Moment of Inertia I varies over the length of the component								

Wind Deflection Report: Field Hydrotest, New								
Component	**Elevation of Bottom above Base (in)**	**Effective OD (ft)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Platform Wind Shear at Bottom (lb_f)**	**Total Wind Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**	**Deflection at Top (in)**
Top Head	354	9.05	29.5	*	292	438	871	0.0074
Shell Course #3	258	9.06	29.5	23.37	292	1 134	7 124	0.0068
Shell Course #2	162	9.06	29.5	23.37	292	1 830	18 986	0.0047
Shell Course #1	66	9.06	29.5	23.37	292	2 526	46 252	0.0026
Bottom Head (top)	61.4797	9.05	29.5	*	539	2 806	53 309	0.0007
Skirt Course	0	8.40	29.5	3.97	539	3 219	68 745	0.0006
*Moment of Inertia I varies over the length of the component								

Wind Pressure (WP) Calculations

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

$Kz = 2.0100 * (Z/\underline{Zg})^{2/\underline{d}}$
$= 2.0100 * (Z/900.00)^{0.2105}$
$qz = 0.00256 * Kz * Kzt * Kd * \underline{V}^2$
$= 0.00256 * Kz * 1.0000 * 0.9500 * 120.0000^2$
$= 35.0208 * Kz$
$WP = 0.6 * \max[qz * \underline{G} * \underline{Cf}, 16 \text{ lb/ft}^2]$
$= 0.6 * \max[qz * \underline{G} * 0.7000, 16 \text{ lb/ft}^2]$

Design Wind Pressures							
Height Z (')	Kz	qz (psf)	WP (psf)				
			Operating	Empty	Hydrotest New	Hydrotest Corroded	Vacuum
15.0	0.8489	29.73	11.15	11.15	9.60	N.A.	N.A.
20.0	0.9019	31.58	11.85	11.85	9.60	N.A.	N.A.
25.0	0.9453	33.10	12.42	12.42	9.60	N.A.	N.A.
30.0	0.9823	34.40	12.90	12.90	9.60	N.A.	N.A.
40.0	1.0436	36.55	13.71	13.71	9.60	N.A.	N.A.
Design Wind Force determined from: F = Pressure * Af , where Af is the projected area.							

Gust Factor Calculations

Operating, Corroded
Empty, Corroded
Hydrotest, New, field

Gust Factor Calculations: Operating, Corroded

Vessel is considered a rigid structure as $n_1 = 8.5274$ Hz ≥ 1 Hz.

$\bar{z} = \max[0.6000 * \underline{h} , \underline{z_{min}}]$
$= \max[0.6000 * 31.4813 , 15.0000]$
$= 18.8888$
$I_{\bar{z}} = \underline{c} * (33 / \bar{z})^{1/6}$
$= 0.2000 * (33 / 18.8888)^{1/6}$
$= 0.2195$
$L_{\bar{z}} = \underline{l} * (\bar{z} / 33)^{\underline{ep}}$
$= 500.0000 * (18.8888 / 33)^{0.2000}$
$= 447.2063$
$Q = Sqr(1 / (1 + 0.6300 * ((\underline{b} + \underline{h}) / L_{\bar{z}})^{0.6300}))$
$= Sqr(1 / (1 + 0.6300 * ((7.5625 + 31.4813) / 447.2063)^{0.6300}))$
$= 0.9384$
$G = 0.925 * (1 + 1.7 * \underline{g_Q} * I_{\bar{z}} * Q) / (1 + 1.7 * \underline{g_v} * I_{\bar{z}})$
$= 0.925 * (1 + 1.7 * 3.4000 * 0.2195 * 0.9384) / (1 + 1.7 * 3.4000 * 0.2195)$
$= 0.8931$

Gust Factor Calculations: Empty, Corroded

Vessel is considered a rigid structure as n_1 = 8.9819 Hz ≥ 1 Hz.

$\bar{z}$ = max[0.6000 * $\underline{h}$, $z_{\underline{min}}$]
= max[0.6000 * 31.4813 , 15.0000]
= 18.8888

$I_{\bar{z}}$ = $\underline{c}$ * (33 / $\bar{z}$)$^{1/6}$
= 0.2000 * (33 / 18.8888)$^{1/6}$
= 0.2195

$L_{\bar{z}}$ = $\underline{l}$ * ($\bar{z}$ / 33)$^{\underline{ep}}$
= 500.0000 * (18.8888 / 33)$^{0.2000}$
= 447.2063

Q = Sqr(1 / (1 + 0.6300 * (($\underline{b}$ + $\underline{h}$) / $L_{\bar{z}}$)$^{0.6300}$))
= Sqr(1 / (1 + 0.6300 * ((7.5625 + 31.4813) / 447.2063)$^{0.6300}$))
= 0.9384

G = 0.925 * (1 + 1.7 * $g_{\underline{Q}}$ * $I_{\bar{z}}$ * Q) / (1 + 1.7 * $g_{\underline{v}}$ * $I_{\bar{z}}$)
= 0.925 * (1 + 1.7 * 3.4000* 0.2195 * 0.9384) / (1 + 1.7 * 3.4000 * 0.2195)
= 0.8931

Gust Factor Calculations: Hydrotest, New, field

Vessel is considered a rigid structure as n_1 = 7.2181 Hz ≥ 1 Hz.

$\bar{z}$ = max[0.6000 * $\underline{h}$, $z_{\underline{min}}$]
= max[0.6000 * 31.4813 , 15.0000]
= 18.8888

$I_{\bar{z}}$ = $\underline{c}$ * (33 / $\bar{z}$)$^{1/6}$
= 0.2000 * (33 / 18.8888)$^{1/6}$
= 0.2195

$L_{\bar{z}}$ = $\underline{l}$ * ($\bar{z}$ / 33)$^{\underline{ep}}$
= 500.0000 * (18.8888 / 33)$^{0.2000}$
= 447.2063

Q = Sqr(1 / (1 + 0.6300 * (($\underline{b}$ + $\underline{h}$) / $L_{\bar{z}}$)$^{0.6300}$))
= Sqr(1 / (1 + 0.6300 * ((7.5625 + 31.4813) / 447.2063)$^{0.6300}$))
= 0.9384

G = 0.925 * (1 + 1.7 * $g_{\underline{Q}}$ * $I_{\bar{z}}$ * Q) / (1 + 1.7 * $g_{\underline{v}}$ * $I_{\bar{z}}$)
= 0.925 * (1 + 1.7 * 3.4000* 0.2195 * 0.9384) / (1 + 1.7 * 3.4000 * 0.2195)
= 0.8931

Table Lookup Values	
d = 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 = 3.4000	[26.9.4 page 254]
g_v = 3.4000	[26.9.4 page 254]

Seismic Code

Building Code: ASCE 7-10 ground supported		
Site Class		D
Importance Factor, I_e		1.2500
Spectral Response Acceleration at short period (% g), S_s		100.00%
Spectral Response Acceleration at period of 1 sec (% g), S_1		40.00%
Response Modification Coeficient from Table 15.4-2, R		3.0000
Acceleration-based Site Coefficient, F_a		1.1000
Velocity-based Site Coefficient, F_v		1.6000
Long-period Transition Period, T_L		12.0000
Redundancy factor, u		1.0000
Risk Category (Table 1.5-1)		III
User Defined Vertical Accelerations Considered		No
Hazardous, toxic, or explosive contents		No
Vessel Characteristics		
Height		31.4813 ft
Weight	Operating, Corroded	104 305 lb
	Empty, Corroded	104 305 lb
Period of Vibration Calculation		
Fundamental Period, T	Operating, Corroded	0.117 sec (f = 8.5 Hz)
	Empty, Corroded	0.111 sec (f = 9.0 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.	$D + P + P_s + 0.7E$	$= (1.0 + 0.14S_{DS})D + P + P_s + 0.7uQ_E$	
8.	$0.6D + P + P_s + 0.7E$	$= (0.6 - 0.14S_{DS})D + P + P_s + 0.7uQ_E$	
Parameter description			
D	= Dead load		
P	= Internal or external pressure load		
P_s	= Static head load		
E	= Seismic load	$= E_h$ +/- E_v	$= uQ_E$ +/- $0.2S_{DS}D$

Seismic Shear Reports:

Operating, Corroded
Empty, Corroded

Base Shear Calculations

Seismic Shear Report: Operating, Corroded					
Component	**Elevation of Bottom above Base (in)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Seismic Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**
Top Head	354	26.5	*	3 594	4 910
Shell Course #3	258	26.5	22.8114	11 614	64 068
Shell Course #2	162	26.5	22.8114	18 016	184 544
Shell Course #1	66	26.5	22.8114	21 837	354 980
Bottom Head (top)	61.4797	26.5	*	21 906	369 191
Skirt Course	0	26.5	3.97	22 310	483 035
*Moment of Inertia I varies over the length of the component					

Seismic Shear Report: Empty, Corroded					
Component	**Elevation of Bottom above Base (in)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Seismic Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**
Top Head	354	29.4	*	3 594	4 910
Shell Course #3	258	29.4	22.8114	11 614	64 068
Shell Course #2	162	29.4	22.8114	18 016	184 544
Shell Course #1	66	29.4	22.8114	21 837	354 980
Bottom Head (top)	61.4797	29.4	*	21 906	369 191
Skirt Course	0	29.4	3.97	22 310	483 035
*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}

$S_{MS} = \underline{F_a} * \underline{S_s} = 1.1000 * 100.00 / 100 = 1.1000$

The maximum considered earthquake spectral response acceleration at 1 s period, S_{M1}

$S_{M1} = \underline{F_v} * \underline{S_1} = 1.6000 * 40.00 / 100 = 0.6400$

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 $\underline{S_{Ds}} = 0.7333$ is D.
From Table 11.6-2, the Seismic Design Category based on $\underline{S_{D1}} = 0.4267$ is D.

This vessel is assigned to Seismic Design Category D.

12.4.2.3: Seismic Load Combinations: Vertical Term

Factor is applied to dead load.

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

Base Shear Calculations

Operating, Corroded
Empty, Corroded

Base Shear Calculations: Operating, Corroded

Paragraph 15.4.4: Period Determination

Fundamental Period is taken from the Rayleigh method listed previously in this report.
T = 0.1173 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 = 0.1173) <= (T_L = 12.0000)

$C_s = \underline{S_{DS}} / (\underline{R} / \underline{I_e}) = 0.7333 / (3.0000 / 1.2500) = 0.3056$

$C_s\text{Min} = \max[\ 0.044 * \underline{S_{DS}} * \underline{I_e}\ ,\ 0.03\ ] = \max[\ 0.044 * 0.7333 * 1.2500\ ,\ 0.03\ ] = 0.0403$

$C_s\text{Max} = \underline{S_{D1}} / (T * (\underline{R} / \underline{I_e})) = 0.4267 / (0.1173 * (3.0000 / 1.2500)) = 1.5160$

$C_s = 0.3056$

12.8.1: Calculation of Base Shear

$V = C_s * \underline{W}$
$= 0.3056 * 104\ 305.3672$
$= 31\ 871.08$ lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E_h

$Q_E = V$

$E_h = 0.7 * u * Q_E$ (Only 70% of seismic load considered as per Section 2.4.1)
$= 0.7000 * 1.0000 * 31\ 871.08$
$= 22\ 309.76$ 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 = 0.1113 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 = 0.1113) <= (T_L = 12.0000)

$C_s = \underline{S_{DS}} / (\underline{R} / \underline{I_e}) = 0.7333 / (3.0000 / 1.2500) = 0.3056$

$C_s\text{Min} = \max[\ 0.044 * \underline{S_{DS}} * \underline{I_e}\ ,\ 0.03\ ] = \max[\ 0.044 * 0.7333 * 1.2500\ ,\ 0.03\ ] = 0.0403$

$C_s\text{Max} = \underline{S_{D1}} / (T * (\underline{R} / \underline{I_e})) = 0.4267 / (0.1113 * (3.0000 / 1.2500)) = 1.5968$

$C_s = 0.3056$

12.8.1: Calculation of Base Shear

$V = C_s * \underline{W}$
$= 0.3056 * 104\ 305.3672$
$= 31\ 871.08$ lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E_h

$Q_E = V$

$E_h = 0.7 * u * Q_E$ (Only 70% of seismic load considered as per Section 2.4.1)
$= 0.7000 * 1.0000 * 31\ 871.08$
$= 22\ 309.76$ lb

Skirt Course

ASME Section VIII Division 1, 2015 Edition		
Component		Support Skirt
Material		SA-516 70 (II-D p. 18, ln. 37)
Skirt is Attached To		Bottom Head
Skirt Attachment Offset		4.5203" down from the top seam
Design Temperature		
Internal		600°F
Dimensions		
Inner Diameter	**Top**	82"
	Botttom	82"
Length (includes base ring thickness)		61.4797"
Nominal Thickness		0.375"
Corrosion	**Inner**	0"
	Outer	0"
Weight		
New		1 654.15 lb
Corroded		1 654.15 lb
Joint Efficiency		
Top		0.55
Bottom		0.8

Skirt design thickness, largest of the following + corrosion = 0.1691 in

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

The skirt thickness of 0.375 in is adequate.

Results Summary							
Loading	**Condition**	**Tensile or Compressive Side**	**Governing Skirt Location**	**Temperature (°F)**	**Allowable Stress (psi)**	**Calculated Stress/E (psi)**	**Required thickness (in)**
Wind	operating, corroded	Tensile	top	600	9 176.73	-159.68	0.0065
		Compressive	bottom			1 683.15	0.0688
	operating, new	Tensile	top	600	9 176.73	-168.7	0.0069
		Compressive	bottom			1 699.49	0.0694
	empty, corroded	Tensile	top	60	12 747.46	-159.68	0.0047
		Compressive	bottom			1 683.15	0.0495
	empty, new	Tensile	top	60	12 747.46	-168.7	0.005
		Compressive	bottom			1 699.49	0.05
		Tensile	top			-659.55	0.0194

	test, new	Compressive	bottom	60	12 747.46	2 062.55	0.0607
Seismic	operating, corroded	Tensile	top	600	19 400	3 077.5	0.0595
		Compressive	bottom		9 176.73	4 077.23	0.1666
	operating, new	Tensile	top	600	19 400	3 122.59	0.0604
		Compressive	bottom		9 176.73	4 137.52	0.1691
	empty, corroded	Tensile	top	60	20 000	3 077.5	0.0577
		Compressive	bottom		12 747.46	4 077.23	0.1199
	empty, new	Tensile	top	60	20 000	3 122.59	0.0585
		Compressive	bottom		12 747.46	4 137.52	0.1217

Loading due to seismic, operating & new

Tensile side

Required thickness, tensile stress at base:

$$t = -(0.6 - 0.14*S_{DS})*W / (s*D*S_t*E) + 48*M / (s*D^2*S_t*E)$$
$$= -(0.6 - 0.14*0.7333)*105\,117.3 / (s*82.375*19\,400*0.8) + 48*490\,164.3 / (s*82.375^2*19\,400*0.8)$$
$$= 0.0581 \text{ in}$$

Required thickness, tensile stress at the top:

$$t = -(0.6 - 0.14*S_{DS})*W_t / (s*D_t*S_t*E) + 48*M_t / (s*D_t^2*S_t*E)$$
$$= -(0.6 - 0.14*0.7333)*103\,463.16 / (s*82.375*19\,400*0.55) + 48*374\,333.1 / (s*82.375^2*19\,400*0.55)$$
$$= 0.0604 \text{ in}$$

Compressive side

Required thickness, compressive stress at base:

$$t = (1 + 0.14*S_{DS})*W / (s*D*S_c*E_c) + 48*M / (s*D^2*S_c*E_c)$$
$$= (1 + 0.14*0.7333)*105\,117.3 / (s*82.375*9\,177*1) + 48*490\,164.3 / (s*82.375^2*9\,177*1)$$
$$= 0.1691 \text{ in}$$

Required thickness, compressive stress at the top:

$$t = (1 + 0.14*S_{DS})*W_t / (s*D_t*S_c*E_c) + 48*M_t / (s*D_t^2*S_c*E_c)$$
$$= (1 + 0.14*0.7333)*103\,463.16 / (s*82.375*9\,177*1) + 48*374\,333.1 / (s*82.375^2*9\,177*1)$$
$$= 0.1399 \text{ in}$$

Base Ring

Inputs	
Base configuration	single base plate without gussets
Base plate material	SA516-70
Base plate allowable stress, S_p	20 000 psi
Foundation compressive strength	1 658 psi
Concrete ultimate 28-day strength	3 000 psi
Bolt circle, BC	87.25"
Base plate inner diameter, D_i	79.75"
Base plate outer diameter, D_o	90.75"
Base plate thickness, t_b	1.25"
Anchor Bolts	
Material	C.S.
Allowable stress, S_b	20 000 psi
Bolt size and type	1.25" series 8 threaded
Number of bolts, N	12
Corrosion allowance (applied to root radius)	0"
Anchor bolt clearance	0.375"
Bolt root area (corroded), A_b	0.93 in^2
Diameter of anchor bolt holes, d_b	1.625"
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	4 964.7	102 564.2	104 305.4	0	0.5221	113.59
Wind	operating, new	4 964.7	102 644.7	105 844	0	0.5246	114.68
Wind	empty, corroded	4 964.7	102 564.2	104 305.4	0	0.5221	113.59
Wind	empty, new	4 964.7	102 644.7	105 844	0	0.5246	114.68
Wind	test, new	3 219.3	68 744.5	160 830.8	0	0.5774	138.92
Seismic	operating, corroded	22 309.8	483 034.8	104 305.4	0.8911	1.0876	492.83
Seismic	operating, new	22 638.9	490 164.3	105 844	0.9043	1.0956	500.1
Seismic	empty, corroded	22 309.8	483 034.8	104 305.4	0.8911	1.0876	492.83
Seismic	empty, new	22 638.9	490 164.3	105 844	0.9043	1.0956	500.1

Anchor bolt load (governing)

$P = -(0.6 - 0.14*S_{DS})*W / N + 48 * M / (N*BC)$
$= -(0.6 - 0.14*0.7333)*105\ 844 / 12 + 48 * 490\ 164.3 / (12*87.25)$
$= 18\ 085.07\ lb_f$

Required area per bolt = $P / S_b = \underline{0.9043}\ in^2$

The area provided ($0.929\ in^2$) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, governing)

Base plate width, t_c:	5.5 in
Average base plate diameter, d:	85.25 in
Base plate elastic modulus, E_s:	29.0E+06 psi
Base plate yield stress, S_y:	38 000 psi

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

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

$t_s = (N*A_b) / (s*d)$
$= (12*0.929) / (s*85.25)$
$= 0.0416$ in

From table 12.4 for k = 0.262547:

$K_1 = 2.5237, K_2 = 1.4056$
$L_1 = 20.246, L_2 = 48.6872, L_3 = 17.7525$

Total tensile force on bolting

$T = (12*M - (0.6 - 0.14*S_{DS})*W *(L_1 + L_3)) / (L_2 + L_3)$
$= (12*490\ 164.3 - (0.6 - 0.14*0.7333)*105\ 844 *(20.246 + 17.7525)) / (48.6872 + 17.7525)$
$= 58\ 425.04\ lb_f$

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

$f_s = T / (t_s * (d / 2) * K_1)$
$= 58\ 425.04 / (0.0416 * (85.25 / 2) * 2.5237)$
$= 13\ 048$ psi

Total compressive load on foundation

$C_c = T + (1 + 0.14*S_{DS})*W + \text{Bolt Preload}$
$= 58\ 425.04 + (1 + 0.14*0.7333)*105\ 844 + 0$
$= 175\ 135.68\ lb_f$

Foundation bearing stress

$f_c = C_c / (((t_c - t_s) + n*t_s)*(d / 2)*K_2)$
$= 175\ 135.68 / (((5.5 - 0.0416) + 9.2889*0.0416)*(85.25 / 2)*1.4056)$
$= \underline{500}$ psi

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

$k = 1 / (1 + f_s / (n*f_c))$
$= 1 / (1 + 13\ 048 / (9.2889*500))$
$= 0.262547$

Base plate required thickness (governing)

$t_r = (3*f_c*L^2 / S_p)^{0.5}$
$= (3*500*4^2 / 20\ 000)^{0.5}$
$= \underline{1.0956}$ in

The base plate thickness is satisfactory.

Outlet (B)

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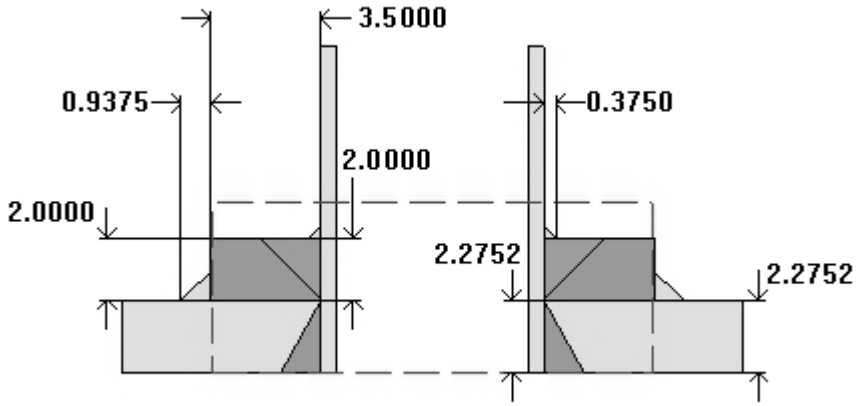	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Bottom Head
Orientation	0°
End of nozzle to datum line	-42"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Description	NPS 8 Sch 80 (XS)
Access opening	No
Material specification	SA-106 B Smls pipe (II-D p. 14, ln. 15)
Inside diameter, new	7.625"
Pipe nominal wall thickness	0.5"
Pipe minimum wall thickness[1]	0.4375"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	12.844"
Projection available outside vessel to flange face, Lf	18.344"
Local vessel minimum thickness	2.2752"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Reinforcing Pad	

Material specification	SA-516 70 (II-D p. 18, ln. 37) (normalized)
Diameter, D_p	15.625"
Thickness, t_e	2"
Is split	No
Welds	
Inner fillet, Leg_{41}	0.375"
Outer fillet, Leg_{42}	0.9375"
Nozzle to vessel groove weld	2.2752"
Pad groove weld	2"

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

ASME B16.5-2013 Flange	
Description	NPS 8 Class 600 WN A350 LF2
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	No
Rated MDMT	-55°F
Liquid static head	0 psi
MAWP rating	1 135 psi @ 600°F
MAP rating	1 480 psi @ 60°F
Hydrotest rating	2 225 psi @ 60°F
PWHT performed	Yes
Impact Tested	No
Circumferential joint radiography	None UW-11(c) Type 1
Bore diameter, B (specified by purchaser)	7.625"
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 26°F applied (ratio = 0.7399). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle	
Governing thickness, t_g =	0.4375"
Exemption temperature from Fig UCS-66 Curve B =	-13°F
t_r = 1 095*3.875 / (17 100*1 - 0.6*1 095) =	0.2581"
Stress ratio = t_r*E^* / (t_n - c) = 0.2581*1 / (0.4375 - 0.0625) =	0.6881
Reduction in MDMT, T_R from Fig UCS-66.1 =	31.2°F
MDMT = max[MDMT - T_R, -55] = max[-13 - 31.2 , -55] =	-44.2°F

Material is exempt from impact testing at the Design MDMT of -20°F.

UCS-66 Material Toughness Requirements Pad	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*0.8986*78.125 / (2*20 000*1 - 0.2*1 095) =	1.9324"
Stress ratio = t_r*E* / (t_n - c) = 1.9324*1 / (2.2752 - 0.0625) =	0.8733
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	12.7°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 12.7 , -155] =	-32.7°F
Design MDMT of -20°F is acceptable.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1 095 psi @ 600 °F The opening is adequately reinforced							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
15.6486	16.5361	1.6838	0.9784	--	13.75	0.1239	0.3443	0.4375

UG-41 Weld Failure Path Analysis Summary (lb$_f$)						
All failure paths are stronger than the applicable weld loads						
Weld load W	Weld load W_{1-1}	Path 1-1 strength	Weld load W_{2-2}	Path 2-2 strength	Weld load W_{3-3}	Path 3-3 strength
274 211.23	288 134.62	286 081.22	54 490.52	861 926.49	321 240.52	649 093.36

UW-16 Weld Sizing Summary			
Weld description	Required weld size (in)	Actual weld size (in)	Status
Nozzle to pad fillet (Leg_{41})	0.25	0.2625	weld size is adequate
Pad to shell fillet (Leg_{42})	0.375	0.6562	weld size is adequate

Fill / Manway (C)

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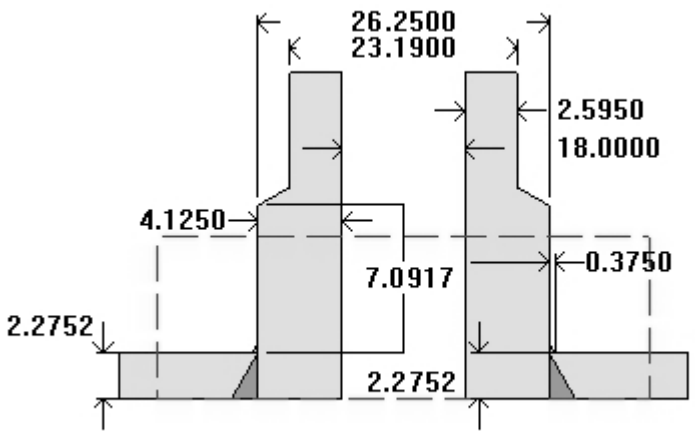
Note: Per UW-16(b) minimum inside corner radius r_1 = min [1 / 4*t , 0.125 in] = 0.125 in

Location and Orientation	
Located on	Top Head
Orientation	0°
End of nozzle to datum line	324"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	18"
Wall thickness, t_n	4.125"
Minimum wall thickness	2.4075"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	9.855"
Heavy barrel length, L_{hb}	7.0917"
Projection available outside vessel to flange face, Lf	13.355"
Local vessel minimum thickness	2.2752"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	

Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	2.2752"

ASME B16.5-2013 Flange	
Description	NPS 18 Class 600 FVC V2 (or equiv.) A350 LF2 Cl.1 (Nut Stop)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	Yes
Rated MDMT	-55°F
Liquid static head	0 psi
MAWP rating	1 135 psi @ 600°F
MAP rating	1 480 psi @ 60°F
Hydrotest rating	2 225 psi @ 60°F
PWHT performed	Yes
Impact Tested	No
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 26°F applied (ratio = 0.7399). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
Impact test temperature per material specification =	-50°F
t_r = 1 095*0.8986*78.125 / (2*20 000*1 - 0.2*1 095) =	1.9324"
Stress ratio = $t_r*E^* / (t_n - c)$ = 1.9324*1 / (2.2752 - 0.0625) =	0.8733
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	12.7°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, max[T_{impact} - T_R, -155]] = min[-50 - 5, max[-50 - 12.7 , -155]] =	-62.7°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1 095*9.0625 / (20 000*1 - 0.6*1 095) =	0.513"
Stress ratio = $t_r*E^* / (t_n - c)$ = 0.513*1 / (2.4075 - 0.0625) =	0.2188
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1 095 psi @ 600 °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}
36.9476	40.7942	3.8992	36.7616	--	--	0.1334	0.6218	2.4075

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

Dump (D)

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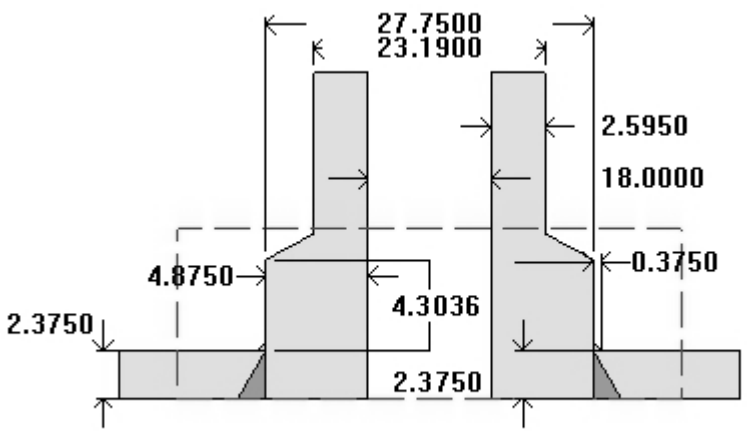
	
Note: Per UW-16(b) minimum inside corner radius r_1 = min [1 / 4*t , 0.125 in] = 0.125 in	
Location and Orientation	
Located on	Shell Course #1
Orientation	0°
Nozzle center line offset to datum line	30"
End of nozzle to shell center	52.375"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	18"
Wall thickness, t_n	4.875"
Minimum wall thickness	2.4075"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	7.5"
Heavy barrel length, L_{hb}	4.3036"
Projection available outside vessel to flange face, Lf	11"
Local vessel minimum thickness	2.375"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

Nozzle to vessel groove weld	2.375"

ASME B16.5-2013 Flange	
Description	NPS 18 Class 600 FVC V3 (or equiv.) A350 LF2 Cl.1 (Nut Stop)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	Yes
Rated MDMT	-55°F
Liquid static head	0 psi
MAWP rating	1 135 psi @ 600°F
MAP rating	1 480 psi @ 60°F
Hydrotest rating	2 225 psi @ 60°F
PWHT performed	Yes
Impact Tested	No
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 26°F applied (ratio = 0.7399). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
Impact test temperature per material specification =	-50°F
Additional reduction per UCS-66(g) =	5°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1 095*9.0625 / (20 000*1 - 0.6*1 095) =	0.513"
Stress ratio = t_r*E^* / (t_n - c) = 0.513*1 / (2.4075 - 0.0625) =	0.2188
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

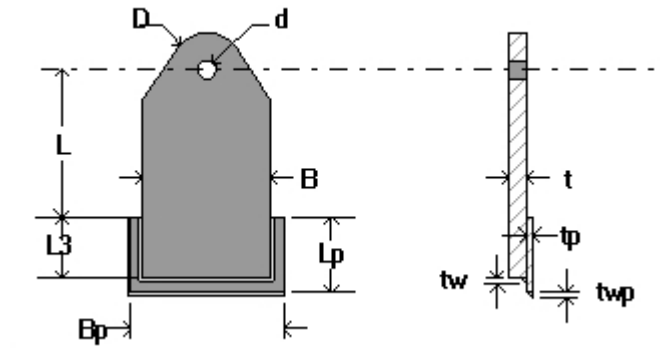
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1 095 psi @ 600 °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}**
42.4943	43.7701	0.5359	43.1008	--	--	0.1334	0.6218	2.4075

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

Lifting Lugs (From Horiz. - Empty)

Geometry Inputs	
	
Attached To	Shell Course #3
Material	SA516-70
Distance of Lift Point From Datum	311.5"
Angular Position	0° and 180°
Length, L	23.5"
Width, B	21"
Thickness, t	1.5"
Hole Diameter, d	3"
Pin Diameter, Dp	2.75"
Diameter at Pin, D	12"
Load Angle from Vertical, i	0°
Has Brace Plate	No
Welds	
Size, t_w	0.5"
Reinforcement Pad	
Width, B_p	25"
Length, L_p	12.5"
Thickness, t_p	0.5"
Weld Size, t_{wp}	0.375"
Weld Length, L_3	10.5"

Intermediate Values	
Load Factor	1.5000
Vessel Weight (new, incl. Load Factor), W	110 933.5 lb
Lug Weight (new), W_{lug}	696.7 lb (Qty=2)
Distance from Center of Gravity to Top Lug, l_1	172.6923"

Distance from Center of Gravity to Tail Lug, l_2	196.5577"
Distance from Vessel Center Line to Tail Lug, l_3	50.375"
Allowable Stress, Tensile, v_t	19 980 psi
Allowable Stress, Shear, v_s	13 320 psi
Allowable Stress, Bearing, v_p	29 970 psi
Allowable Stress, Bending, v_b	22 201 psi
Allowable Stress, Weld Shear, $w_{allowable}$	13 320 psi
Allowable Stress set to 1/3 Sy per ASME B30.20	No

Summary Values	
Required Lift Pin Diameter, d_{reqd}	1.6282"
Required Lug Thickness, t_{reqd}	0.673"
Lug Stress Ratio, v_{ratio}	0.29
Weld Shear Stress Ratio, w_{ratio}	0.85
Lug Design	Acceptable
Local Stresses WRC 107	Acceptable
Maximum Out of Plane Lift Angle - Weak Axis Bending	7.64°

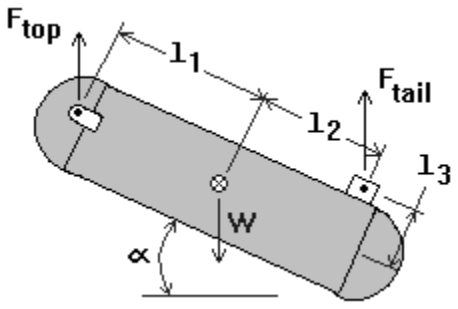
COMPRESS recommends a spreader beam be used to prevent weak axis bending of the top lugs.
No consideration is given for any bracing plate from the lug to the vessel.

Lift Forces

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

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

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



α [°]	F_{top}[lbf]	F_{tail}[lbf]
0	29 526	51 882
15	30 441	50 052
30	31 420	48 094
45	32 640	45 654
60	34 484	41 966

75	38 278	34 378
90	55 467	0
16[1]	30 502	49 929
14[2]	30 379	50 175
15[3]	30 441	50 052
[1]Lift angle at maximum lug stress.		
[2]Lift angle at maximum weld stress.		
[3]Lift angle at maximum pad weld stress.		
Shell angle at lift lug	0.00°	

Lug Pin Diameter - Shear stress

$d_{reqd} = (2*F_v / (s*v_s))^{0.5}$

$= (2*55\,467 / (s*13\,320))^{0.5} = \underline{1.6282"}$

$d_{reqd} / D_p = 1.6282 / 2.75 = 0.59$ Acceptable

$v = F_v / A$

$= F_v / (2*(0.25*s*D_p^2))$

$= 55\,467 / (2*(0.25*s*2.75^2)) = 4\,669$ psi

$v / v_s = 4\,669 / 13\,320 = 0.35$ Acceptable

Lug Thickness - Tensile stress

$t_{reqd} = F_v / ((D - d)*v_t)$

$= 55\,467 / ((12 - 3)*19\,980) = 0.3085"$

$t_{reqd} / t = 0.3085 / 1.5 = 0.21$ Acceptable

$v = F_v / A$

$= F_v / ((D - d)*t)$

$= 55\,467 / ((12 - 3)*1.5) = 4\,109$ psi

$v / v_t = 4\,109 / 19\,980 = 0.21$ Acceptable

Lug Thickness - Bearing stress

$t_{reqd} = F_v / (D_p*v_p)$

$= 55\,467 / (2.75*29\,970) = \underline{0.673"}$

$t_{reqd} / t = 0.673 / 1.5 = 0.45$ Acceptable

$v = F_v / A_{bearing}$

$= F_v / (D_p*(t))$

$= 55\,467 / (2.75*(1.5)) = 13\,446$ psi

$v / v_p = 13\,446 / 29\,970 = 0.45$ Acceptable

Lug Thickness - Shear stress

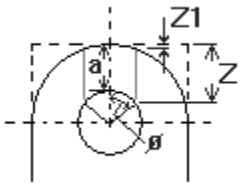
t_{reqd} = $[F_v / v_s] / (2*L_{shear})$
= (55 467 / 13 320) / (2*4.9045) = 0.4245"

t_{reqd} / t = 0.4245 / 1.5 = 0.28 Acceptable

w = F_v / A_{shear}
= $F_v / (2*t*L_{shear})$
= 55 467 / (2*1.5*4.9045) = 3 770 psi

w / v_s = 3 770 / 13 320 = 0.28 Acceptable

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



i = $55*D_p / d$
= 55*2.75 / 3
= 50.4167°

Z = $0.5*(D - d) + 0.5*D_p*(1 - \cos(i))$
= $0.5*(12 - 3) + 0.5*2.75*(1 - \cos(50.4167))$
= 4.9989"

Z1 = $0.5*D - \sqrt{0.25*D*D - (0.5*D_p*\sin(i))^2}$
= $0.5*12 - \sqrt{0.25*12*12 - (0.5*2.75*\sin(50.4167))^2}$
= 0.0943"

L_{shear} = Z - Z1
= 4.9045"

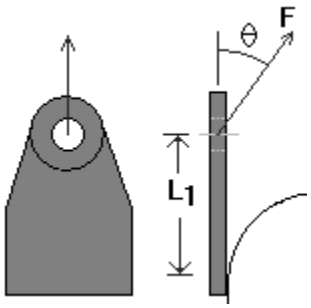
Lug Plate Stress

Lug stress, tensile + bending, during rotational lift:

v_{ratio} = $[F_{ten} / (A_{ten}*v_t)] + [M_{bend} / (Z_{bend}*v_b)] \le 1$
= $[(F_{top}(d)*\sin(d)) / (t*B*v_t)] + [(6*F_{top}(d)*L*\cos(d)) / (t*B^2 * v_b)] \le 1$
= $30\,502*\sin(16.0) / (1.5*21*19\,980) + 6*(30\,502)*23.5*\cos(16.0) / (1.5*21^2*22\,201)$
= 0.29 Acceptable

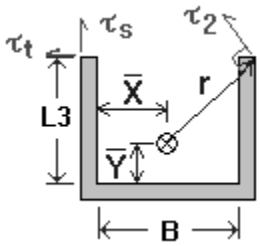
Weak Axis Bending Stress

Maximum lift cable angle from vertical t = 7.64°



v_b = M / Z = $(F*\sin(t)* L_1) / Z$
F*cos(t) = 0.5*W => F = 0.5*W / cos(t)
t = $\arctan((2*v_b*Z) / (W* L_1))$
t = $\arctan((2*22\,201*(21*1.5^2/6)) / (110\,933*23.5))$ = 7.64°

Weld Stress



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

Direct shear:

Maximum weld shear stress occurs at lift angle 14.00°; lift force = 30 379 lb_f

$A_{weld} = 0.707*t_w*(2*L_3 + B)$
$= 0.707*0.5*(2*10.5 + 21) = 14.847\ in^2$

$w_t = F_{lug}*\cos(d) / A_{weld}$
$= 30\ 379*\cos(14.0) / 14.847 = 1\ 985\ psi$

$w_s = F_{lug}*\sin(d) / A_{weld}$
$= 30\ 379*\sin(14.0) / 14.847 = 495\ psi$

Torsional shear:

Weld centroid:

$Y_{bar} = L_3^2 / (2*L_3 + B)$
$= 10.5^2 / (2*10.5 + 21) = 2.625"$

Second polar moment of area:

$J = 0.707*t_w*((8*L_3^3 + 6*L_3*B^2 + B^3) / 12 - L_3^4 / (2*L_3 + B))$
$= 0.707*0.5*((8*10.5^3 + 6*10.5*21^2 + 21^3) / 12 - 10.5^4 / (2*10.5 + 21)) = 1261.76\ in^4$

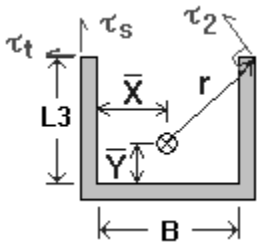
Radial distance from centroid to weld:

$r = sqr((X_{bar})^2 + (L_3 - Y_{bar})^2)$
$= sqr((0.5*21)^2 + (10.5 - 2.625)^2) = 13.125"$

$t_r = \arctan((L_3 - Y_{bar}) / (X_{bar}))$
$= \arctan(7.875 / 10.5) = 36.87°$

$w_2 = M * r / J$
$= [F(d)*\cos(d)*(L + L_3 - Y_{bar})] * r / J$
$= (30\ 379*\cos(14.0)*31.375)*13.125 / 1261.7630$
$= 9\ 620\ psi$

$w_{ratio} = sqr((w_t + w_2*\sin(t_r))^2 + (w_s + w_2*\cos(t_r))^2) / w_{allowable} \le 1$
$= sqr ((1\ 985 + 9\ 620*\sin(36.87))^2 + (495 + 9\ 620*\cos(36.87))^2) / 13\ 320$
$= \underline{0.85}$ Acceptable



Pad Weld Stress

Direct shear:

Maximum weld shear stress occurs at lift angle 15.00°; lift force = 30 441 lb_f

$A_{weld} = 0.707*t_{wp}*(2*L_p + B_p)$
$= 0.707*0.375*(2*12.5 + 25) = 13.2563\ in^2$

$w_t = F_{lug}*\cos(d) / A_{weld}$
$= 30\,441*\cos(15.0) / 13.2563 = 2\,218$ psi

$w_s = F_{lug}*\sin(d) / A_{weld}$
$= 30\,441*\sin(15.0) / 13.2563 = 594$ psi

Torsional shear:

Weld centroid:

$Y_{barp} = L_p^2 / (2*L_p + B_p)$
$= 12.5^2 / (2*12.5 + 25) = 3.125"$

Second polar moment of area:

$J_p = 0.707*t_{wp}*((8*L_p^3 + 6*L_p*B_p^2 + B_p^3) / 12 - L_p^4 / (2*L_p + B_p))$
$= 0.707*0.375*\ ((8*12.5^3 + 6*12.5*25^2 + 25^3) / 12 - 12.5^4 / (2*12.5 + 25)) = 1596.62\ in^4$

Radial distance from centroid to weld:

$r_p = sqr((X_{barp})^2 + (L_p - Y_{barp})^2)$
$= sqr((0.5*25)^2 + (12.5 - 3.125)^2) = 15.625"$

$t_r = \arctan((L_p - Y_{barp}) / (X_{barp}))$
$= \arctan(9.375 / 12.5) = 36.87°$

$w_2 = M * r_p / J_p$
$= [F(d)*\cos(d)*(L + L_p - Y_{barp})] * r_p / J_p$
$= (30\,441*\cos(15.0)*32.875)*15.625 / 1596.6187$
$= 9\,460$ psi

$w_{ratio} = sqr((w_t + w_2*\sin(t_r))^2 + (w_s + w_2*\cos(t_r))^2) / w_{allowable} \le 1$
$= sqr\ ((2\,218 + 9\,460*\sin(36.87))^2 + (594 + 9\,460*\cos(36.87))^2) / 13\,320$
$= 0.85$ Acceptable

WRC 107 Analysis

Maximum stress ratio occurs at lift angle = 90.00° with lift force = 55 467 lb_f

Geometry	
Height (radial)	1.5"
Width (circumferential)	21"
Length	10.5"
Fillet Weld Size:	0.5"
Located On	Shell Course #3 (10.5" from top end)
Location Angle	0.00° and 180.00°
Reinforcement Pad	
Thickness	0.5"
Width	25"
Length	12.5"
Weld Size	0.375"

Applied Loads	
Radial load, P_r	0 lb_f
Circumferential moment, M_c	0 lb_f-in
Circumferential shear, V_c	0 lb_f
Longitudinal moment, M_L	69 333.4 lb_f-in
Longitudinal shear, V_L	55 466.73 lb_f
Torsion moment, M_t	0 lb_f-in
Internal pressure, P	0 psi
Mean shell radius, R_m	40.1875"
Design factor	3

Maximum stresses due to the applied loads at the lug edge

$j = R_m / T = 40.1875 / 2.875 = 13.9783$

$C_1 = 11$, $C_2 = 5.75$ in

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

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

Maximum combined stress (P_L+P_b+Q) = 1 678 psi
Allowable combined stress (P_L+P_b+Q) = $\pm 3*S = \pm 60\,000$ psi

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

Maximum local primary membrane stress (P_L) = -111 psi
Allowable local primary membrane stress (P_L) = $\pm 1.5*S = \pm 30\,000$ psi

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

Stresses at the lug edge per WRC Bulletin 107										
Figure	**value**	**e**	**A_u**	**A_l**	**B_u**	**B_l**	**C_u**	**C_l**	**D_u**	**D_l**
3C*	2.0219	0.1925	0	0	0	0	0	0	0	0
4C*	2.2633	0.2389	0	0	0	0	0	0	0	0
1C	0.0839	0.2437	0	0	0	0	0	0	0	0
2C-1	0.054	0.2437	0	0	0	0	0	0	0	0
3A*	0.531	0.2205	0	0	0	0	0	0	0	0
1A	0.0869	0.2636	0	0	0	0	0	0	0	0
3B*	1.4742	0.1776	-111	-111	111	111	0	0	0	0
1B-1	0.0436	0.1913	-285	285	285	-285	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-396	174	396	-174	0	0	0	0
Primary membrane circumferential stress*			-111	-111	111	111	0	0	0	0
3C*	1.7801	0.2389	0	0	0	0	0	0	0	0
4C*	2.375	0.1925	0	0	0	0	0	0	0	0
1C-1	0.0986	0.2099	0	0	0	0	0	0	0	0
2C	0.0659	0.2099	0	0	0	0	0	0	0	0
4A*	0.8817	0.2205	0	0	0	0	0	0	0	0
2A	0.0505	0.2177	0	0	0	0	0	0	0	0
4B*	0.4439	0.1776	-29	-29	29	29	0	0	0	0
2B-1	0.0714	0.185	-483	483	483	-483	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-512	454	512	-454	0	0	0	0
Primary membrane longitudinal stress*			-29	-29	29	29	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-839	-839	839	839
Total Shear stress			0	0	0	0	-839	-839	839	839
Combined stress (P_L+P_b+Q)			-512	454	512	-454	1 678	1 678	1 678	1 678
* denotes primary stress.										

Maximum stresses due to the applied loads at the pad edge

$j = R_m / T = 40.1875 / 2.375 = 16.9211$

$C_1 = 12.875$, $C_2 = 6.625$ in

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

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

Maximum combined stress (P_L+P_b+Q) = 1 762 psi
Allowable combined stress (P_L+P_b+Q) = ±3*S = ±60 000 psi

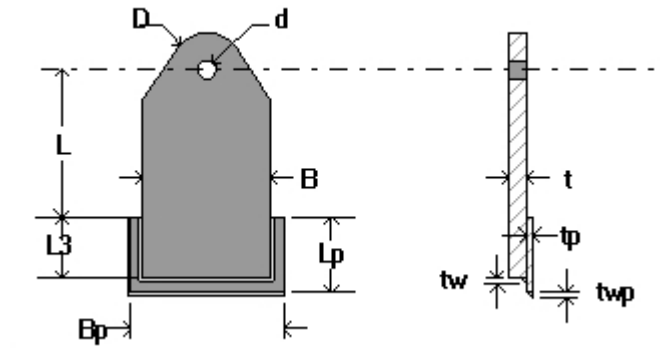
The maximum combined stress (P_L+P_b+Q) is within allowable limits.

Maximum local primary membrane stress (P_L) = -151 psi
Allowable local primary membrane stress (P_L) = ±1.5*S = ±30 000 psi

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

Stresses at the pad edge per WRC Bulletin 107										
Figure	**value**	**e**	**A_u**	**A_l**	**B_u**	**B_l**	**C_u**	**C_l**	**D_u**	**D_l**
3C*	2.0638	0.2233	0	0	0	0	0	0	0	0
4C*	2.4619	0.279	0	0	0	0	0	0	0	0
1C	0.0666	0.2847	0	0	0	0	0	0	0	0
2C-1	0.0377	0.2847	0	0	0	0	0	0	0	0
3A*	0.7166	0.2567	0	0	0	0	0	0	0	0
1A	0.0803	0.3068	0	0	0	0	0	0	0	0
3B*	1.9105	0.2057	-151	-151	151	151	0	0	0	0
1B-1	0.0364	0.2217	-301	301	301	-301	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-452	150	452	-150	0	0	0	0
Primary membrane circumferential stress*			-151	-151	151	151	0	0	0	0
3C*	1.7476	0.279	0	0	0	0	0	0	0	0
4C*	2.6721	0.2233	0	0	0	0	0	0	0	0
1C-1	0.0767	0.2443	0	0	0	0	0	0	0	0
2C	0.0469	0.2443	0	0	0	0	0	0	0	0
4A*	1.281	0.2567	0	0	0	0	0	0	0	0
2A	0.0448	0.2518	0	0	0	0	0	0	0	0
4B*	0.6325	0.2057	-43	-43	43	43	0	0	0	0
2B-1	0.0605	0.2141	-519	519	519	-519	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-562	476	562	-476	0	0	0	0
Primary membrane longitudinal stress*			-43	-43	43	43	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-881	-881	881	881
Total Shear stress			0	0	0	0	-881	-881	881	881
Combined stress (P_L+P_b+Q)			-562	476	562	-476	1 762	1 762	1 762	1 762
* denotes primary stress.										

Lifting Lugs (Vertical Lift Loaded)

Geometry Inputs	
	
Attached To	Shell Course #3
Material	SA516-70
Distance of Lift Point From Datum	311.5"
Angular Position	0° and 180°
Length, L	23.5"
Width, B	21"
Thickness, t	1.5"
Hole Diameter, d	3"
Pin Diameter, Dp	2.75"
Diameter at Pin, D	12"
Load Angle from Vertical, i	0°
Has Brace Plate	No
Welds	
Size, t_w	0.5"
Reinforcement Pad	
Width, B_p	25"
Length, L_p	12.5"
Thickness, t_p	0.5"
Weld Size, t_{wp}	0.375"
Weld Length, L_3	10.5"

Intermediate Values	
Load Factor	1.5000
Vessel Weight (new, incl. Load Factor), W	158 655.1 lb
Lug Weight (new), W_{lug}	696.7 lb (Qty=2)
Allowable Stress, Tensile, v_t	19 980 psi

Allowable Stress, Shear, v_s	13 320 psi
Allowable Stress, Bearing, v_p	29 970 psi
Allowable Stress, Bending, v_b	22 201 psi
Allowable Stress, Weld Shear, $w_{allowable}$	13 320 psi
Allowable Stress set to 1/3 Sy per ASME B30.20	No

Summary Values	
Required Lift Pin Diameter, d_{reqd}	1.9472"
Required Lug Thickness, t_{reqd}	0.9625"
Lug Stress Ratio, v_{ratio}	0.13
Weld Shear Stress Ratio, w_{ratio}	0.4
Lug Design	Acceptable
Local Stresses WRC 107	Acceptable
Maximum Out of Plane Lift Angle - Weak Axis Bending	5.36°

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

Lift Forces

F_r = force on vessel at lug

$F_r = [W / \cos(i_1)]*(1 - x_1 / (x_1 + x_2))$

$= (158\,655.1) / \cos(0)*(1 - 41.375/ (41.375 + 41.375))$

$= 79\,328\ lb_f$

where 'x_1' is the distance between this lug and the center of gravity

'x_2' is the distance between the second lift lug and the center of gravity

Lug Pin Diameter - Shear stress

$d_{reqd} = (2*F_v / (s*v_s))^{0.5}$

$= (2*79\,328 / (s*13\,320))^{0.5} = 1.9472"$

$d_{reqd} / D_p = 1.9472 / 2.75 = 0.71$ Acceptable

$v = F_v / A$

$= F_v / (2*(0.25*s*D_p^2))$

$= 79\,328 / (2*(0.25*s*2.75^2)) = 6\,678$ psi

$v / v_s = 6\,678 / 13\,320 = 0.5$ Acceptable

Lug Thickness - Tensile stress

$t_{reqd} = F_v / ((D - d)*v_t)$

$= 79\,328 / ((12 - 3)*19\,980) = 0.4411"$

$t_{reqd} / t = 0.4411 / 1.5 = 0.29$ Acceptable

$v = F_v / A$
$= F_v / ((D - d)*t)$
$= 79\,328 / ((12 - 3)*1.5) = 5\,876$ psi

$v / v_t = 5\,876 / 19\,980 = 0.29$ Acceptable

Lug Thickness - Bearing stress

$t_{reqd} = F_v / (D_p*v_p)$
$= 79\,328 / (2.75*29\,970) = \underline{0.9625"}$

$t_{reqd} / t = 0.9625 / 1.5 = 0.64$ Acceptable

$v = F_v / A_{bearing}$
$= F_v / (D_p*(t))$
$= 79\,328 / (2.75*(1.5)) = 19\,231$ psi

$v / v_p = 19\,231 / 29\,970 = 0.64$ Acceptable

Lug Thickness - Shear stress

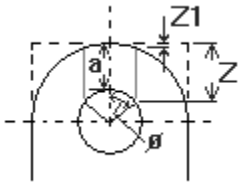
$t_{reqd} = [F_v / v_s] / (2*L_{shear})$
$= (79\,328 / 13\,320) / (2*4.9045) = \underline{0.6071"}$

$t_{reqd} / t = 0.6071 / 1.5 = 0.40$ Acceptable

$w = F_v / A_{shear}$
$= F_v / (2*t*L_{shear})$
$= 79\,328 / (2*1.5*4.9045) = 5\,391$ psi

$w / v_s = 5\,391 / 13\,320 = 0.4$ Acceptable

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



$i = 55*D_p / d$
$= 55*2.75 / 3$
$= 50.4167°$

$Z = 0.5*(D - d) + 0.5*D_p*(1 - \cos(i))$
$= 0.5*(12 - 3) + 0.5*2.75*(1 - \cos(50.4167))$
$= 4.9989"$

$Z1 = 0.5*D - \text{sqr}(0.25*D*D - (0.5*D_p*\sin(i))^2)$
$= 0.5*12 - \text{sqr}(0.25*12*12 - (0.5*2.75*\sin(50.4167))^2)$
$= 0.0943"$

$L_{shear} = Z - Z1$
$= 4.9045"$

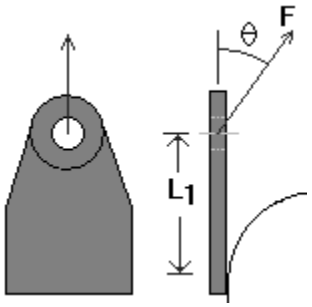
Lug Plate Stress

Lug stress, tensile + bending, during rotational lift:

$v_{ratio} = [F_{ten} / (A_{ten}*v_t)] + [M_{bend} / (Z_{bend}*v_b)] \le 1$
$= [(F_{top}(d)*\sin(d)) / (t*B*v_t)] + [(6*F_{top}(d)*L*\cos(d)) / (t*B^2 * v_b)] \le 1$
$= 79\,328*\sin(90.0) / (1.5*21*19\,980) + 6*(79\,328)*23.5*\cos(90.0) / (1.5*21^2*22\,201)$
$= \underline{0.13}$ Acceptable

Weak Axis Bending Stress

Maximum lift cable angle from vertical $t = 5.36°$



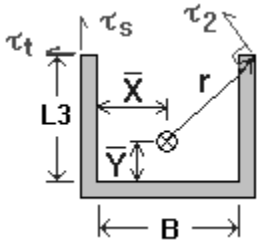
v_b $= M / Z$ $= (F*\sin(t)* L_1) / Z$

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

$t = \arctan((2*v_b*Z) / (W* L_1))$

$t = \arctan((2*22\,201*(21*1.5^2/6)) / (158\,655*23.5)) = 5.36°$

Weld Stress



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

Direct shear:

Maximum weld shear stress occurs at lift angle 90.00°; lift force = 79 328 lb_f

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

$= 0.707*0.5*(2*10.5 + 21) = 14.847\ in^2$

$w_t = F_{lug}*\cos(d) / A_{weld}$

$= 79\,328*\cos(90.0) / 14.847 = 0\ psi$

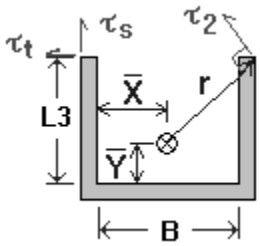
$w_s = F_{lug}*\sin(d) / A_{weld}$

$= 79\,328*\sin(90.0) / 14.847 = 5\,343\ psi$

$w = sqr(w_t^2 + w_s^2)$

$= sqr(0^2 + 5\,343^2) = 5\,343\ psi$

$w / w_{allowable} = 5\,343 / 13\,320 = \underline{0.40} \leq 1$ Acceptable



Pad Weld Stress

Direct shear:

Maximum weld shear stress occurs at lift angle 90.00°; lift force = 79 328 lb_f

$A_{weld} = 0.707*t_{wp}*(2*L_p + B_p)$

$= 0.707*0.375*(2*12.5 + 25) = 13.2563\ in^2$

$w_t = F_{lug}*\cos(d) / A_{weld}$

$= 79\ 328*\cos(90.0) / 13.2563 = 0$ psi

$w_s = F_{lug}*\sin(d) / A_{weld}$

$= 79\ 328*\sin(90.0) / 13.2563 = 5\ 984$ psi

$w = sqr(w_t^2 + w_s^2)$

$= sqr(0^2 + 5\ 984^2) = 5\ 984$ psi

$w / w_{allowable} = 5\ 984 / 13\ 320 = 0.45 \leq 1$ Acceptable

WRC 107 Analysis

Geometry	
Height (radial)	1.5"
Width (circumferential)	21"
Length	10.5"
Fillet Weld Size:	0.5"
Located On	Shell Course #3 (10.5" from top end)
Location Angle	0.00° and 180.00°
Reinforcement Pad	
Thickness	0.5"
Width	25"
Length	12.5"
Weld Size	0.375"

Applied Loads	
Radial load, P_r	0 lb_f
Circumferential moment, M_c	0 lb_f-in

Circumferential shear, V_c	0 lb_f
Longitudinal moment, M_L	99 159.4 lb_f-in
Longitudinal shear, V_L	79 327.54 lb_f
Torsion moment, M_t	0 lb_f-in
Internal pressure, P	0 psi
Mean shell radius, R_m	40.1875"
Design factor	3

Maximum stresses due to the applied loads at the lug edge

$j = R_m / T = 40.1875 / 2.875 = 13.9783$

$C_1 = 11$, $C_2 = 5.75$ in

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

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

Maximum combined stress (P_L+P_b+Q) = 2 400 psi
Allowable combined stress (P_L+P_b+Q) = $\pm 3*S = \pm 60\ 000$ psi

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

Maximum local primary membrane stress (P_L) = -159 psi
Allowable local primary membrane stress (P_L) = $\pm 1.5*S = \pm 30\ 000$ psi

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

Stresses at the lug edge per WRC Bulletin 107										
Figure	**value**	**e**	**A_u**	**A_l**	**B_u**	**B_l**	**C_u**	**C_l**	**D_u**	**D_l**
3C*	2.0219	0.1925	0	0	0	0	0	0	0	0
4C*	2.2633	0.2389	0	0	0	0	0	0	0	0
1C	0.0839	0.2437	0	0	0	0	0	0	0	0
2C-1	0.054	0.2437	0	0	0	0	0	0	0	0
3A*	0.531	0.2205	0	0	0	0	0	0	0	0
1A	0.0869	0.2636	0	0	0	0	0	0	0	0
3B*	1.4742	0.1776	-159	-159	159	159	0	0	0	0
1B-1	0.0436	0.1913	-408	408	408	-408	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-567	249	567	-249	0	0	0	0
Primary membrane circumferential stress*			-159	-159	159	159	0	0	0	0
3C*	1.7801	0.2389	0	0	0	0	0	0	0	0
4C*	2.375	0.1925	0	0	0	0	0	0	0	0
1C-1	0.0986	0.2099	0	0	0	0	0	0	0	0
2C	0.0659	0.2099	0	0	0	0	0	0	0	0
4A*	0.8817	0.2205	0	0	0	0	0	0	0	0

2A	0.0505	0.2177	0	0	0	0	0	0	0	0
4B*	0.4439	0.1776	-41	-41	41	41	0	0	0	0
2B-1	0.0714	0.185	-691	691	691	-691	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-732	650	732	-650	0	0	0	0
Primary membrane longitudinal stress*			-41	-41	41	41	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-1 200	-1 200	1 200	1 200
Total Shear stress			0	0	0	0	-1 200	-1 200	1 200	1 200
Combined stress (P_L+P_b+Q)			-732	650	732	-650	2 400	2 400	2 400	2 400
* denotes primary stress.										

Maximum stresses due to the applied loads at the pad edge

j = R_m / T = 40.1875 / 2.375 = 16.9211

C_1 = 12.875, C_2 = 6.625 in

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

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

Maximum combined stress (P_L+P_b+Q) = 2 520 psi
Allowable combined stress (P_L+P_b+Q) = ±3*S = ±60 000 psi

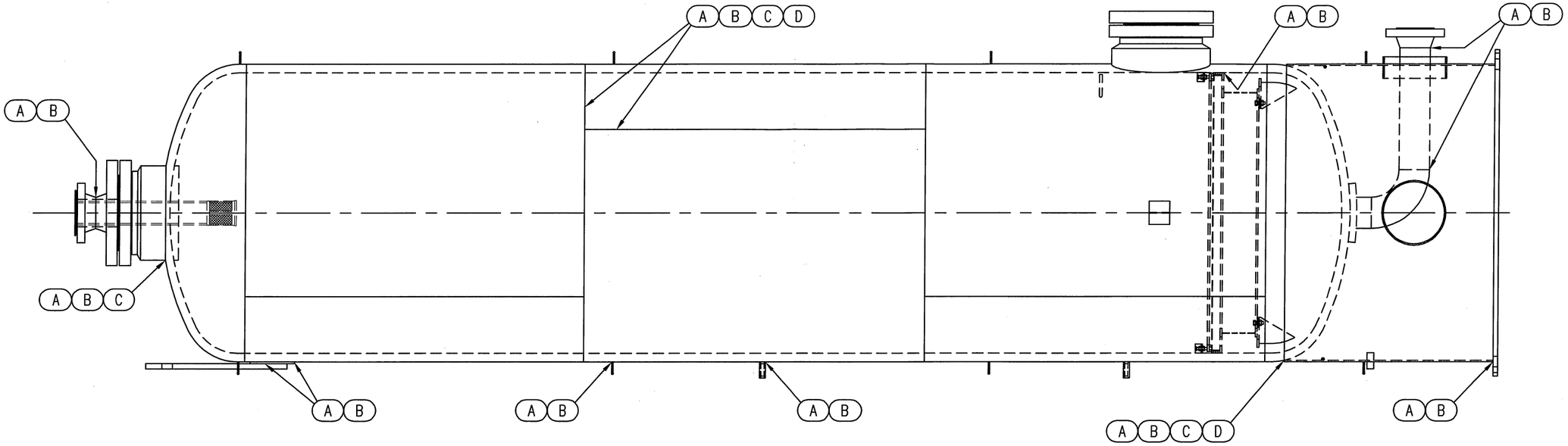
The maximum combined stress (P_L+P_b+Q) is within allowable limits.

Maximum local primary membrane stress (P_L) = -216 psi
Allowable local primary membrane stress (P_L) = ±1.5*S = ±30 000 psi

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

Stresses at the pad edge per WRC Bulletin 107										
Figure	**value**	**e**	**A_u**	**A_l**	**B_u**	**B_l**	**C_u**	**C_l**	**D_u**	**D_l**
3C*	2.0638	0.2233	0	0	0	0	0	0	0	0
4C*	2.4619	0.279	0	0	0	0	0	0	0	0
1C	0.0666	0.2847	0	0	0	0	0	0	0	0
2C-1	0.0377	0.2847	0	0	0	0	0	0	0	0
3A*	0.7166	0.2567	0	0	0	0	0	0	0	0
1A	0.0803	0.3068	0	0	0	0	0	0	0	0
3B*	1.9105	0.2057	-216	-216	216	216	0	0	0	0
1B-1	0.0364	0.2217	-431	431	431	-431	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-647	215	647	-215	0	0	0	0
Primary membrane circumferential stress*			-216	-216	216	216	0	0	0	0
3C*	1.7476	0.279	0	0	0	0	0	0	0	0

4C*	2.6721	0.2233	0	0	0	0	0	0	0	0
1C-1	0.0767	0.2443	0	0	0	0	0	0	0	0
2C	0.0469	0.2443	0	0	0	0	0	0	0	0
4A*	1.281	0.2567	0	0	0	0	0	0	0	0
2A	0.0448	0.2518	0	0	0	0	0	0	0	0
4B*	0.6325	0.2057	-61	-61	61	61	0	0	0	0
2B-1	0.0605	0.2141	-742	742	742	-742	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-803	681	803	-681	0	0	0	0
Primary membrane longitudinal stress*			-61	-61	61	61	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-1 260	-1 260	1 260	1 260
Total Shear stress			0	0	0	0	-1 260	-1 260	1 260	1 260
Combined stress (P_L+P_b+Q)			-803	681	803	-681	2 520	2 520	2 520	2 520
* denotes primary stress.										



PROCEDURE NOTES:

P1-M-26:

* BASE METAL OR WELD METAL BACKING SHALL BE USED WITH THIS PROCEDURE. THIS PROCEDURE SHALL NOT BE USED FOR OPEN GROOVE WELDS.

* PROCEDURE SHALL ONLY BE USED FOR ATTACHMENT WELDS, REPAIRS WELDS, PIPE WELDS AND BACK-UP PASSES FOR SUB-ARC WELDING. THIS PROCEDURE SHALL NOT BE USE TO WELD OUT NOZZLES TO SHELL, LONG SEAMS OR ROUND SEAMS.

P1-GMFC-3:

* GMAW-S SHALL ONLY BE USED ON OPEN ROOT GROOVE WELDS NOT ACCESSIBLE FROM BOTH SIDES WITH A DOWNHILL WELD PROGRESSION. NO WELD SHALL BE MADE ENTIRELY WITH GMAW-S

P1-A-1A DC/AC:

* THIS PROCEDURE CAN BE USED FOR SINGLE OR TANDEM WIRE APPLICATIONS.
* WELDS USING THIS PROCEDURE SHALL BE BACK GOUGED TO CLEAN METAL AND BACK WELDED.

P1-A-1A AC/AC:

* WELDS USING THIS PROCEDURE SHALL BE BACK GOUGED TO CLEAN METAL AND BACK WELDED.

(A) P1-M-26 - W/ E7018-1 (SMAW)
(B) P1-GMFC-3 - W/ ER70S-6 & E71T-12MJ (GMAW/FCAW)
(C) P1-A-1A-DC/AC (W-CVN) - W/ LA-71 / 880M FLUX (SAW)
(D) P1-A-1A-AC/AC (W-CVN) - W/ LA-71 / 880M FLUX (SAW)

AS BUILT

ACAD FILE NAME 70699-WP DATE PLOTTED 01/05/17

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	REVISIONS	DATE	BY		REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/06/17	R W		

ORDER NO. 70699 | ITEM NO. V-442, V-443 | PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

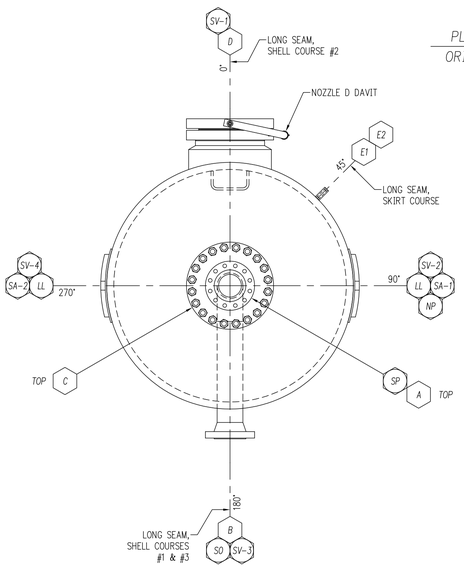
DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC - TULSA, OKLAHOMA
WELD MAP

CUSTOMER UOP RUSSELL LLC | P.O. NO. 4500754152

DRAWN BY R. Wolf | SCALE NONE | DATE 01/05/17

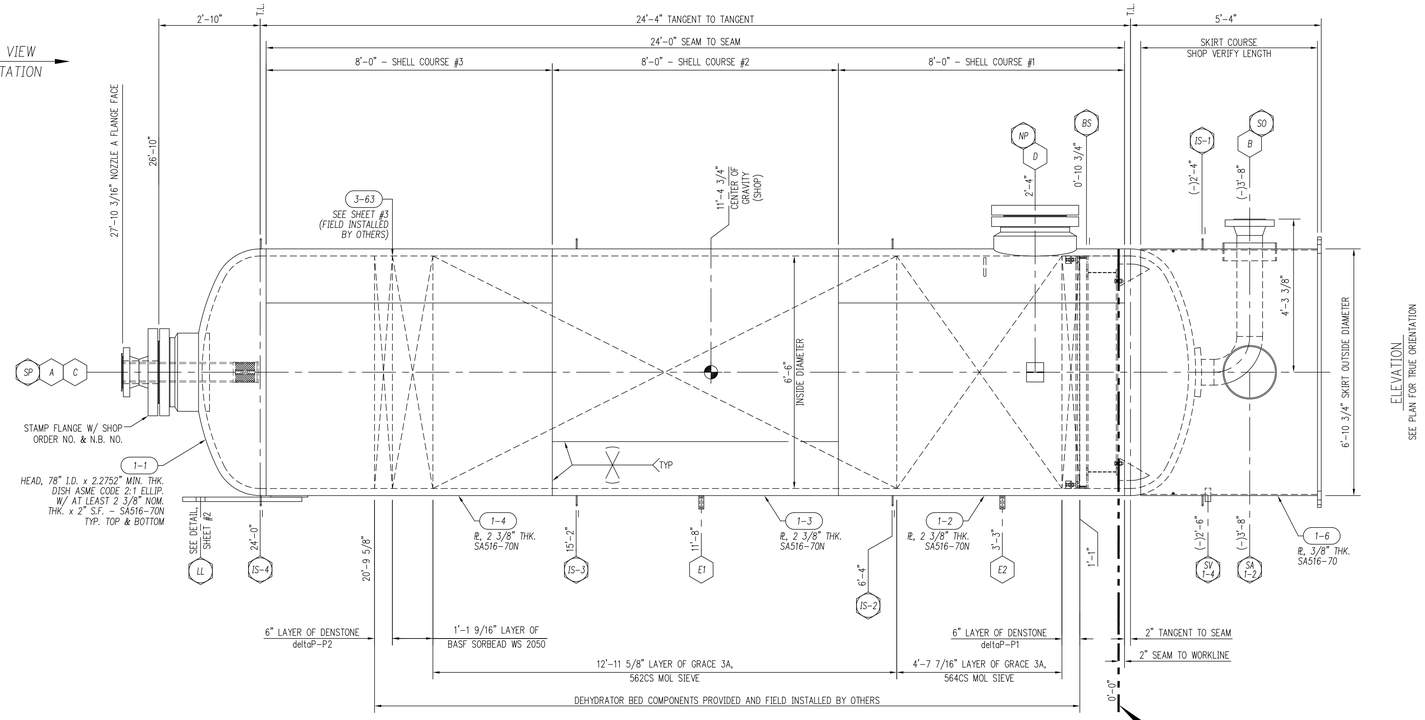
CHECKED BY

APPROVED BY J S | DRAWING NO. B- 21564 SHT 1 OF 1 | REV. 0



PLAN
V-442

PLAN VIEW ORIENTATION



ELEVATION
SEE PLAN FOR TRUE ORIENTATION

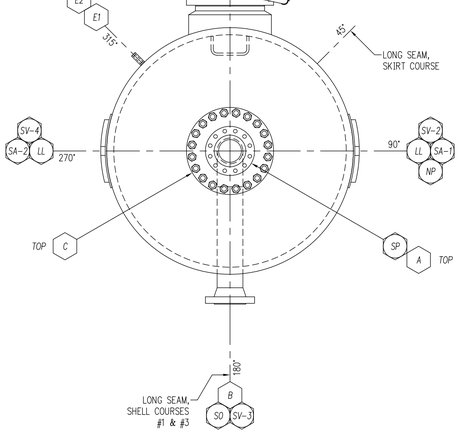
WORKLINE

CENTER PUNCH INSIDE AND OUTSIDE FOR PERMANENT REFERENCE... ALL ELEV. DIMENSIONS ARE TO THIS LINE.

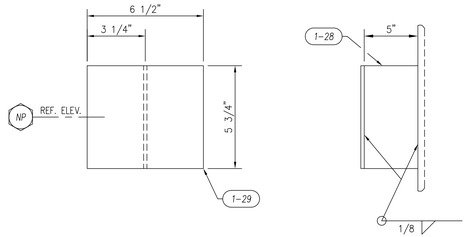
BILL OF MATERIAL						
	ITEM	QTY	LEGEND	ITEM	QTY	LEGEND
	SV	4	SKIRT VENT	LL	2	LIFTING LUG
	SO	1	SKIRT OPENING	IS	4	INSULATION SUPPORT
	SA	2	SKIRT ACCESS	SP	1	STINGER PIPE/DIVERTER PLATE
	NP	1	NAMEPLATE W/ BRACKET	BS	1	BED SUPPORT

REV	ITEM	QTY	DESCRIPTION	MAT'L
	NO.	FOR 2		SPEC.
			HEAD, SHELL, AND REPAD MATERIAL TO BE IMPACT TESTED TO (-)20° F. PER UG-84	
	1-1	4	HEAD, 78" I.D. x 2.2752" MIN. THK. DISH ASME CODE 2:1 ELLIP. W/ AT LEAST 2 3/8" NOM. THK. x 2" S.F.	SA516-70N
	1-2	2	ROLLED CYLINDER, 2 3/8" x 78" I.D. x 96" LONG	SA516-70N
	1-3	2	ROLLED CYLINDER, 2 3/8" x 78" I.D. x 96" LONG	SA516-70N
	1-4	2	ROLLED CYLINDER, 2 3/8" x 78" I.D. x 96" LONG	SA516-70N
	1-5		INTENTIONALLY LEFT BLANK	
	1-6	2	SKIRT PLATE, 3/8" x 62" x 258 13/16" LONG - SHOP TO DETERMINE LENGTH OF SKIRT COURSE	SA516-70
	1-7	4	FLANGE, 8" CL. 600 RF/WN, SCH. 80 BORE	SA350-LF2
	1-8	4	GASKET, 8" CL. 600 FLANGE, SPIRAL WOUND, FOR TESTING	--
	1-9	2	GASKET, 8" CL. 600 FLANGE, FLEXITALLIC STYLE "CG" OR EQUAL, 304 S.S. SPIRAL WOUND, W/ FLEXIBLE GRAPHITE FILLER & C.S. CENTERING RING FOR SERVICE	--
	1-10	2	PIPE, 8" SCH. 80 x 9" LONG (BOE)	SA106-B
	1-11	2	REPAD., MAKE FROM PLATE, 2" x 18" x 18" LONG	SA516-70N
	1-12	2	LR WELD ELBOW, 8" SCH. 80, 90 DEGREE	SA234-WPB
	1-13	2	PIPE, 8" SCH. 80 x 33 7/8" LONG (BBE)	SA106-B
	1-14	2	FLANGE, 18" CL. 600 RF/V2 x 17" LONG	SA350-LF2
	1-15	2	REDUCING FLANGE, 18" x 8" CL. 600 RF/WN, SCH. 80 BORE	SA350-LF2
	1-16	80	STUD, 1 5/8"-8NC x 12" LONG (ZINC OR CADMIUM PLATED)	SA193-B7
	1-17	160	NUT, 1 5/8-8NC, HEAVY HEX (ZINC OR CADMIUM PLATED)	SA194-2H
	1-18	4	GASKET, 18" CL. 600 FLANGE, SPIRAL WOUND, FOR TESTING	--
	1-19	4	GASKET, 18" CL. 600 FLANGE, FLEXITALLIC STYLE "CG" OR EQUAL, 304 S.S. SPIRAL WOUND, W/ FLEXIBLE GRAPHITE FILLER & C.S. CENTERING RING FOR SERVICE	--
	1-20	2	FLANGE, 18" CL. 600 RF/V3 x 16 3/16" LONG - RADIUS BTM. TO FIT 78" I.D.	SA350-LF2
	1-21	2	BLIND FLANGE, 18" CL. 600, RF	SA350-LF2
	1-22	4	SPECIAL FULL COUPLING, 3/4" 6000# NPT x 4 1/2" O.A.L.	SA105
	1-23	4	HEX HEAD PLUG, 3/4" NPT - FOR TESTING/SHIPPING	SA105
	1-24			
	1-25			
	1-26			
	1-27	4	SHIPPING COVER, 8" CL. 600 FLANGE	C.S.
	1-28	2	PLATE, 1/4" x 5" x 5 3/4" LONG	SA516-70
	1-29	2	SHEET, 10 GAUGE x 5 3/4" x 6 1/2" LONG	C.S.
	1-30	2	ASME NAMEPLATE, BOARDMAN STANDARD	S.S.

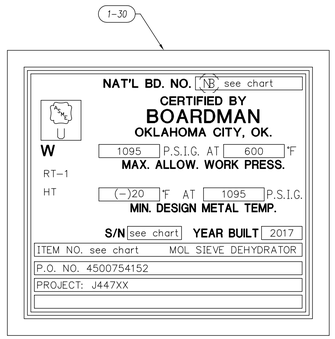
VESSEL PAINT:
UOPR SYSTEM #2 - PRIMER - SHERWIN WILLIAMS ZINC CLAD II, B69V3, B69D11, DATA SHEET 6.02, 2-4 MILS DFT, APPROX. 2,500 SQ.FT. (1,250 PER VESSEL). FINISH - SHERWIN WILLIAMS HI-TEMP ALUMINUM CK100A518 WITH B59V405 CATALYST, 1-2 MILS DFT, APPROX. 700 SQ.FT. (350 PER VESSEL).



PLAN
V-443



NP NAMEPLATE BRACKET DETAIL
SCALE: 1/4" = 1"



SERIAL NO.	N.B. NO.	ITEM NO.
70699-A	3979	V-442
70699-B	3980	V-443

NP NAMEPLATE DETAIL

AS BUILT

1. DESIGN NOTES
DESIGN, FABRICATION AND INSPECTION TO BE IN ACCORDANCE WITH THE ASME CODE, SECTION VIII, DIV. 1, 2015 EDITION, NO ADDENDUM. CODE STAMP IS REQUIRED. NAT'L BOARD REGISTRATION IS REQUIRED.

2. DESIGN DATA
DESIGN PRESS. (INT.) 1,095 PSIG @ 600 °F
DESIGN PRESS. (EXT.) n/a PSIG @ n/a °F
M.A.P. (NAC) 1,095 LIMITED BY DESIGN
M.A.W.P. (CORR.) 1,095 LIMITED BY DESIGN
M.D.M.T. (–)20 °F @ 1,095 PSIG
CHARPY IMPACT TEST REQ'MTS REQUIRED PER UG-84 TO (–)20° F. ON HEADS, SHELLS AND REPAD. SA350-LF2 NOZZLES ARE TESTED PER UCS-66(g). SA105 NOZZLES ARE EXEMPT PER UCS-66(b)(3). SA106-B PIPE EXEMPT PER FIG. UCS-66, CURVE B.
CORROSION ALLOW. HEADS 1/16" SHELL 1/16" NOZZLES 1/16"
RADIOGRAPHY RT-1
SHELL CAT. A (LONG SEAMS) FULL PER UW-11(a) TYPE 1
SHELL CAT. B (CIRC. SEAMS) FULL PER UW-11(a) TYPE 1
HEAD TO SHELL SEAMS FULL PER UW-11(a) TYPE 1
HEAD CAT. A SEAMLESS, OR FULL X-RAY
SHOP HYDRO-TEST @ 1,424 PSIG NEW & COLD (HORIZ. POS.).
WATER USED FOR TESTING MUST BE POTABLE AND AT LEAST 60° F. CHLORIDE CONTENT SHALL NOT EXCEED 50 ppm.
FIELD HYDRO-TEST @ 1,424 PSIG VERTICAL POSITION
P.W.H.T. REQ'D PER CODE. HOLD FOR MINIMUM 1.35 MINUTES AT 1150° F. +/– 25° F. CHARTS ARE REQUIRED
INSULATION THICKNESS 4" (BY OTHERS)
FIREPROOFING THICKNESS NONE
AUTHORIZED INSPECTION BY QC/AI/CUSTOMER
FAB. WEIGHT EMPTY 67,201 LBS, FULL H_2O (SHOP) 122,166 LBS

FABRICATION NOTES

3. FLANGES TO BE PER ASME B16.5 UNLESS NOTED OTHERWISE. FLANGE GASKET SURFACE FINISH TO BE BETWEEN 125 & 250 AARH. SPECIAL ATTENTION TO BE APPLIED TO FLANGE FACE PROTECTION. VISUAL INSPECTION PRIOR TO RELEASE FOR SHIPMENT.
4. ALL BOLT HOLES ARE TO STRADDLE THE VESSEL CENTERLINES.
5. ALL SHELL BUTT WELDS AND NOZZLE TO VESSEL WELDS SHALL BE COMPLETE PENETRATION, FULL FUSION.
6. INSIDE EDGE OF NOZZLES TO HAVE 1/8" RADIUS.
7. PRESSURE RETAINING WELD SEAMS UNDER REPADS AND LIFTING LUGS SHALL BE GROUND FLUSH AND 100% RADIOGRAPHED.
8. [REFERENCE (*) ABOVE NOZZLE SCHEDULE] UNLESS NOTED OTHERWISE, NOZZLES MAY BE SQUARE CUT AND MAY PROJECT A MAXIMUM OF 1 1/2" (MEASURED FROM SHORT SIDE OF PIPE), PROVIDED PROJECTION DOES NOT INTERFERE W/ VESSEL INTERNALS. TRIM PROJECTIONS IF REQ'D.
9. PROVIDE 1/4" NPT WEEP HOLE IN REINFORCING PADS OR SEGMENT. TEST REPADS PRIOR TO HYDRO-TEST AT 15 PSIG, USING DRY AIR AND SOAP SUDS. UNLESS NOTED OTHERWISE, PROVIDE A 1/4" NPT VENT HOLE IN REPADS FOR INTERNAL AND EXTERNAL STRUCTURAL ATTACHMENTS TO VESSEL SHELLS AND HEADS. LEAVE WEEP AND VENT HOLES OPEN DURING PWHT (IF REQ'D) AND HYDRO-TEST, FILL WITH RUST INHIBITING GREASE PRIOR TO SHIPMENT.
10. IN ADDITION TO STRENGTH WELDS SHOWN, WHERE POSSIBLE, ALL INTERNAL ATTACHMENTS SHALL BE SEAL WELDED, UNLESS NOTED OTHERWISE.
11. PRIOR TO HYDRO-TEST CLEAN VESSEL OF ALL GREASE, WELD SPATTER, SLAG AND OTHER FOREIGN MATTER.
12. USE TEST GASKETS FOR HYDRO-TEST FOR ALL FLANGES INCLUDING BLIND FLANGES WHERE FURNISHED.
13. AFTER HYDRO-TEST VESSEL SHALL BE THOROUGHLY DRIED AND CLEANED OF ALL LOOSE SCALE, RUST, GREASE, DIRT OR OTHER FOREIGN MATERIAL.
14. TEMP. FOR PAINTING MUST BE ABOVE DEW POINT (MIN. 5° ABOVE DEW POINT).
15. PREPARATION AND PAINT:

UOPR PAINT SYSTEM #2:

	SURFACE PREP	PRIMER	FINISH
INSULATED PORTIONS OF VESSEL	SSPC-SP10 1.5-3 MILS PROFILE	S.W. ZINC CLAD II INORGANIC ZINC 2-4 MILS DFT	NONE
UNINSULATED PORTIONS OF VESSEL, INCL. O.S. & I.S. OF SKIRT, BASE RING, NOZZLES, CLIPS, ETC., PROJECTING BEYOND INSULATION	SSPC-SP10 1.5-3 MILS PROFILE	S.W. ZINC CLAD II INORGANIC ZINC 2-4 MILS DFT	S.W. HI-TEMP ALUMINUM 1-2 MILS DFT

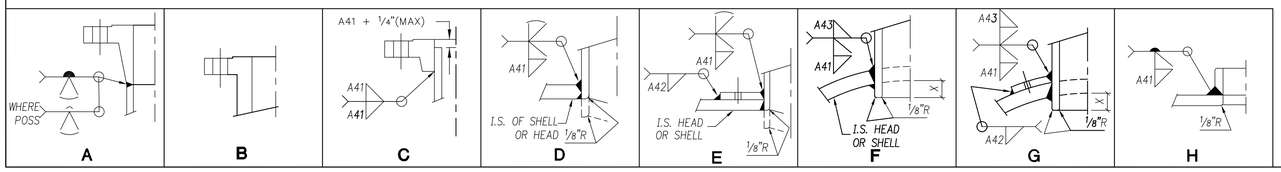
MINIMAL OVERSPRAY IS ACCEPTABLE.

16. PAINT IN 3" HIGH LETTERS AS LOADED (BOTH SIDES OF VESSEL):
P.O. NUMBER: 4500754152
PROJECT: J447XX
ITEM NUMBER: V-442 (OR V-443 – DEPENDING ON VESSEL)
PWHT – DO NOT WELD OR BURN
17. PROTECT ALL FLANGE FACES AND THREADS WITH RUST-INHIBITING GREASE. ALL FLANGES WITHOUT BLINDS TO BE PROTECTED WITH METAL COVERS WITH A MIN. OF FOUR BOLTS. BOLT BLINDS IN PLACE. USE TEST GASKETS AND BOLTING FOR NOZZLES FURNISHED WITH BLINDS.
18. ALL SPARE BOLTING, GASKETS AND OTHER LOOSE ITEMS TO BE CRATED, TAGGED WITH THE NAME OF THE PARTS, VESSEL ITEM NO. & P.O. NO., AND LISTED ON PACKING LIST.

* SEE NOTE #8

MARK	QUAN.	SIZE	RATE	TYPE	SERVICE	NECK	NECK O.D.	PROJECTION FROM C.L.	PROJECTION FROM O.S.	PROJECTION I.S. "X"	FLANGE TYPE	ATTACH. TYPE	f1	f2	WELD SIZES A41	WELD SIZES A42	WELD SIZES A43	REPAD	REMARKS	BILL OF MATERIAL No. FLG	NECK	PAD	COVER	BOLTS	GASKET	X	X
E1-2	TWO	3/4"	6000	CPLG	TI	--	1" I.D.	3'-9 7/8"	4 1/2"	n/a	n/a	H			5/16"	–	–		SET-ON NOZZLE	1-22					1-23		
D	ONE	18"	600	RF/V3	DUMP	--	2'-3 3/4"	4'-4 3/8"	11"	0°	B	D			3/8"	–	–		W/ BLIND, STUDS, NUTS, GASKET & DAVIT	1-20			1-21	1-16/1-17	1-18/1-19		
C	ONE	18"	600	RF/V2	FILL / MANWAY	--	2'-2 1/4"	SEE ELEV.	SEE ELEV.	*	B	D			3/8"	–	–		W/ RDC'G WN, STUDS, NUTS, & GASKET	1-14			1-15	1-16/1-17	1-18/1-19		
B	ONE	8"	600	RF/WN	OUTLET	SCH. 80	8 5/8"	SEE ELEV.	SEE ELEV.	0"	A	E			3/8"	15/16"	–	2" x 3 1/2" WIDE		1-7	1-10	1-11			1-8	1-12	1-13
A	ONE	8"	600	RF/WN	INLET	SCH. 80	8 5/8"	SEE ELEV.	SEE ELEV.	n/a	A	A			–	–	–		W/ STINGER PIPE AND DIVERTER PLATE	1-7					1-8/1-9		

SCHEDULE of OPENINGS



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	REVISIONS	DATE	BY		REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/11/17	R	W	B-21564-WP – WELD MAP
					D-21564-2 – SKIRT, LL, MNWY & MISC DTLS
					D-21564-3 – MISC. INTERNAL DETAILS
					D-21564-4 – VESSEL L & P CLIP DETAILS
					D-21564-5 – VESSEL PIPING & CLIP DETAILS

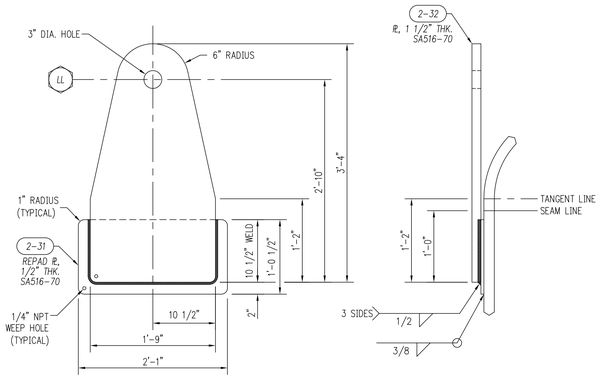
60 mm CRYO PLANT | ACAD FILE NAME 70699 | DATE PLOTTED 01/11/17

ORDER NO. 70699 | ITEM NO. V-442, V-443 | PROJECT: J447XX

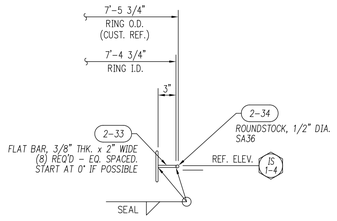
BOARDMAN
OKLAHOMA CITY, OKLAHOMA

DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC – TULSA, OKLAHOMA
PLAN, ELEVATION, AND GENERAL NOTES

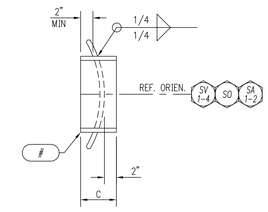
CUSTOMER UOP RUSSELL LLC | P.O. NO. 4500754152
DRAWN BY R. Wolff | SCALE 1/2"=1'-0" | DATE 01/05/17
CHECKED BY WLF | DRAWING NO. D-21564 | SHT 1 OF 5 | REV. 0
APPROVED BY E A



LIFTING LUG DETAIL
(TYPICAL 4)



INSULATION SUPPORT DETAIL
NOTCH AROUND OBSTRUCTIONS AS REQ'D

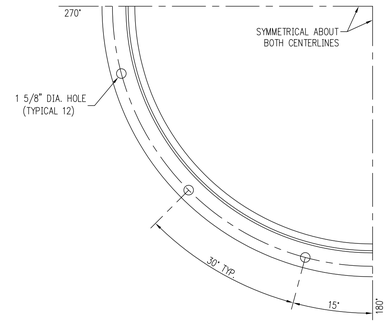


MARK NO.	ITEM NO.	DESCRIPTION	QUANTITY	"C"
SV1-4	2-35	1 1/2" STD. WT PIPE	4	4 1/2"
SO	2-36	20" STD. WT PIPE	1	6"
SA1-2	2-37	18" STD. WT. PIPE	2	6"

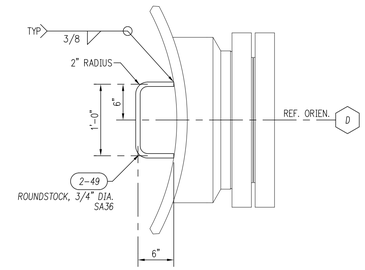
SKIRT VENT/OPENING/ACCESS DETAIL

REV	ITEM NO.	QTY FOR 2	DESCRIPTION	MAT'L SPEC.
	2-31	4	REPAD PLATE, 1/2" x 12 1/2" x 25" LONG	SA516-70
	2-32	4	LIFTING LUG PLATE, 1 1/2" x 21" x 40" LONG	SA516-70
	2-33	64	FLAT BAR, 3/8" x 2" x 3" LONG	SA36
	2-34	8	ROUND BAR, 1/2" DIA. x 280 3/8" LONG - ROLL TO 88 3/4" I.D.	SA36
	2-35	8	PIPE, 1 1/2" SCH. 40 x 4 1/2" LONG	SA106-B
	2-36	2	PIPE, 20" STD. WT. x 6" LONG	SA106-B
	2-37	4	PIPE, 18" STD. WT. x 6" LONG	SA106-B
	2-38	2	PLATE, 1 1/4" x 90 3/4" O.D. x 79 3/4" I.D.	SA516-70
	2-39	42	NUT, 3/8"-16NC HEAVY HEX	C.S.
	2-40	2	PLATE, 1/2" x 3 9/16" x 6 1/2" LONG	SA516-70
	2-41	2	PIPE, 2 1/2" SCH. 40 x 7" LONG	SA106-B
	2-42	2	GREASE FITTING, 1/4" NPT	PLATED C.S.
	2-43	2	DAVIT ARM PIPE, 2" XX-STG x 40 1/16" LONG - SHOP VERIFY LENGTH	SA106-B
	2-44	2	PIPE, 2 1/2" SCH. 40 x 3/4" LONG	SA106-B
	2-45	2	EYEBOLT, 3/4"-10NC x 10" LONG - McMASTER CARR P/N 3016T65 - SHOP TO ADD THREADS AS REQ'D - SEE MANWAY DAVIT DETAIL	GALV. C.S.
	2-46	2	FLAT WASHER, 3/4" NOMINAL	C.S.
	2-47	4	NUT, 3/4"-10NC	C.S.
	2-48	2	ROUND BAR, 3/4" DIA. x 5 7/8" LONG - SHOP VERIFY LENGTH	SA36
	2-49	2	ROUND BAR, 3/4" DIA. x 24" LONG - SHOP VERIFY LENGTH	SA36
	2-50			

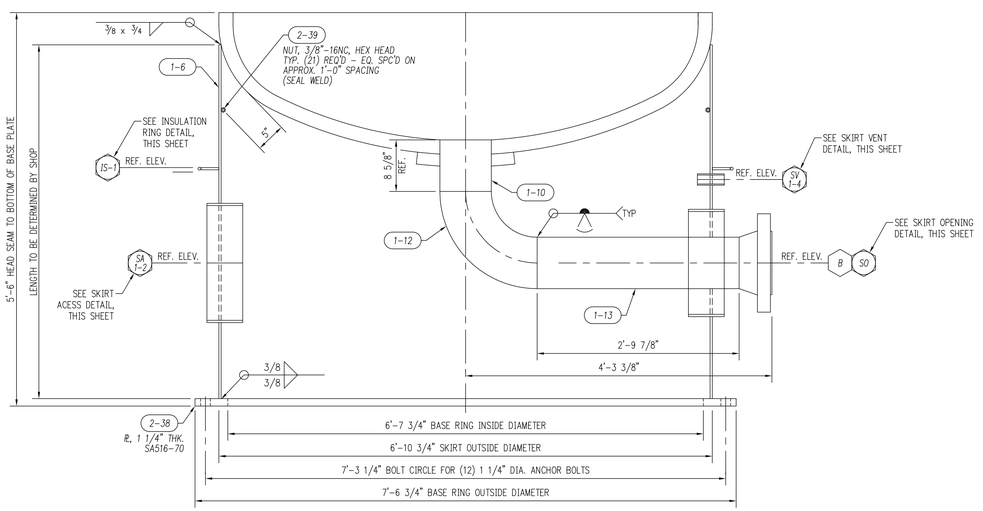
AS BUILT



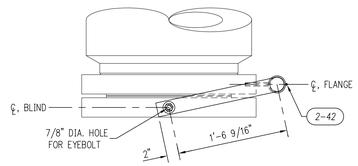
PARTIAL BASE RING DETAIL

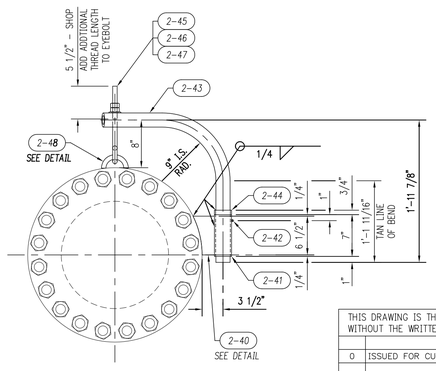


TOP VIEW

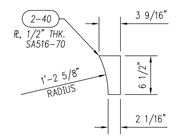


SKIRT DETAIL

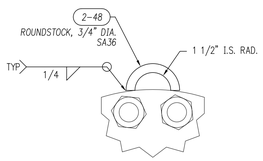




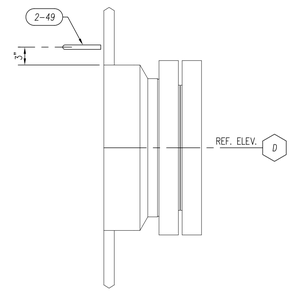
MANWAY DAVIT DETAIL
SEE SHEET ONE FOR TRUE DAVIT LOCATION



ITEM 2-40 DETAIL
(TYPICAL 2)



ITEM 2-48 DETAIL
(TYPICAL 2)
NOT TO SCALE – EYEBOLT NOT SHOWN FOR CLARITY – INSTALL PRIOR TO WELDING



SIDE VIEW

GRAB RUNG DETAIL
(TYPICAL 1 PLACE PER VESSEL)

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	REVISIONS	DATE	BY		REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/11/17	R	W	

60 mm CRYO PLANT — ACAD FILE NAME 70699 — DATE PLOTTED 01/11/17

ORDER NO. 70699 — ITEM NO. V-442, V-443 — PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC – TULSA, OKLAHOMA
SKIRT, LIFTING LUG, MANWAY DAVIT, & MISC. DETAILS

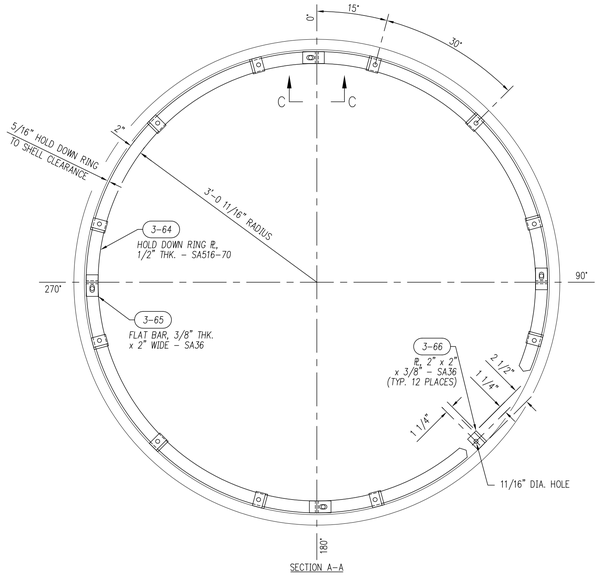
CUSTOMER UOP RUSSELL LLC — P.O. NO. 4500754152

DRAWN BY R. Wolf — SCALE 1"=1'-0" — DATE 01/05/17

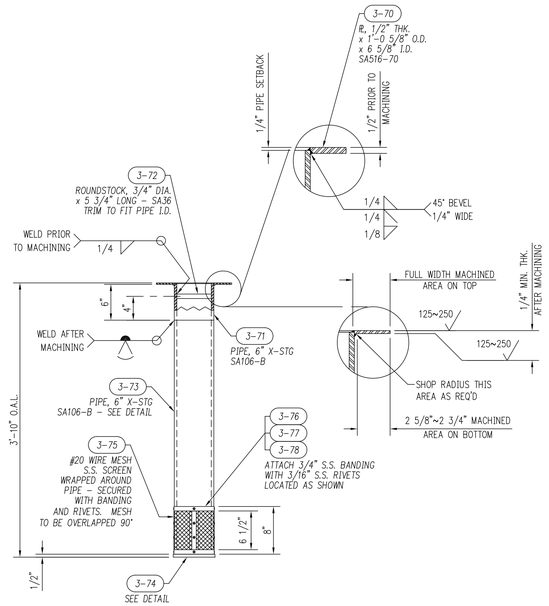
CHECKED BY WLF

APPROVED BY

DRAWING NO. D- 21564 — SHT 2 OF 5 — REV. 0

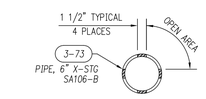


SECTION A–A



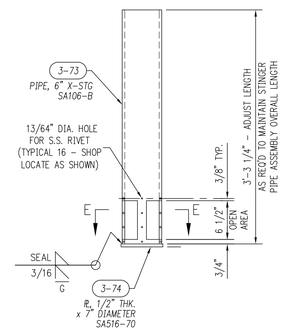
SP A STINGER PIPE/DIVERTER PLATE DETAIL

SHIP LOOSE FOR FIELD INSTALLATION BY OTHERS



SECTION E–E

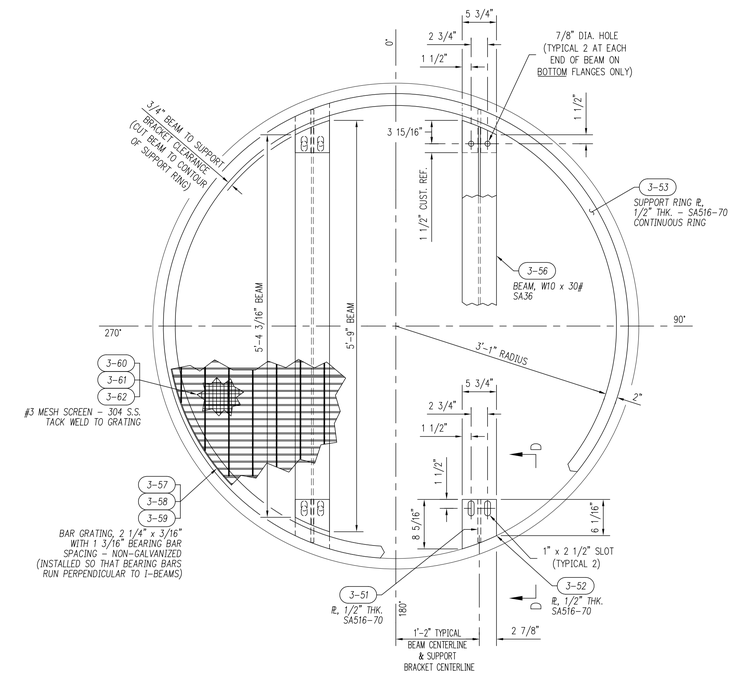
SHOWING PIPE ONLY



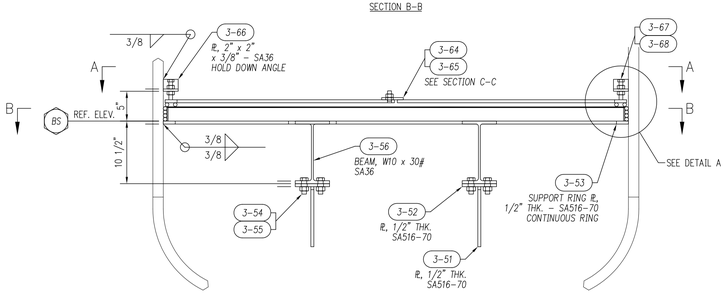
ITEM 3–73/3–74 DETAIL

REV	ITEM NO.	QTY FOR 2	DESCRIPTION	MAT'L SPEC.
	3-51	8	PLATE, 1/2" x 7 1/4" x 10 1/16" LONG - SHOP VERIFY LENGTH	SA516-70
	3-52	8	PLATE, 1/2" x 5 3/4" x 8 5/16" LONG	SA516-70
	3-53	2	PLATE, 1/2" x 78" O.D. x 74" I.D.	SA516-70
	3-54	16	BOLT, 3/4"-10NC x 2 1/4" LONG	A307
	3-55	16	NUT, 3/4"-10NC, HEAVY HEX	A325
	3-56	4	BEAM, W10 x 30# x 69" LONG	SA36
	3-57	4	GRATING, 2 1/4" x 3/16" BEARING BARS ON 1 3/16" SPACING W/ CROSS BARS ON 4" SPACING, McNICHOLS GW-225 OR EQUAL - SEE DETAIL FOR SIZE	A36
	3-58	4	GRATING, 2 1/4" x 3/16" BEARING BARS ON 1 3/16" SPACING W/ CROSS BARS ON 4" SPACING, McNICHOLS GW-225 OR EQUAL - SEE DETAIL FOR SIZE	A36
	3-59	2	GRATING, 2 1/4" x 3/16" BEARING BARS ON 1 3/16" SPACING W/ CROSS BARS ON 4" SPACING, McNICHOLS GW-225 OR EQUAL - SEE DETAIL FOR SIZE	A36
	3-60	4	MESH SCREEN, #3 MESH x 0.080" WIRE - SEE DETAIL FOR SIZE	304 S.S.
	3-61	4	MESH SCREEN, #3 MESH x 0.080" WIRE - SEE DETAIL FOR SIZE	304 S.S.
	3-62	2	MESH SCREEN, #3 MESH x 0.080" WIRE - SEE DETAIL FOR SIZE	304 S.S.
	3-63	4	MESH SCREEN, #20 MESH x 0.016" WIRE x 82" DIAMETER - MESH **MUST** EITHER BE MADE IN ONE PIECE, OR HAVE "PITTSBURGH SEAMS" AT ALL SPLICES - SEE UOPR SPEC. ENG-13p FOR DETAILS	304 S.S.
	3-64	8	RING SEGMENT, 1/2" x 77 3/8" O.D. x 73 3/8" I.D.	SA516-70
	3-65	8	FLAT BAR, 3/8" x 2" x 3 5/8" LONG	SA36
	3-66	24	ANGLE, 2" x 3/8" x 2 1/2" LONG	SA36
	3-67	24	BOLT, 5/8"-11NC x 3" LONG - FULLY THREADED	A307
	3-68	56	NUT, 5/8"-11NC, HEAVY HEX	A325
	3-69		INTENTIONALLY LEFT BLANK	
	3-70	2	PLATE, 1/2" x 12 5/8" O.D. x 6 5/8" I.D.	SA516-70
	3-71	2	PIPE, 6" A-STG x 6 1/8" LONG - LENGTH ADJUSTED FOR SETBACK AFTER FINAL MACHINING OF ITEM 3-70	SA106-B
	3-72	2	ROUND BAR, 3/4" DIA. x 5 3/4" LONG	SA36
	3-73	2	PIPE, 6" A-STG x 39 1/4" LONG - SHOP ADJUST LENGTH AS REQUIRED TO HOLD OVERALL LENGTH OF STINGER PIPE ASSEMBLY	SA106-B
	3-74	2	PLATE, 1/2" x 7" DIAMETER	SA516-70
	3-75	2	MESH SCREEN, #20 MESH x 0.016" WIRE x 8" x 26 1/2" LONG (MINIMUM)	316 S.S.
	3-76	4	BANDING STRAP, 3/4" x 24" LONG - SLIGHT OVERLAP AS REQ'D	316 S.S.
	3-77	8	BANDING STRAP, 3/4" x 8" LONG - SLIGHT OVERLAP AS REQ'D	316 S.S.
	3-78	32	RIVET, 3/16" DIA. x 0.787" LONG - McMASTER-CARR P/N 97550A330 OR EQUAL	316 S.S.
	3-79	8	STUD, 5/8"-11NC x 1 3/4" LONG	A307
	3-80			

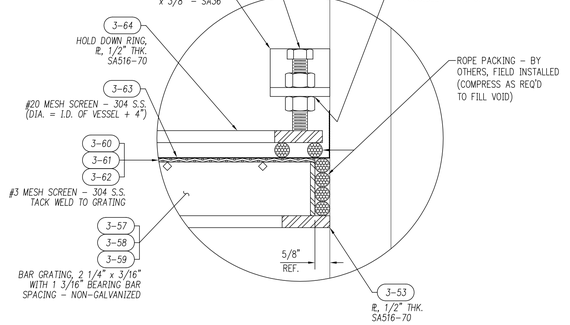
AS BUILT



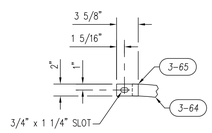
SECTION B–B



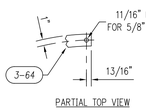
BS BED SUPPORT DETAIL



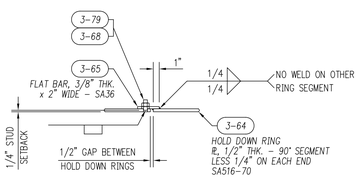
DETAIL A



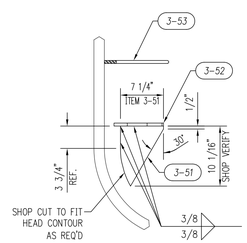
PARTIAL TOP VIEW



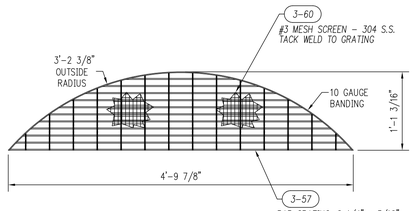
PARTIAL TOP VIEW



SECTION C–C



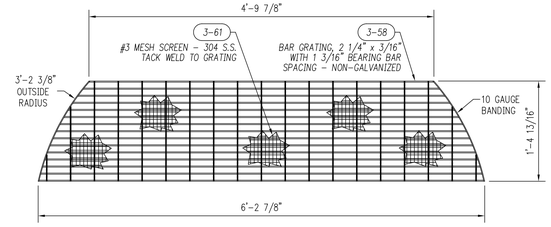
SECTION D–D



ITEM 3–57/3–60 DETAIL

(TYPICAL 4)

#3 MESH TO BE CUT TO MATCH GRATING AND TACK WELDED IN PLACE (TOP SIDE OF GRATING ONLY)



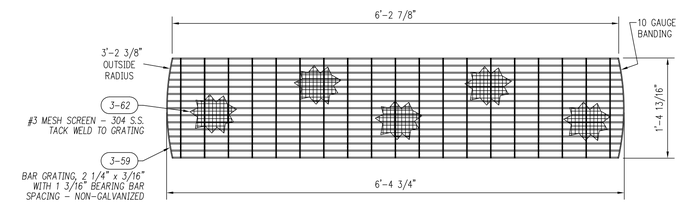
ITEM 3–58/3–61 DETAIL

(TYPICAL 4)

#3 MESH TO BE CUT TO MATCH GRATING AND TACK WELDED IN PLACE (TOP SIDE OF GRATING ONLY)

SHOP NOTES:

1. GRATING SECTIONS TO BE PRE ASSEMBLED AND DIAMETER TO BE VERIFIED.
2. I-BEAMS TO BE BOLTED AND SHIPPED IN PLACE.
3. BOLTING FOR HOLD DOWN ANGLES TO BE SHIPPED IN PLACE – TIGHTEN AS REQUIRED TO PREVENT THEM FROM COMING LOOSE DURING SHIPMENT.
4. HOLD DOWN RING PLATES, #20 MESH, AND #3 MESH/GRATING SECTIONS TO BE SHIPPED LOOSE FOR FIELD INSTALLATION BY OTHERS.
5. AN ADDITIONAL #20 MESH SCREEN (ITEM 3-63) IS REQUIRED AND WILL SHIP LOOSE FOR FIELD INSTALLATION BY OTHERS. LOCATION SHOWN ON SHEET #1.



ITEM 3–59/3–62 DETAIL

(TYPICAL 2)

#3 MESH TO BE CUT TO MATCH GRATING AND TACK WELDED IN PLACE (TOP SIDE OF GRATING ONLY)

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	REVISIONS	DATE	BY	REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/11/17	R W	

60 mm CRYO PLANT — ACAD FILE NAME 70699 — DATE PLOTTED 01/11/17

ORDER NO. 70699 — ITEM NO. V-442, V-443 — PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC – TULSA, OKLAHOMA
MISCELLANEOUS INTERNAL DETAILS

CUSTOMER UOP RUSSELL LLC — P.O. NO. 4500754152

DRAWN BY R. Wolff — SCALE 1"=1'-0" — DATE 01/05/17

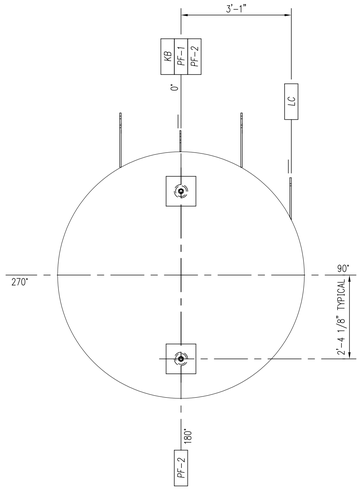
CHECKED BY WLF — DRAWING NO. D- 21564 — SHT 3 OF 5 — REV. 0

APPROVED BY

BILL OF MATERIAL						
	ITEM	QTY	LEGEND	ITEM	QTY	LEGEND
	PF	2	PLATFORM CLIP GROUP	LC	1	LADDER CLIP GROUP
	KB	1	KNEE BRACE CLIP			

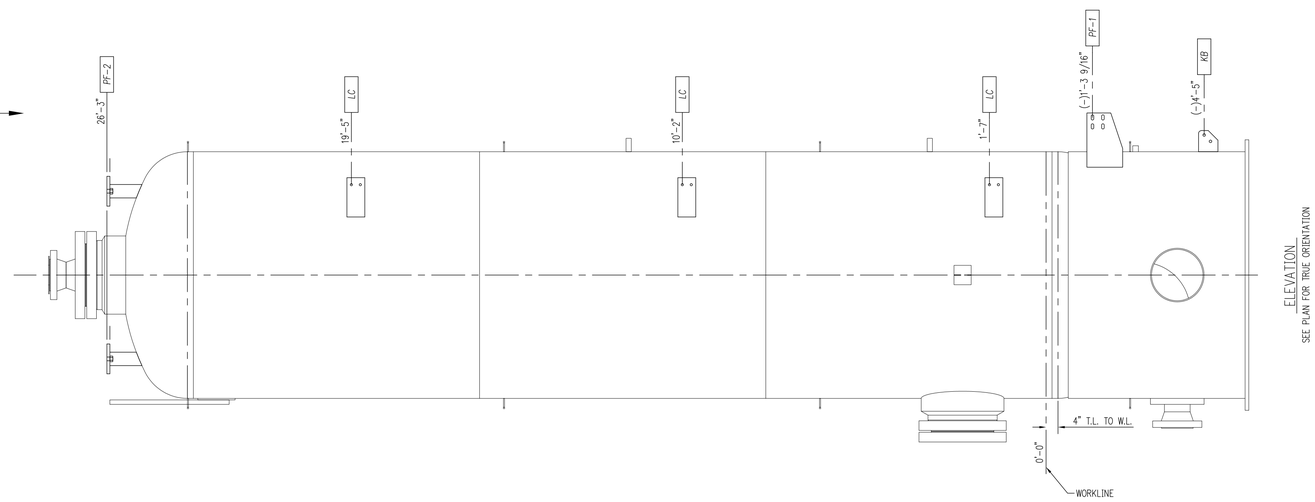
REV	ITEM NO.	QTY FOR 2	DESCRIPTION	MAT'L SPEC.
	4-81	2	PLATE, 1/2" x 6 1/2" x 7 1/8" LONG	SA516-70
	4-82	4	PLATE, 1/2" x 12" x 18 3/16" LONG	SA516-70
	4-83	4	PIPE, 4" SCH. 120 x 12" LONG - SHOP TRIM TO LENGTH AS REQ'D	SA106
	4-84	4	PLATE, 1" x 10" x 10" LONG	SA516-70
	4-85	4	NUT, 1"-8NC, HEAVY HEX	A325
	4-86	6	PLATE, 1/2" x 6" x 14 3/16" LONG	SA516-70
	4-87			
	4-88			
	4-89			
	4-90			

AS BUILT

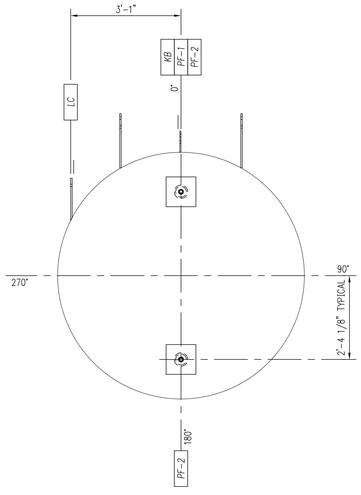


PLAN
V-442

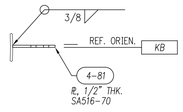
PLAN VIEW ORIENTATION

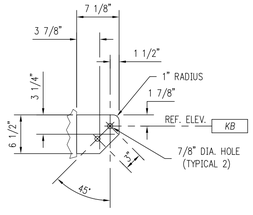


ELEVATION
SEE PLAN FOR TRUE ORIENTATION

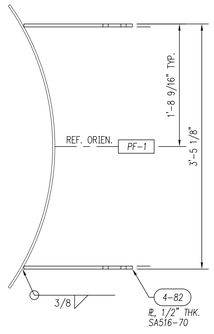


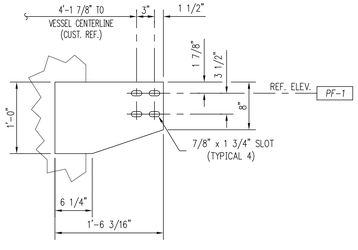
PLAN
V-443



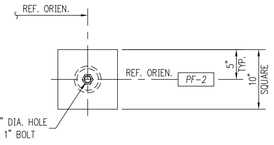


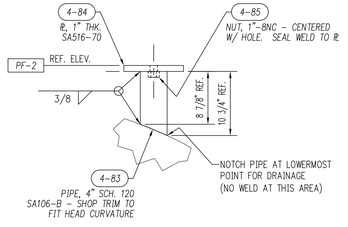
KNEE BRACE CLIP DETAIL
(SCALE: 1"=1'-0")
TYPICAL (1) PER VESSEL



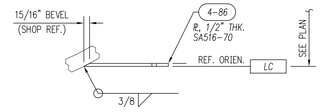


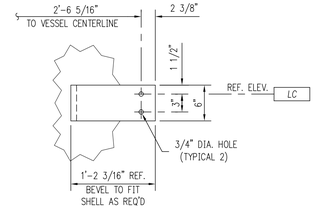
PLATFORM CLIP DETAIL
(SCALE: 1"=1'-0")
TYPICAL (2) PER VESSEL





PLATFORM CLIP DETAIL
[SCALE: 1"=1'-0"]
TYPICAL (2) PER VESSEL





LADDER CLIP DETAIL
[SCALE: 1"=1'-0"]
TYPICAL (3) CLIPS PER VESSEL
V-442 AS SHOWN
V-443 OPPOSITE HAND

THIS DRAWING IS THE PROPERTY OF BOARDMAN AND IS NOT TO BE PRINTED, COPIED, PHOTOGRAPHED, LOANED, OR USED WITHOUT THE WRITTEN PERMISSION OF BOARDMAN.

	REVISIONS	DATE	BY		REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/11/17	R	W	

60 mm CRYO PLANT | ACAD FILE NAME 70699 | DATE PLOTTED 01/11/17

ORDER NO. 70699 | ITEM NO. V-442, V-443 | PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

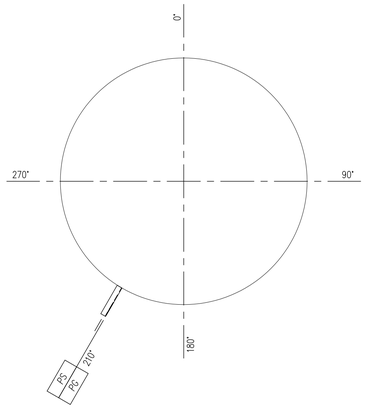
DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC - TULSA, OKLAHOMA
VESSEL LADDER & PLATFORM CLIP DETAILS

CUSTOMER UOP RUSSELL LLC | P.O. NO. 4500754152

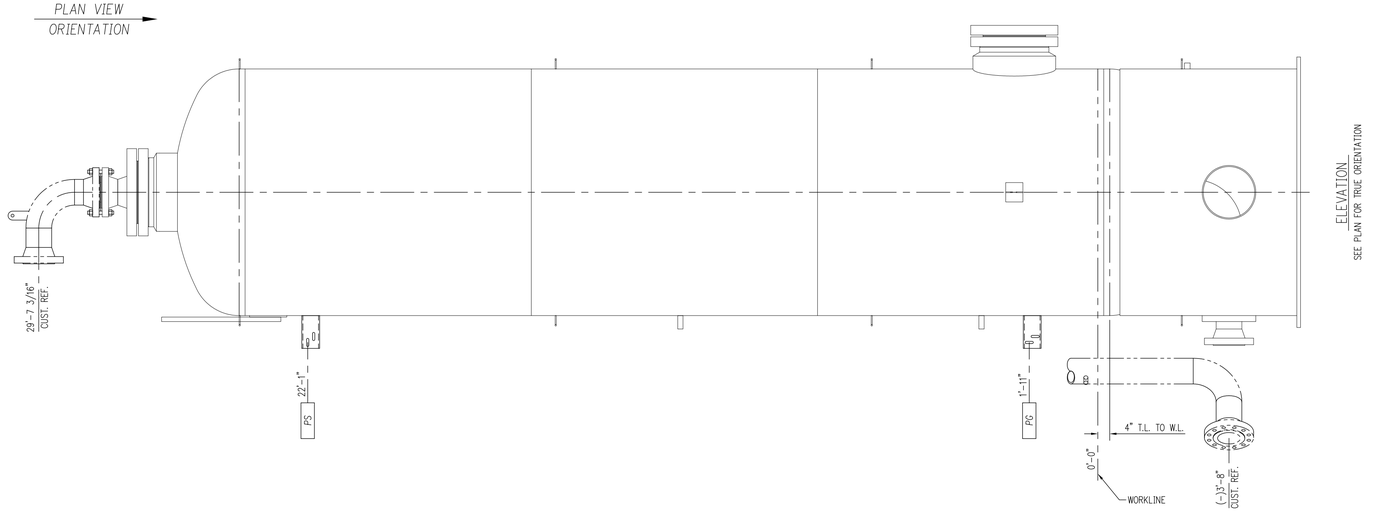
DRAWN BY R. Wolf | SCALE 1/2"=1'-0" | DATE 01/05/17

CHECKED BY WLF | DRAWING NO. D- 21564 SHT 4 OF 5 | REV. 0

APPROVED BY J. S

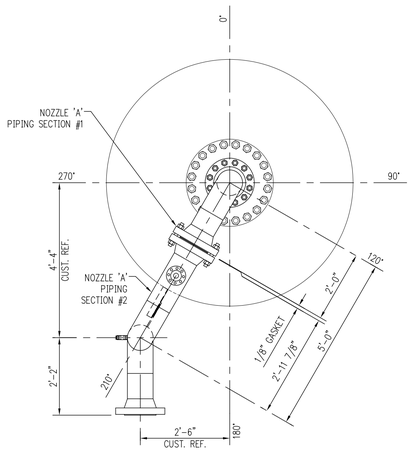


PLAN
PIPE SUPPORT/GUIDE CLIPS
V-442 & V-443

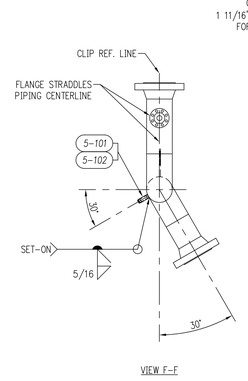


BILL OF MATERIAL						
	ITEM	QTY	LEGEND	ITEM	QTY.	LEGEND
	PS	1	PIPE SUPPORT CLIP	PG	1	PIPE GUIDE CLIP

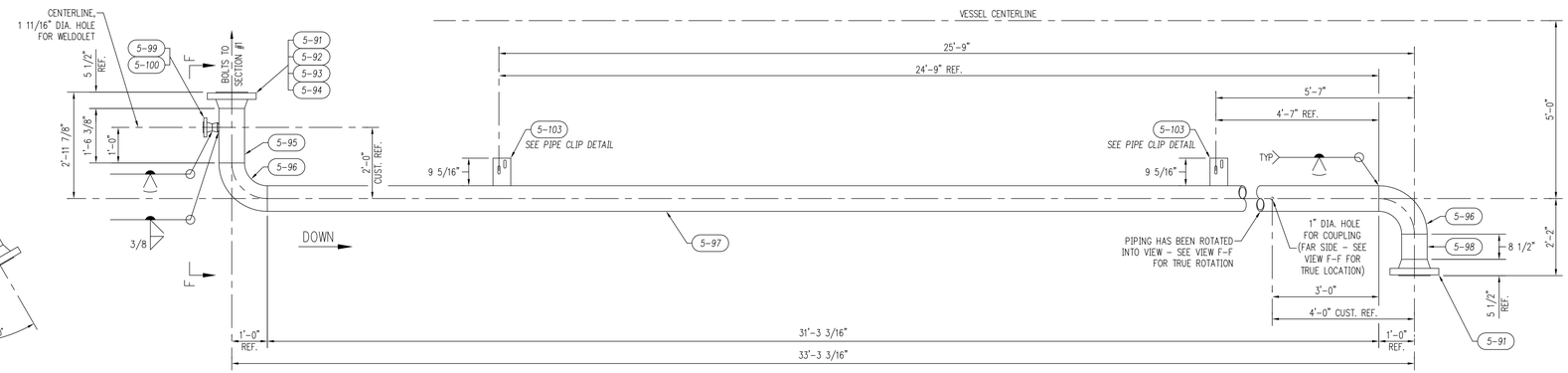
REV	ITEM NO.	QTY FOR 2	DESCRIPTION	MAT'L SPEC
	5-91	8	FLANGE, 8" CL. 600 RF/WN, X-STG BORE	SA105
	5-92	48	STUD, 1 1/8"-8NC x 8 3/4" LONG (ZINC OR CADMIUM PLATED)	SA193-B7
	5-93	96	NUT, 1 1/8"-8NC, HEAVY HEX (ZINC OR CADMIUM PLATED)	SA194-2H
	5-94	4	GASKET, 8" CL. 600 FLANGE, FLEXITALLIC STYLE "CG" OR EQUAL, 304 S.S. SPIRAL WOUND, W/ FLEXIBLE GRAPHITE FILLER & C.S. CENTERING RING FOR SERVICE	--
	5-95	2	PIPE, 8" X-STG x 18 3/8" LONG (BBE)	SA106-B
	5-96	6	LR WELD ELBOW, 8" X-STG, 90 DEGREE	SA234-WPB
	5-97	2	PIPE, 8" X-STG x 375 3/16" LONG (MAKE IN MULT. PIECES IF REQ'D) (BBE)	SA106-B
	5-98	2	PIPE, 8" X-STG x 8 1/2" LONG (BBE)	SA106-B
	5-99	2	WELDOLET, 2" SCH. 160, 8-6 RUN SIZE	SA105
	5-100	2	FLANGE, 2" CL. 600 RF/WN, SCH. 160 BORE	SA105
	5-101	2	SPECIAL CPLG, 3/4" 3000# NPT x 3 1/2" LONG - THRD'D ON ONE END ONLY	SA105
	5-102	2	HEX HEAD PLUG, 3/4" NPT - USE FOR HYDROTESTING AND SHIPPING	SA105
	5-103	4	PLATE, 3/8" x 6" x 9 5/16" LONG	SA516-70
	5-104	8	BOLT, 5/8"-11NC x 2" LONG	A307
	5-105	8	LOCK WASHER, 5/8" NOMINAL	A307
	5-106	16	FLAT WASHER, 5/8" NOMINAL	A307
	5-107	8	NUT, 5/8"-11NC	A307
	5-108	2	CHANNEL, C6 x 8.2# x 11" LONG	SA36
	5-109	2	CHANNEL, C6 x 8.2# x 11" LONG	SA36
	5-110	2	PIPE, 8" X-STG x 3" LONG (BBE)	SA106-B
	5-111	2	PIPE, 8" X-STG x 6 1/2" LONG (BBE)	SA106-B
	5-112	2	PLATE, 3/8" x 3" x 7" LONG	SA516-70
	5-113			
	5-114			
	5-115			
	5-116			
	5-117			
	5-118			
	5-119			
	5-120	6	GASKET, 8" CL. 600 FLANGE, SPIRAL WOUND, FOR TESTING	--



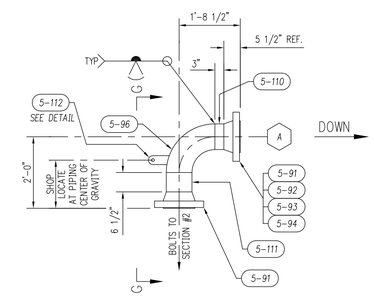
PLAN
PIPING
V-442 & V-443



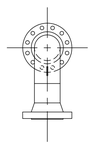
VIEW F-F



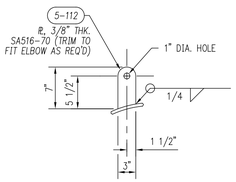
DOWNCOMER PIPING DETAIL
SECTION #2 FOR NOZZLE 'A'
(TYPICAL 2)



DOWNCOMER PIPING DETAIL
SECTION #1 FOR NOZZLE 'A'
(TYPICAL 2)



VIEW G-G

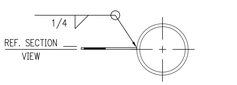


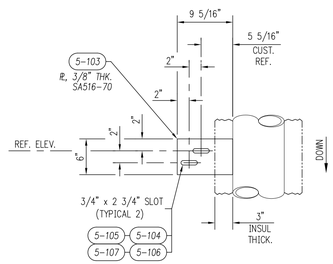
ITEM 5-112 DETAIL
[SCALE: 1"=1'-0"]
TYPICAL 2

PIPING NOTES:

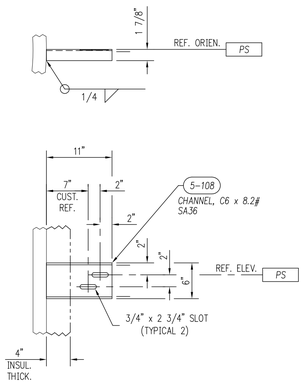
1. INSPECTION AND TESTING TO FOLLOW B31.3 REQUIREMENTS. SEE NOTE #4 FOR RADIOGRAPHY.
2. ALL PIPING SPLICES TO BE FULL PENETRATION WELDED.
3. FLANGE BOLT HOLES TO STRADDLE VESSEL CENTERLINES UNLESS NOTED OTHERWISE. DETAILS ARE NOTED WHERE SPECIAL ROTATIONS ARE REQ'D.
4. RADIOGRAPHY: 100% REQ'D.
5. TEST FIT TO VESSEL.
6. STRESS RELIEVE: NONE REQ'D.
7. HYDROTEST PRESSURE: 1,643 PSIG. HOLD FOR ONE HOUR.
8. PAINT: PER NOTE #15, SHEET 1, UOPR PAINT SYSTEM #2. ONLY THE CLIPS AND FLANGES REQUIRE FINISH PAINT.

AS BUILT

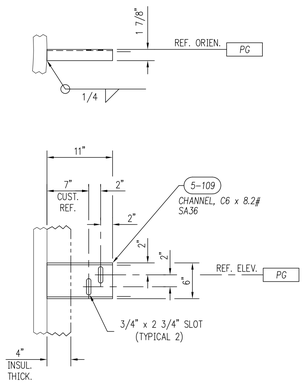




PIPE CLIP DETAIL
[SCALE: 1"=1'-0"]
(TYPICAL 4)



PIPE SUPPORT DETAIL
TOWER PIPE DROP ANCHOR
[SCALE: 1"=1'-0"]
(TYPICAL 2)



PIPE GUIDE DETAIL
TOWER PIPE DROP GUIDE
[SCALE: 1"=1'-0"]
(TYPICAL 2)

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REVISIONS	DATE	BY		REFERENCE DRAWINGS
0 ISSUED FOR CUSTOMER INFORMATION	01/11/17	R	W	

60 mm CRYO PLANT | ACAD FILE NAME 70699 | DATE PLOTTED 01/11/17

ORDER NO. 70699 | ITEM NO. V-442, V-443 | PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC - TULSA, OKLAHOMA
VESSEL PIPING & CLIP DETAILS

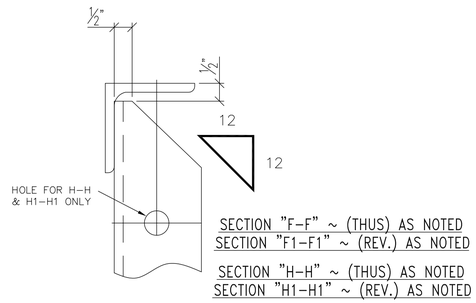
CUSTOMER UOP RUSSELL LLC | P.O. NO. 4500754152

DRAWN BY R. Wolf | SCALE 1/2"=1'-0" | DATE 01/05/17

CHECKED BY WLF

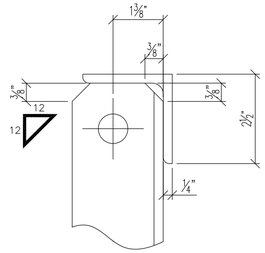
APPROVED BY

DRAWING NO. D- 21564 | SHT 5 OF 5 | REV. 0



SECTION "F-F" ~ (THUS) AS NOTED
SECTION "F1-F1" ~ (REV.) AS NOTED

SECTION "H-H" ~ (THUS) AS NOTED
SECTION "H1-H1" ~ (REV.) AS NOTED



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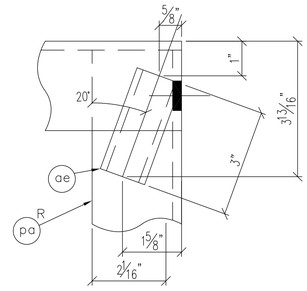

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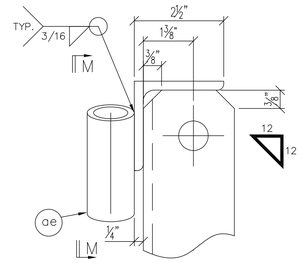
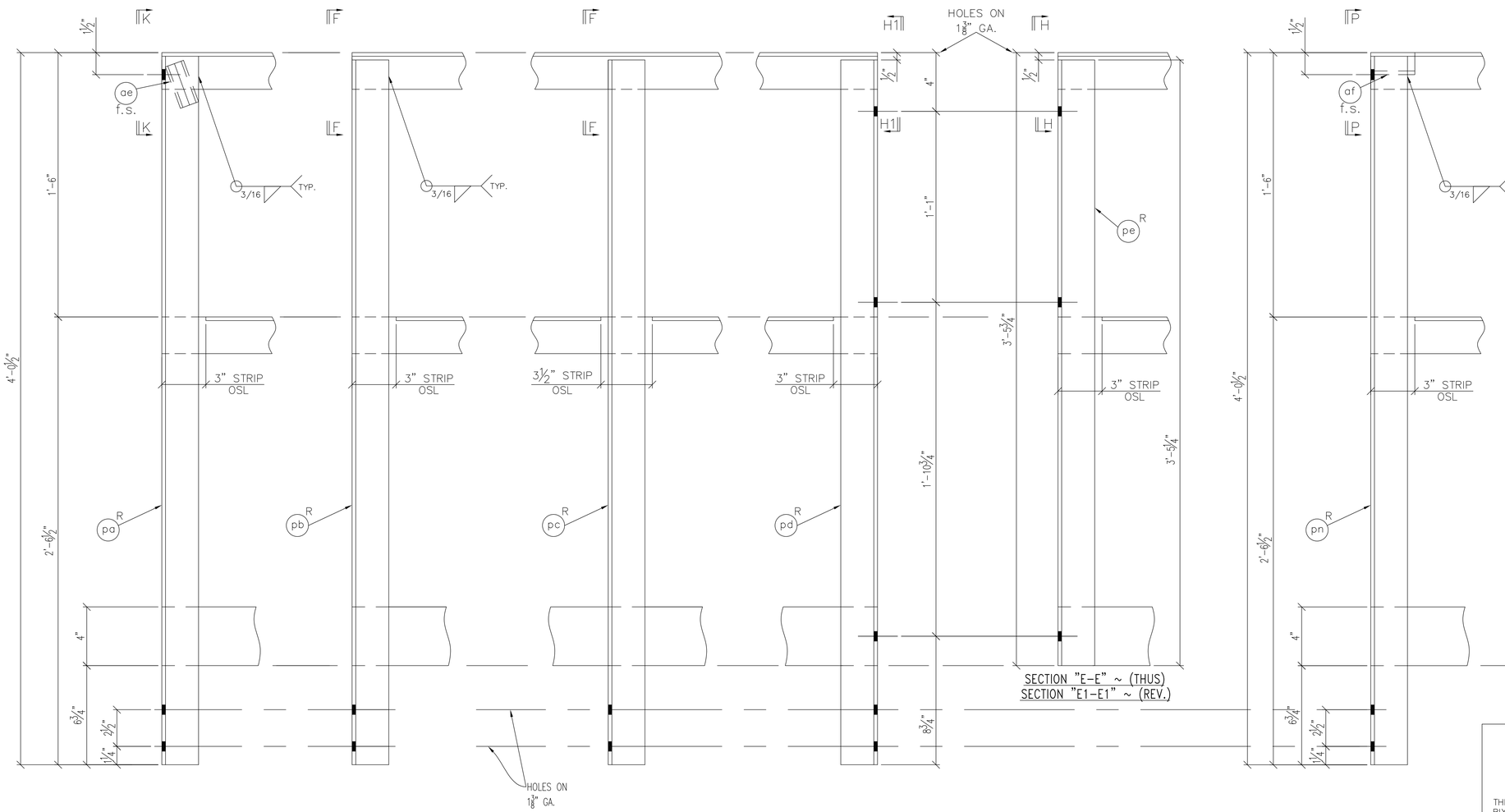


SECTION "K-K"

AS BUILT

BILL OF MATERIAL						
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
pa^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
pa^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
pb^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pb^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pc^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pc^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pd^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pd^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pe^R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
pe^L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
pn^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
pn^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
ps	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
ae	1	1" Sch. 80 Pipe	0	3	A36	1
af	1	L 1 1/2 x 1 1/2 x 3/16	0	3	A36	1



SECTION "A-A" ~ (THUS)
SECTION "A1-A1" ~ (REV.)

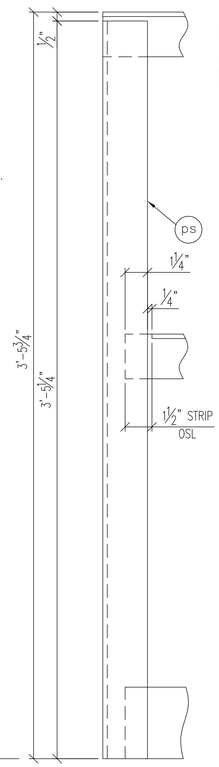
SECTION "B-B" ~ (THUS)
SECTION "B1-B1" ~ (REV.)

SECTION "C-C" ~ (THUS)
SECTION "C1-C1" ~ (REV.)

SECTION "D-D" ~ (THUS)
SECTION "D1-D1" ~ (REV.)

SECTION "E-E" ~ (THUS)
SECTION "E1-E1" ~ (REV.)

SECTION "N-N" ~ (THUS)
SECTION "N1-N1" ~ (REV.)



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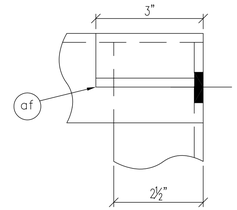

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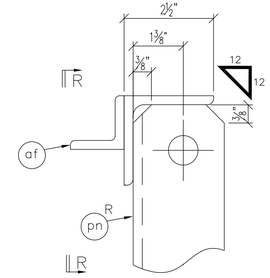

SECTION "P-P"

NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. SEAL WELD CONSTRUCTION. (TYP U.O.N.)
4. GALVANIZE PER ASTM-A-123.
5. WORK w/ DRAWING 6805-D2.
6. B.O.M. THIS DRAWING IS REFERENCE ONLY.
7. SECTION T-T ON DRAWING 6805-D2

BIXBY Fabco STEEL FABRICATORS

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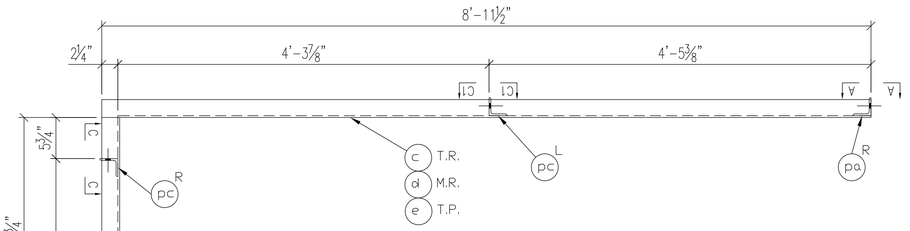
BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN INC, 61237/61238

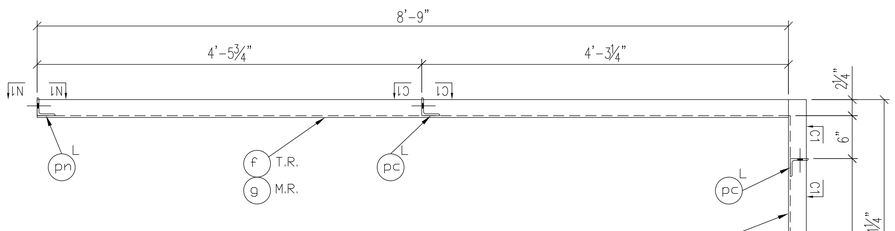
HANDRAIL POST DETAILS

6805

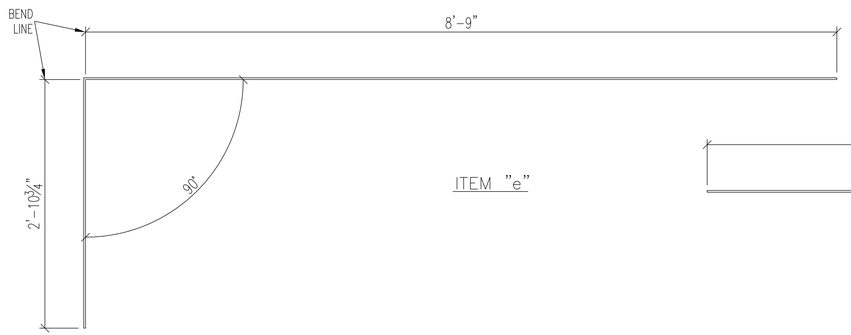
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D1	–	0



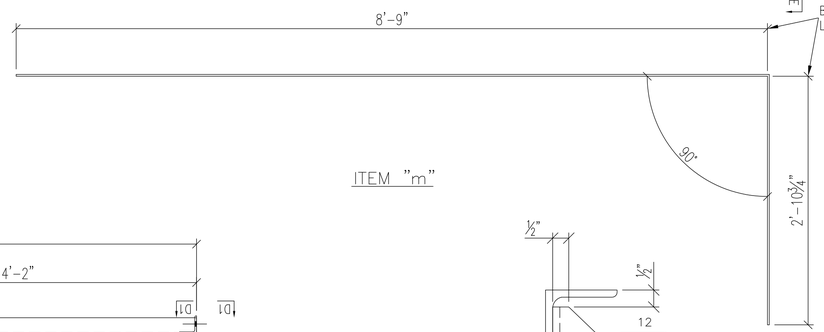
(ONE) HANDRAIL MK D2-A



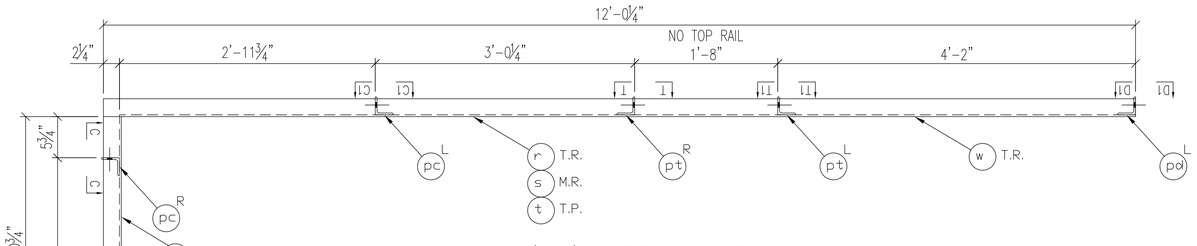
(ONE) HANDRAIL MK D2-B



ITEM "e"



ITEM "m"



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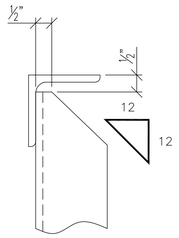
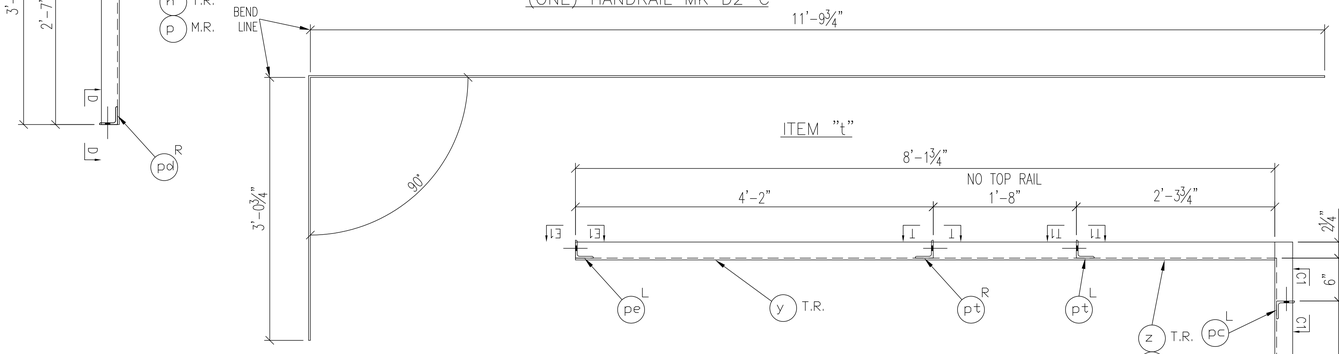
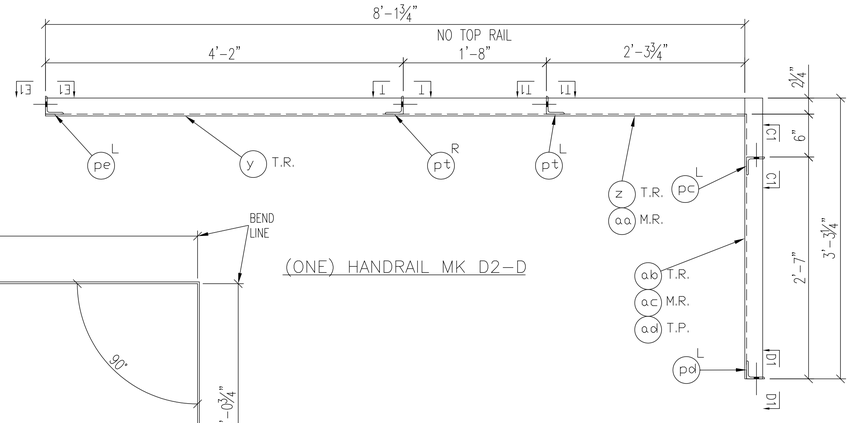
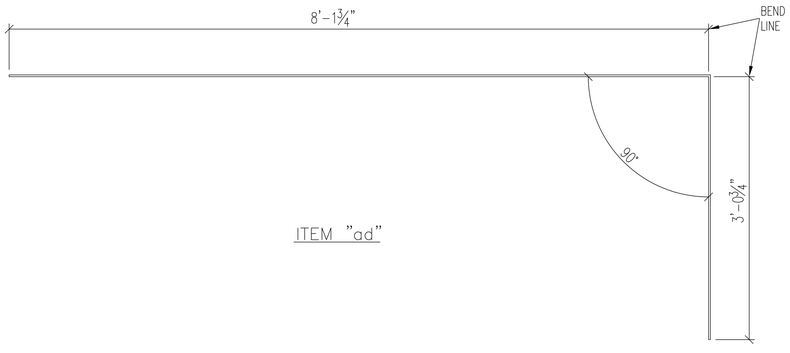


SECTION "F-F" ~ (THUS) AS NOTED
SECTION "F1-F1" ~ (REV.) AS NOTED



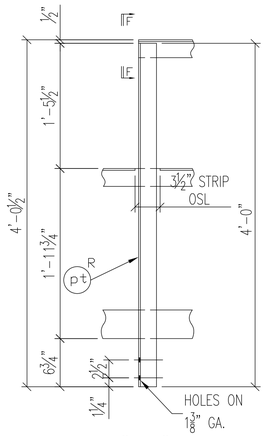
ITEM "t"





ITEM "ad"

(ONE) HANDRAIL MK D2-D



SECTION "T-T" ~ THUS
SECTION "T1-T1" ~ REV

BILL OF MATERIAL

MK.		DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
D2-A	ONE	HANDRAIL				
a	1	L 2 1/2 x 2 1/2 x 1/4	2	10 3/4	A36	12
b	1	L 2 1/2 x 2 1/2 x 1/4	2	10 3/4	A36	12
c	1	L 2 1/2 x 2 1/2 x 1/4	8	11 1/2	A36	37
d	1	L 2 1/2 x 2 1/2 x 1/4	8	11 1/2	A36	37
e	1	BAR 4 x 1/4 (BEND)	11	7 3/4	A36	40
ae	1	1" Sch. 80 Pipe	0	3	A36	1
pa R	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
pc L R	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
pe L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
					TOTAL	202
D2-B	ONE	HANDRAIL				
f	1	L 2 1/2 x 2 1/2 x 1/4	8	9	A36	36
g	1	L 2 1/2 x 2 1/2 x 1/4	8	9	A36	36
h	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
k	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
m	1	BAR 4 x 1/4 (BEND)	11	7 3/4	A36	40
af	1	L 1 1/2 x 1 1/2 x 3/16	0	3	A36	1
pc L	2	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
pe R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
pn L	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
					TOTAL	202
D2-C	ONE	HANDRAIL				
n	1	L 2 1/2 x 2 1/2 x 1/4	3	0 3/4	A36	13
p	1	L 2 1/2 x 2 1/2 x 1/4	3	0 3/4	A36	13
r	1	L 2 1/2 x 2 1/2 x 1/4	6	2 1/4	A36	25
s	1	L 2 1/2 x 2 1/2 x 1/4	12	0 1/4	A36	49
t	1	BAR 4 x 1/4 (BEND)	14	10 1/2	A36	51
w	1	L 2 1/2 x 2 1/2 x 1/4	4	2	A36	17
pc R R	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
pd R R	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
pt L L	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
					TOTAL	267
D2-D	ONE	HANDRAIL				
y	1	L 2 1/2 x 2 1/2 x 1/4	4	2	A36	17
z	1	L 2 1/2 x 2 1/2 x 1/4	2	3 3/4	A36	10
aa	1	L 2 1/2 x 2 1/2 x 1/4	8	1 3/4	A36	33
ab	1	L 2 1/2 x 2 1/2 x 1/4	3	3 1/4	A36	13
ac	1	L 2 1/2 x 2 1/2 x 1/4	3	3 1/4	A36	13
ad	1	BAR 4 x 1/4 (BEND)	11	2 1/2	A36	38
pc L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pd L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pe L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
pt R L	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
					TOTAL	203
		FIELD MATERIAL				
+4	48	5/8Ø x 1 3/4 HEX BOLTS w/ NUT & HFW GALV.			A325	19
		TOTAL				893

NOTES:
1. REFERENCE 6805-D1 FOR SECTIONS & DETAILS.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP U.N.O.)
5. GALV. PER ASTM A-123.
6. ALL HOLE TO BE (3/4)"ø UNLESS NOTED OTHERWISE.

AS BUILT

BIXBY Fabco STEEL FABRICATORS

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BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

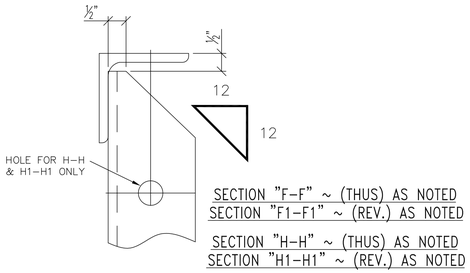
CLIENT: BOARDMAN INC, 61237/61238

HANDRAIL DETAILS

FOR PLATFORM @ EL. 32'-6" T/G

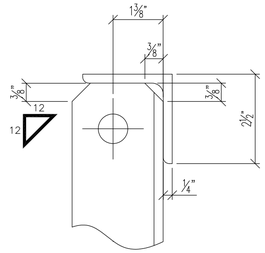
6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D2	–	0

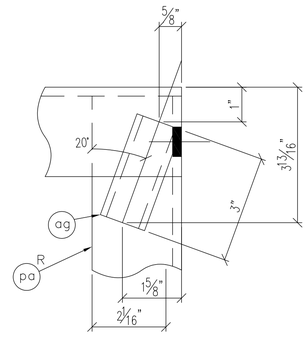


SECTION "F-F" ~ (THUS) AS NOTED
SECTION "F1-F1" ~ (REV.) AS NOTED

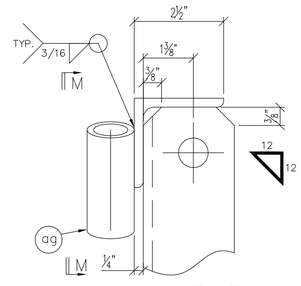
SECTION "H-H" ~ (THUS) AS NOTED
SECTION "H1-H1" ~ (REV.) AS NOTED



SECTION "G-G"

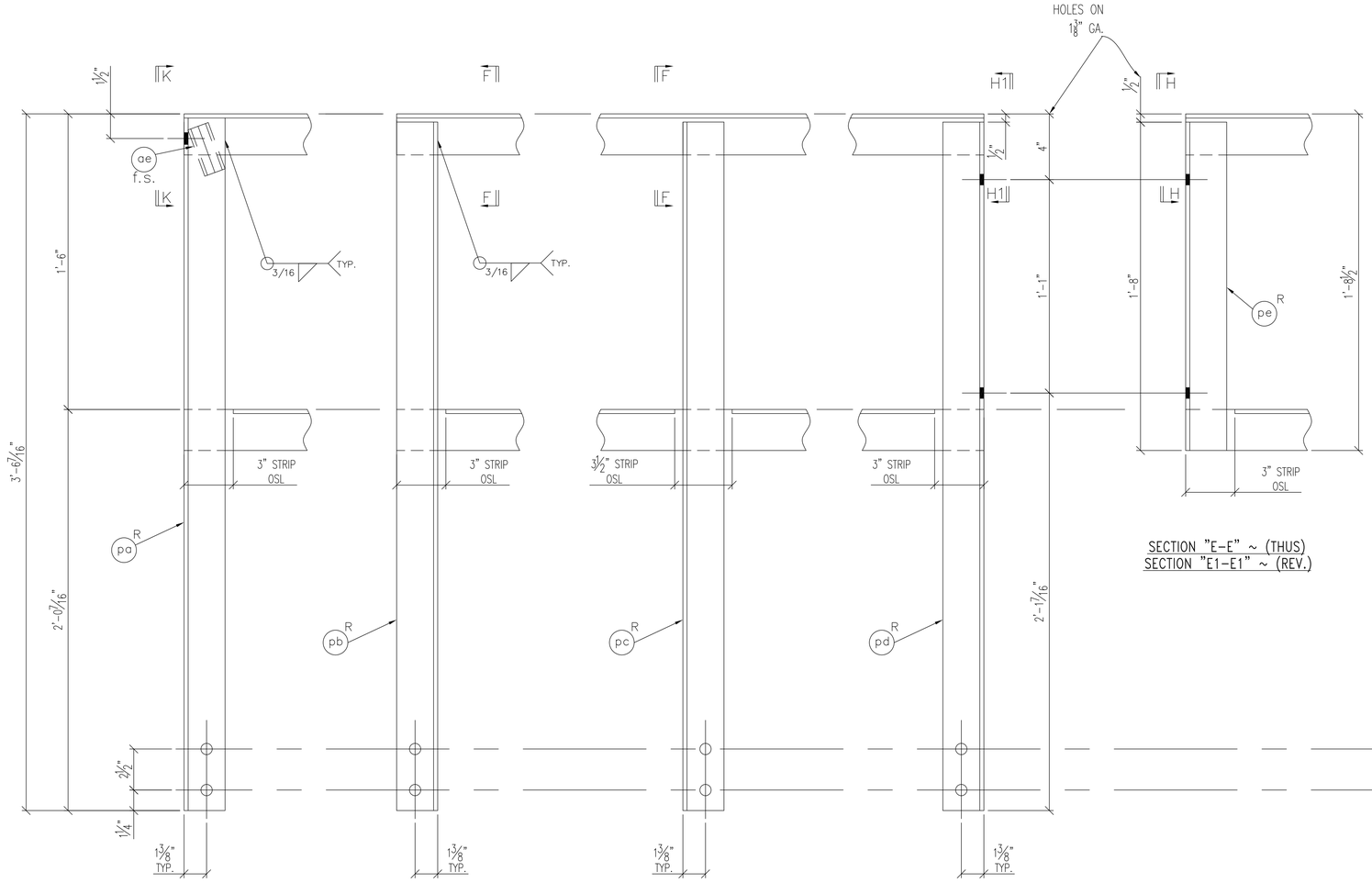


SECTION "M-M"



SECTION "K-K"

BILL OF MATERIAL						
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
pa R	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
pa L	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
pb R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pb L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pc R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pc L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pd R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pd L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pe R	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
pe L	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
pn R	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
pn L	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
ps	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
ag	1	1" Sch. 80 Pipe	0	3	A36	1
ah	1	L 1 1/2 x 1 1/2 x 3/16	0	3	A36	1



SECTION "A-A" ~ (THUS)
SECTION "A1-A1" ~ (REV.)

SECTION "B-B" ~ (THUS)
SECTION "B1-B1" ~ (REV.)

SECTION "C-C" ~ (THUS)
SECTION "C1-C1" ~ (REV.)

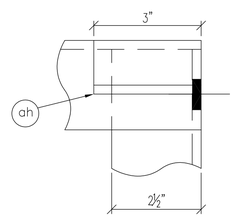
SECTION "D-D" ~ (THUS)
SECTION "D1-D1" ~ (REV.)

SECTION "E-E" ~ (THUS)
SECTION "E1-E1" ~ (REV.)

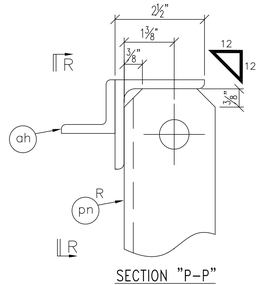
SECTION "N-N" ~ (THUS)
SECTION "N1-N1" ~ (REV.)

SECTION "S-S"

NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. SEAL WELD CONSTRUCTION. (TYP U.O.N.)
4. GALVANIZE PER ASTM-A-123.
5. WORK w/ DRAWING 6805-D4.
6. B.O.M. THIS DRAWING IS REFERENCE ONLY.



SECTION "R-R"



SECTION "P-P"

AS BUILT

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BIXBY FABCO
STEEL FABRICATORS

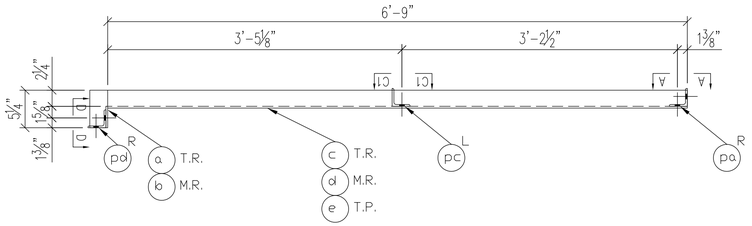
BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN INC, 61237/61238

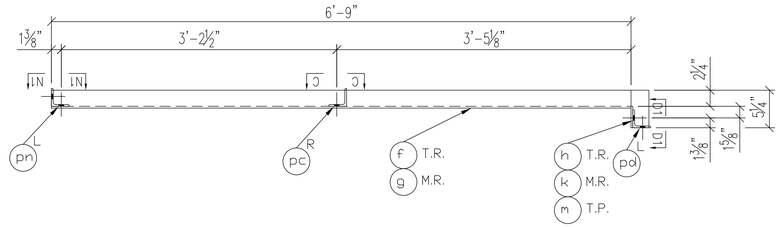
HANDRAIL POST DETAILS

6805

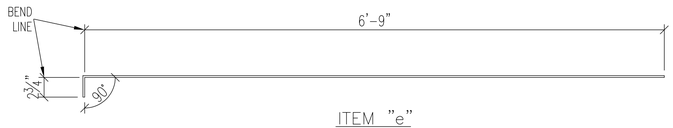
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D3	–	0



(ONE) HANDRAIL MK D4-A



(ONE) HANDRAIL MK D4-B



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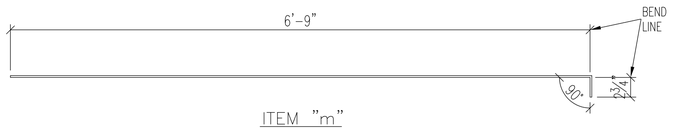
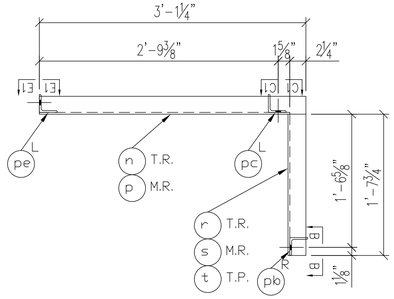
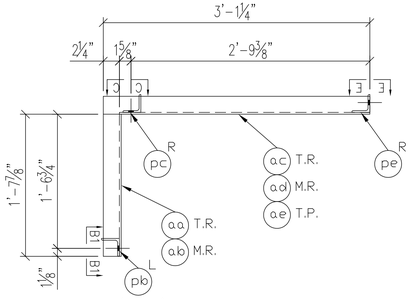


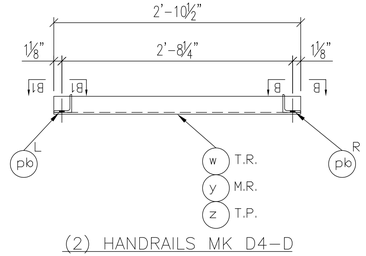
ITEM "m"



(ONE) HANDRAIL MK D4-C



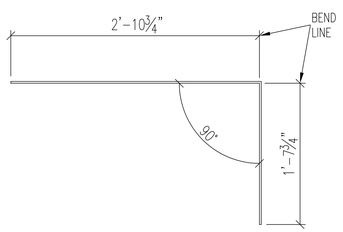
(ONE) HANDRAIL MK D4-E



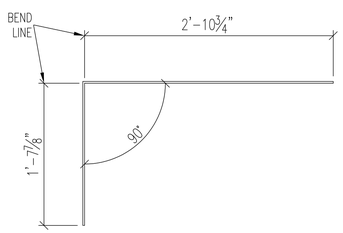
(2) HANDRAILS MK D4-D

BILL OF MATERIAL						
MK.		DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
D4-A	ONE	HANDRAIL				
a	1	L 2 1/2 x 2 1/2 x 1/4	0	5 1/4	A36	2
b	1	L 2 1/2 x 2 1/2 x 1/4	0	5 1/4	A36	2
c	1	L 2 1/2 x 2 1/2 x 1/4	6	9	A36	28
d	1	L 2 1/2 x 2 1/2 x 1/4	6	9	A36	28
e	1	BAR 4 x 1/4 (BEND)	6	11 3/4	A36	24
ae	1	1" Sch. 80 Pipe	0	3	A36	1
pa R	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
pc L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pd R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
					TOTAL	127
D4-B	ONE	HANDRAIL				
f	1	L 2 1/2 x 2 1/2 x 1/4	6	9	A36	28
g	1	L 2 1/2 x 2 1/2 x 1/4	6	9	A36	28
h	1	L 2 1/2 x 2 1/2 x 1/4	0	5 1/4	A36	2
k	1	L 2 1/2 x 2 1/2 x 1/4	0	5 1/4	A36	2
m	1	BAR 4 x 1/4 (BEND)	6	11 3/4	A36	24
af	1	L 1 1/2 x 1 1/2 x 3/16	0	3	A36	1
pc R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pd L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pn L	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
					TOTAL	127
D4-C	ONE	HANDRAIL				
n	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
p	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
r	1	L 2 1/2 x 2 1/2 x 1/4	1	7 3/4	A36	7
s	1	L 2 1/2 x 2 1/2 x 1/4	1	7 3/4	A36	7
t	1	BAR 4 x 1/4 (BEND)	4	6 1/2	A36	16
pb R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pc L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pe L	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
					TOTAL	91
D4-D	2	HANDRAILS				
w	2	L 2 1/2 x 2 1/2 x 1/4	2	10 1/2	A36	12
y	2	L 2 1/2 x 2 1/2 x 1/4	2	10 1/2	A36	12
z	2	BAR 4 x 1/4 (BEND)	2	10 1/2	A36	10
pb R L	2/2	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	57
					TOTAL	91
D4-E	ONE	HANDRAIL				
aa	1	L 2 1/2 x 2 1/2 x 1/4	1	7 7/8	A36	7
ab	1	L 2 1/2 x 2 1/2 x 1/4	1	7 7/8	A36	7
ac	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
ad	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
ae	1	BAR 4 x 1/4 (BEND)	4	6 5/8	A36	16
pb L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pc R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pe R	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
					TOTAL	91
D4-F	2	SAFETY GATES				
aa	2	1" Pipe SCH 80	0	0 1/4	A36	1
ag	2	3/4" Bar	3	1 1/8	A36	9
					TOTAL	10
		FIELD MATERIAL				
+3	35	5/8ø x 1 3/4 HEX BOLTS w/ NUT & HFW GALV.			A325	14
+0	2	3/16ø x 1 3/4 LNG. COTTER PIN			A325	
		TOTAL				551

NOTES:
1. REFERENCE 6805-D3 FOR SECTIONS & DETAILS.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP U.N.O.)
5. GALV. PER ASTM A-123.
6. ALL HOLE TO BE (3/4)"ø UNLESS NOTED OTHERWISE.



ITEM "t"



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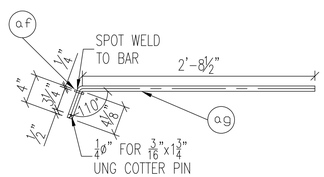

(TWO) SAFETY GATES D4-F

AS BUILT

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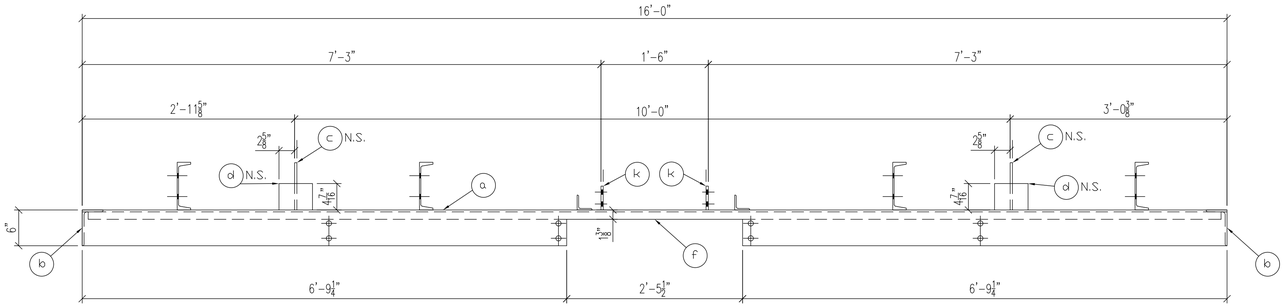
BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

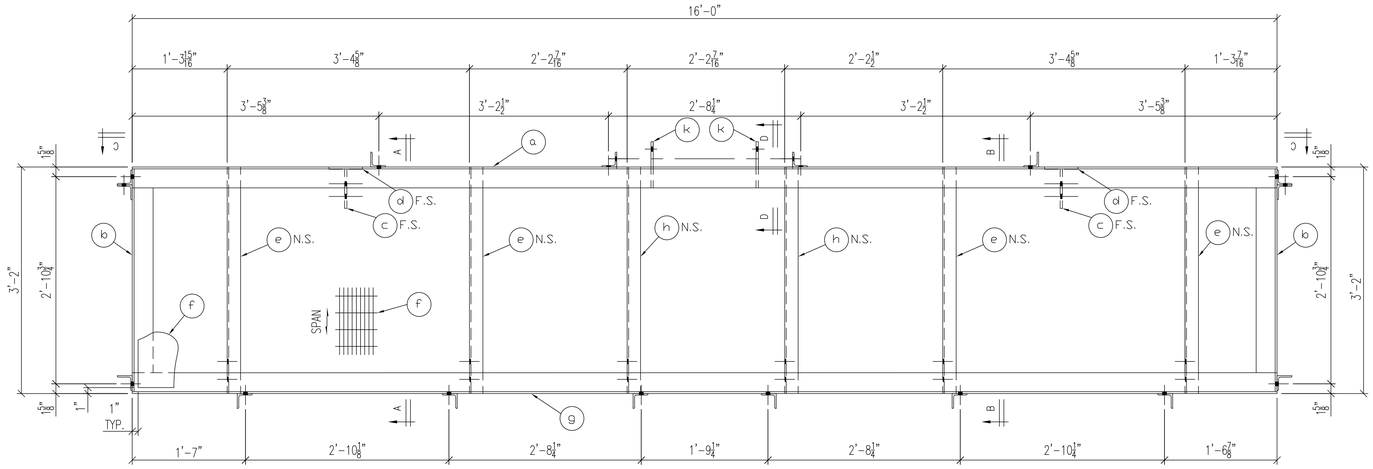
CLIENT: BOARDMAN 61237/61238

HANDRAIL DETAILS
FOR PLATFORM @ EL. 4'-8" T/G
6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D4	-	0



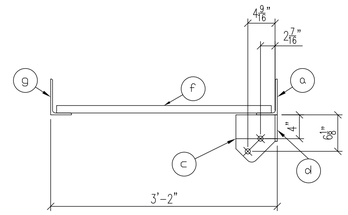
VIEW C-C



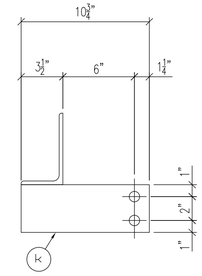
(ONE) PLATFORM MK D5-A

BILL OF MATERIAL						
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
D5-A	ONE	PLATFORM				
a	1	L 6 x 3 1/2 x 5/16	16	0	A36	157
b	2	L 6 x 3 1/2 x 5/16	3	1 3/8	A36	61
c	2	PL 3/8 x 6 9/16	0	7 15/16	A36	11
d	2	PL 3/8 x 4 7/16	0	5 5/8	A36	5
e	6	C8 x 11.5	3	2	A36	146
f	48	SQ. FT. 1 x 3/16 SERRATED BAR GRATING				360
g	1	L 6 x 3 1/2 x 5/16	16	0	A36	157
h	2	L 2 1/2 x 2 1/2 x 1/4	3	2	A36	26
k	2	PL 3/8 x 4	0	10 3/4	A36	9
					TOTAL	932
D5-B	2	KNEE BRACES				
m	2	L 3 x 3 x 1/4	4	8 1/2	A36	47
					TOTAL	47
		FIELD MATERIAL				
+2	22	3/4"ø x 1 3/4" HEX BOLTS W/ HHN & LW			A325	14
+1	9	3/4"ø x 2 1/4" HEX BOLTS W/ HHN & HFW			A325	6
					TOTAL	999

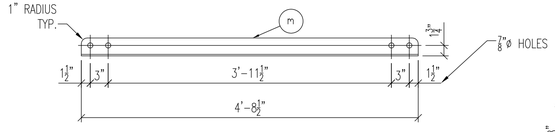
NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP. U.N.O.)
5. HOT DIP GALVANIZE.
6. ⅛" GAP BETWEEN GRATING & ANGLE FRAME.



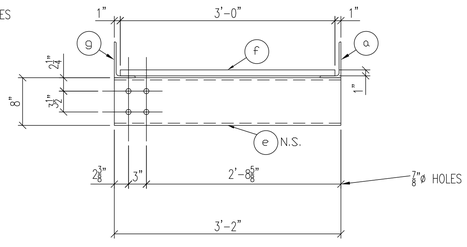
SECTION A-A



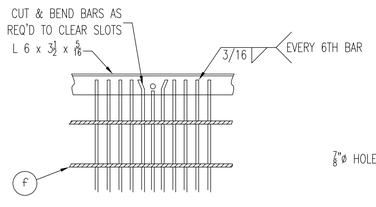
SECTION D-D



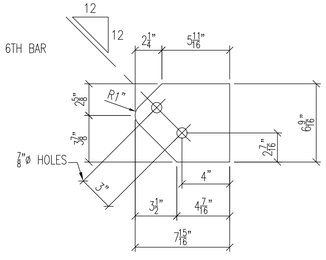
(2) KNEE BRACES MK D5-B



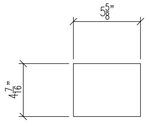
SECTION B-B



INSTALLATION DETAIL FOR GRATING



ITEM "c"



ITEM "d"

TYP. @ HR POST LOCATIONS

AS BUILT

THIS DRAWING IS THE PROPERTY OF BIXBY FABCO, INC. 8900 EAST 171ST STREET SOUTH, BIXBY, OK. 74008 AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OR EQUIPMENT EXCEPT WITH WRITTEN PERMISSION & AGREEMENT FROM:
BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN 61237/61238

PLATFORM

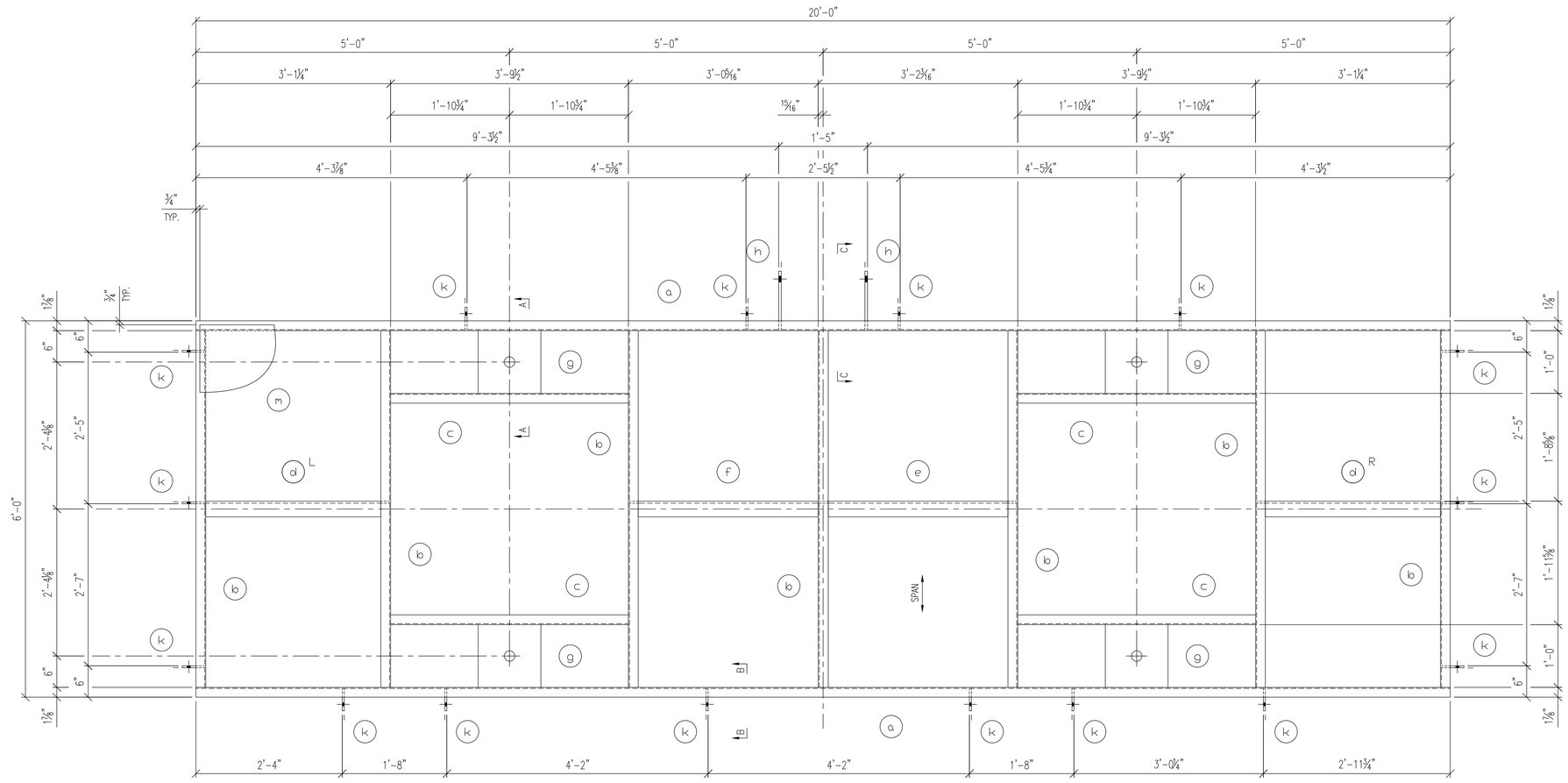
EL. 4'-8 T/G

6805

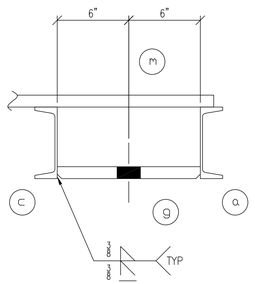
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D5	-	0

BILL OF MATERIAL						
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
D6-1	ONE	PLATFORM				
a	2	C6 x 8.2	20	0	A36	328
b	7	C6 x 8.2	5	8 1/4	A36	326
c	4	C6 x 8.2	3	9 1/2	A36	124
d L/R	1/1	L 3 x 3 x 3/8	2	11 3/16	A36	42
e	1	L 3 x 3 x 3/8	3	1 13/16	A36	23
f	1	L 3 x 3 x 3/8	3	0 1/8	A36	22
g	4	PL 1" x 12	1	0	A36	163
h	2	PL 1/2 x 5 1/2	0	11 3/16	A36	17
k	16	PL 3/8 x 4 7/16	0	5	A36	38
m	117	SQ.FT. 1" x 3/16 SERR. BAR GRTG. W/ SADDLE CLIPS			A36	878
n	2	BAR 1 x 1/4 (ROLL)	8	2 15/16	A36	14
					TOTAL	1975

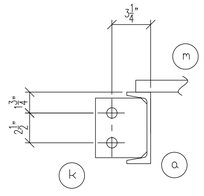
NOTES:
1. ALL HOLES TO BE AS NOTED
2. FABRICATE PER A.I.S.C.
3. SEAL WELD CONSTRUCTION. (TYP U.N.O.)
4. GALVANIZE PER A-123.
5. SPLIT GRATING @ PENETRATION
6. MIN. 4 SADDLE CLIPS PER PANEL



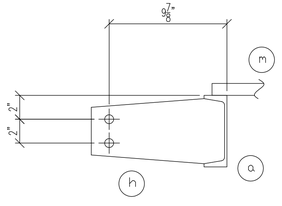
(ONE) PLATFORM MK D6-A



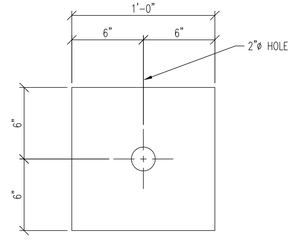
SECTION A-A



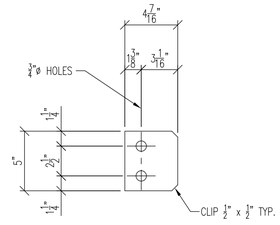
SECTION B-B



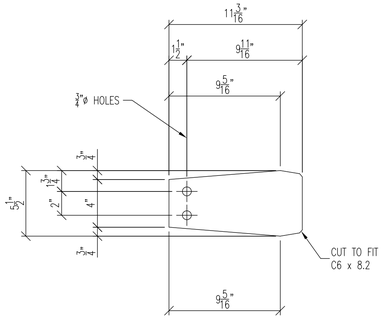
SECTION C-C



ITEM "g"



ITEM "k"



ITEM "h"

AS BUILT

WORK THIS DWG. W/ DWG D7.

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BIXBY FABCO, INC.

BIXBY Fabco STEEL FABRICATORS

BIXBY FABCO, INC.
BIXBY, OK.

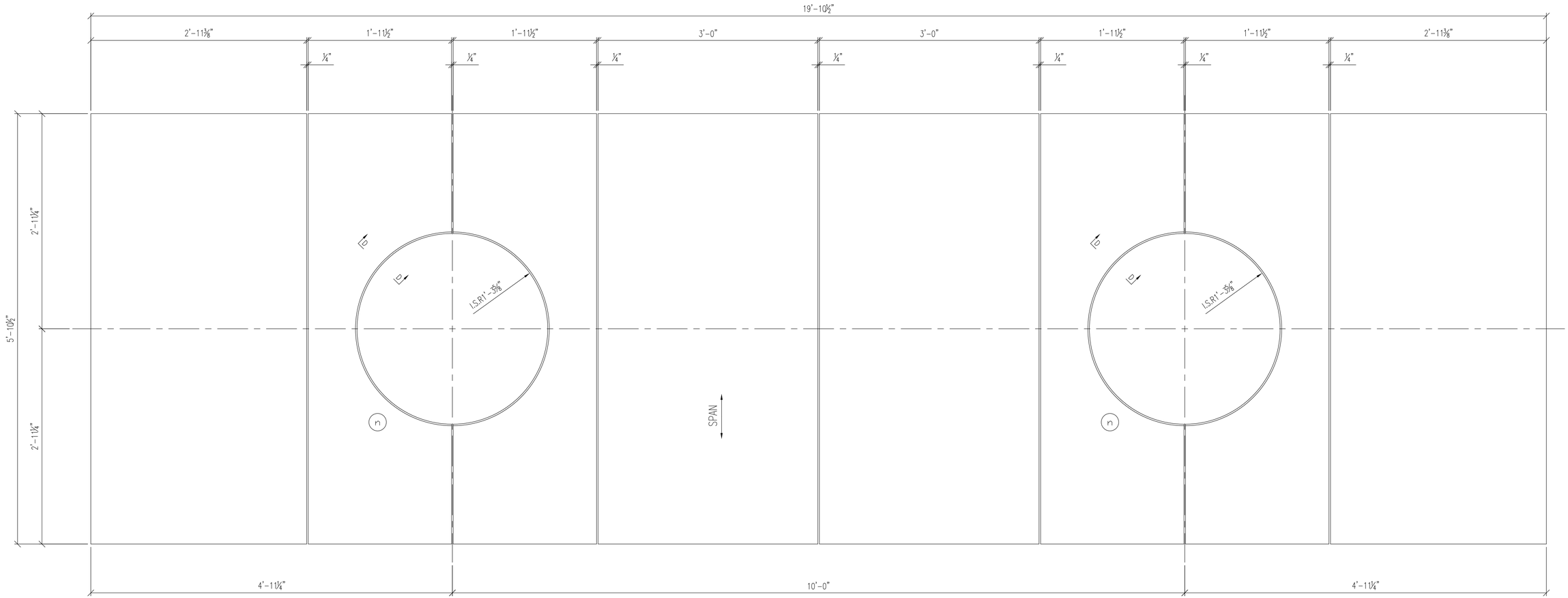
CLIENT: BOARDMAN, INC. 61237/61238

PLATFORM

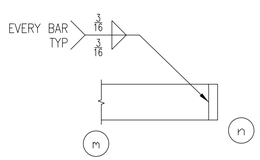
EL. 32'-6" T.O.G.

6805

TDOKC	9/23/13	R W	NTS	D6	–	0
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.



LAYOUT OF ITEM "m"



SECTION D-D

AS BUILT

WORK THIS DWG. W/ DWG D6.

THIS DRAWING IS THE PROPERTY OF BIXBY FABCO, INC. 8900 EAST 171ST STREET SOUTH, BIXBY, OK. 74008 AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OR EQUIPMENT EXCEPT WITH WRITTEN PERMISSION & AGREEMENT FROM:
BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

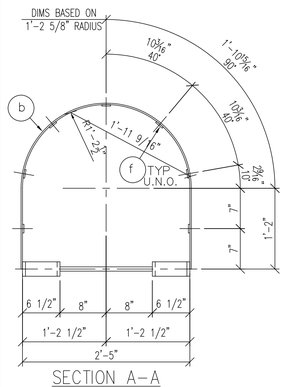
CLIENT: BOARDMAN, INC. 61237/61238

PLATFORM GRATING

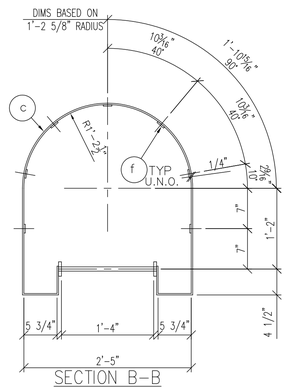
EL. 32'-6" T.O.G.

6805

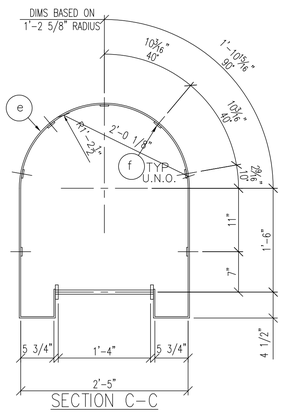
TDOKC	9/23/13	R W	NTS	D7	-	0
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.



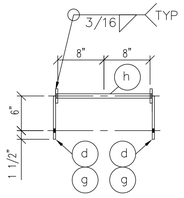
SECTION A–A



SECTION B–B

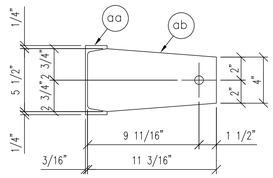


SECTION C–C

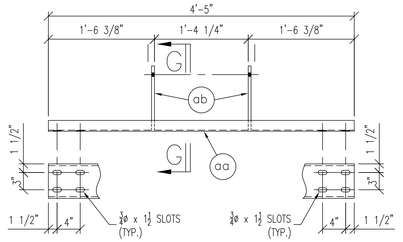


SECTION D–D

(10) 5/8ø x 2 HEX BOLTS W/ NUT & HFW

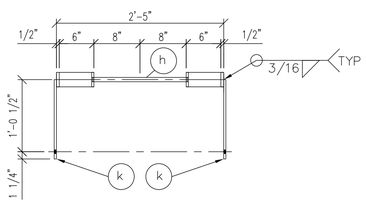


SECTION G–G



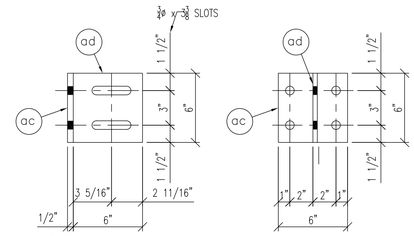
(3) LADDER SUPPORTS MK D8–B

(24) 5/8ø x 1 3/4 HEX BOLTS W/ NUT & HFW



SECTION E–E

(2) 1/2ø x 1 1/2 HEX BOLTS W/ NUT & HFW



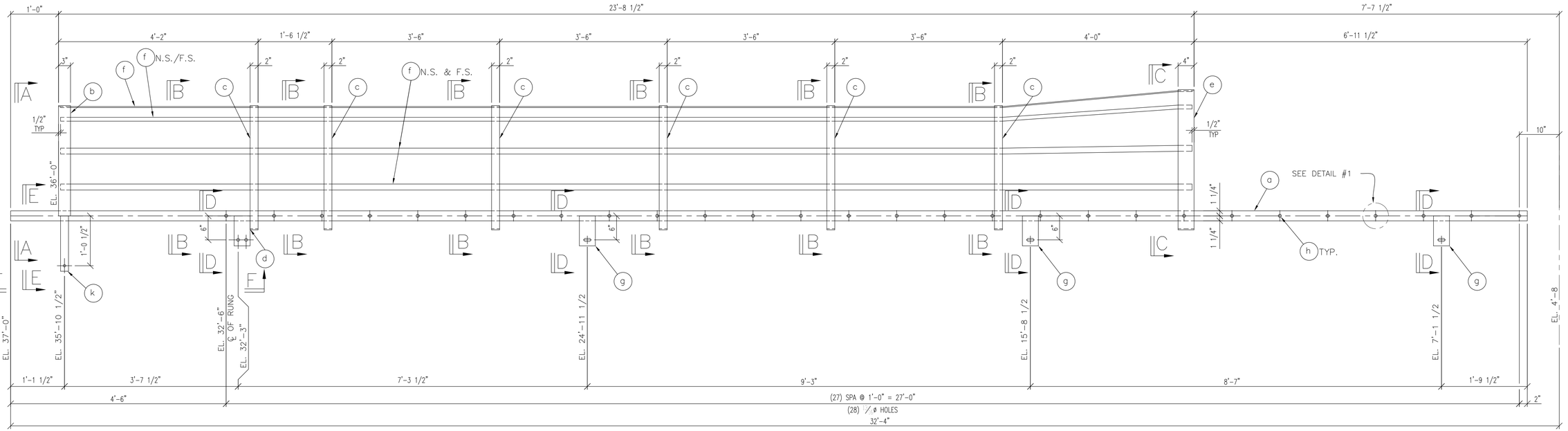
(6) LADDER SUPPORT CLIPS MK D8–C

(12) 5/8ø x 1 3/4 HEX BOLTS W/ NUT & HFW

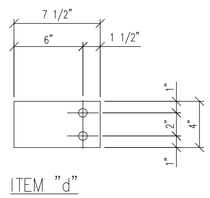
NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP U.O.N.)
5. GALVANIZE PER A-123.

BILL OF MATERIAL

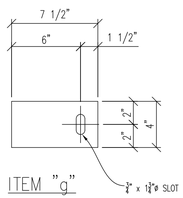
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
L2	ONE	LADDER				
a	2	BAR 2 1/2 x 1/2 (BEND)	31	10	A36	271
b	1	BAR 3 x 1/4 (BEND)	6	1 15/16	A36	16
c	6	BAR 2 x 1/4 (BEND)	8	8 7/16	A36	89
d	2	BAR 4 x 3/8	0	7 1/2	A36	6
e	1	BAR 4 x 1/4 (BEND)	9	4 7/16	A36	32
f	7	BAR 1 1/2 x 1/4 (BEND)	23	7 11/16	A36	211
g	6	BAR 4 x 3/8	0	7 1/2	A36	19
h	28	3/4"ø RD. BAR	1	4 1/2	A36	59
k	2	BAR 2 x 3/8	1	1 3/4	A36	6
					TOTAL	709
D8–B	3	LADDER SUPPORTS				
aa	3	C6 x 8.2	4	5	A36	109
ab	6	BAR 5 1/2 x 1/2	0	11 3/16	A36	52
					TOTAL	161
D8–C	6	LADDER SUPPORT CLIPS				
ac	6	BAR 6 x 1/2	0	6	A36	31
ad	6	BAR 6 x 3/8	0	6	A36	23
					TOTAL	54
		FIELD MATERIAL				
+1	3	1/2ø x 1 1/2 HEX BOLTS w/ HHN & HFW				1
+4	40	5/8ø x 1 3/4 HEX BOLTS w/ HHN & HFW				16
+1	11	5/8ø x 2 HEX BOLTS w/ HHN & HFW				5
					TOTAL	946



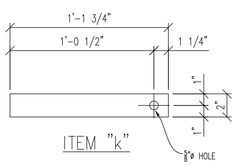
(ONE) LADDER MK L2



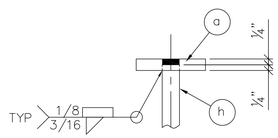
ITEM "d"



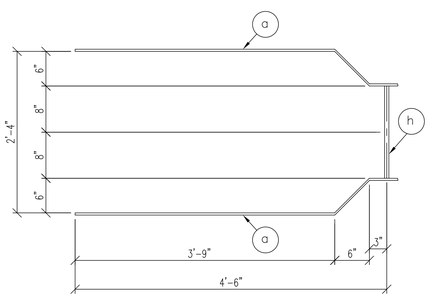
ITEM "g"



ITEM "k"



DETAIL #1



SECTION F–F

AS BUILT

BIXBY FABCO
STEEL FABRICATORS
BIXBY, OK.

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BIXBY FABCO, INC.
BIXBY, OK.

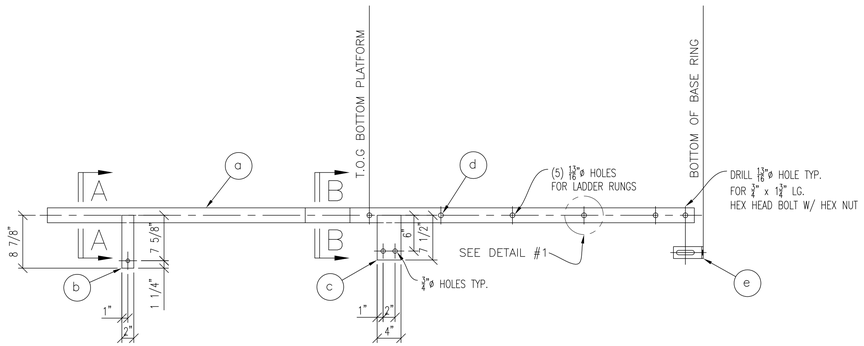
CLIENT: BOARDMAN INC, 61237/61238

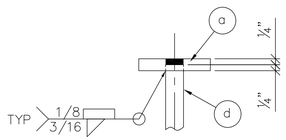
LADDER #2

EL. 4'-8" TO 32'-6" T/G

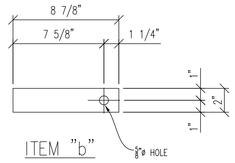
6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D8		0

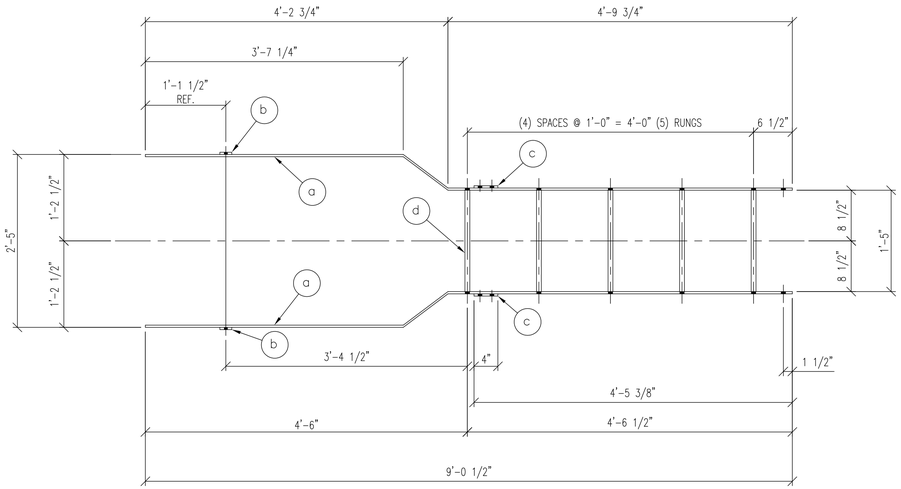




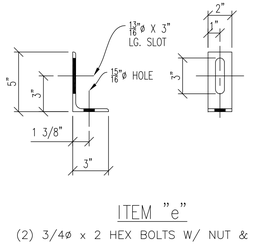
DETAIL #1



ITEM "b"

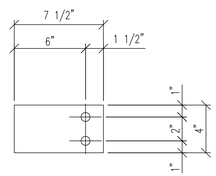


(ONE) LADDER MK L1

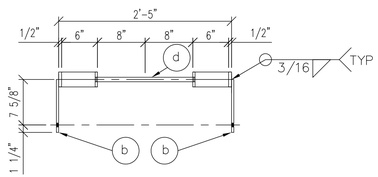


ITEM "e"

(2) 3/4ø x 2 HEX BOLTS W/ NUT & HFW

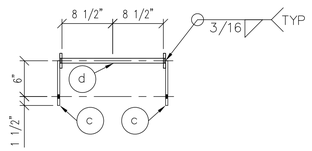


ITEM "c"



SECTION A-A

(2) 1/2ø x 1 1/2 HEX BOLTS W/ NUT & HFW



SECTION B-B

(4) 5/8ø x 2 HEX BOLTS W/ NUT & HFW

BILL OF MATERIAL

MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
L1	ONE	LADDER				
a	2	BAR 2 1/2 x 1/2 (BEND)	9	3	A36	79
b	2	BAR 2 x 3/8	0	8 7/8	A36	4
c	2	BAR 4 x 3/8	0	7 1/2	A36	6
d	5	3/4"ø RD. BAR	1	5 1/2	A36	11
e	2	L 5 x 3 x 1/4	0	2	A36	2
		TOTAL				102
		FIELD MATERIAL				
+1	3	1/2ø x 1 1/2 HEX BOLTS w/ HHN & HFW				1
+1	5	5/8ø x 2 HEX BOLTS w/ HHN & HFW				2
+1	3	3/4ø x 2 HEX BOLTS w/ HHN & HFW				2
		TOTAL				107

NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP U.O.N.)
5. GALVANIZE PER A-123.

AS BUILT

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BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN INC, 61237/61238

LADDER #1

EL. 0'-0 TO 4'-8 T/G

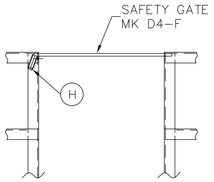
6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D9		0

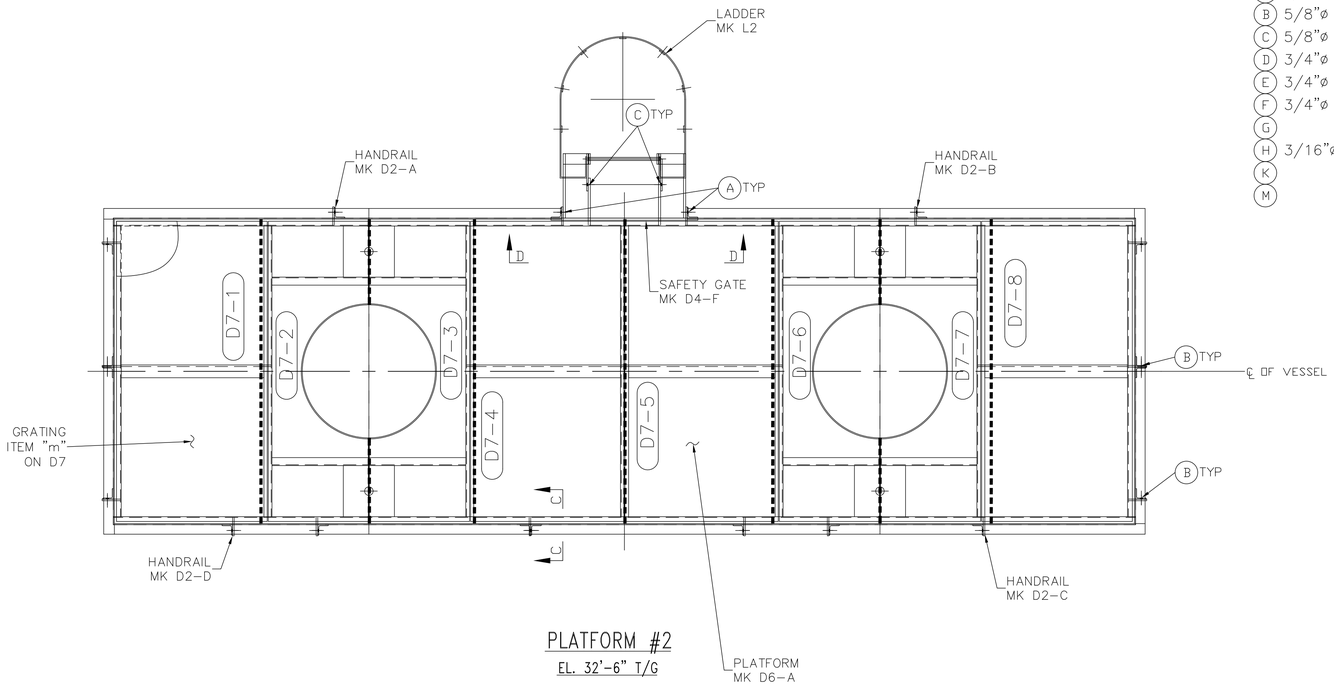
0°
270° 90°
180°

BOLT LIST (10% ADDED)
(ALL BOLTS TO BE GALVANIZED)

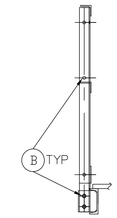
- (A) 1/2"ø x 1 1/2" (A307) HEX BOLTS W/ HHN & HFW (6)
- (B) 5/8"ø x 1 3/4" (A307) HEX BOLTS W/ HHN & HFW (83)
- (C) 5/8"ø x 2" (A307) HEX BOLTS W/ HHN & HFW (16)
- (D) 3/4"ø x 1 3/4" (A325) HEX BOLTS W/ HHN & LW (22)
- (E) 3/4"ø x 2 " (A325) HEX BOLTS W/ HHN & HFW (3)
- (F) 3/4"ø x 2 1/4" (A325) HEX BOLTS W/ HHN & HFW (9)
- (G)
- (H) 3/16"ø x 1 3/4" LG. COTTER PIN (2)
- (K)
- (M)



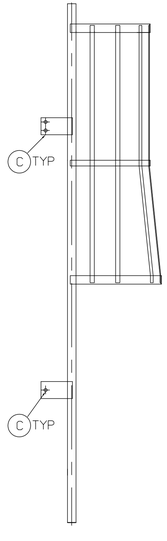
SECTION D-D



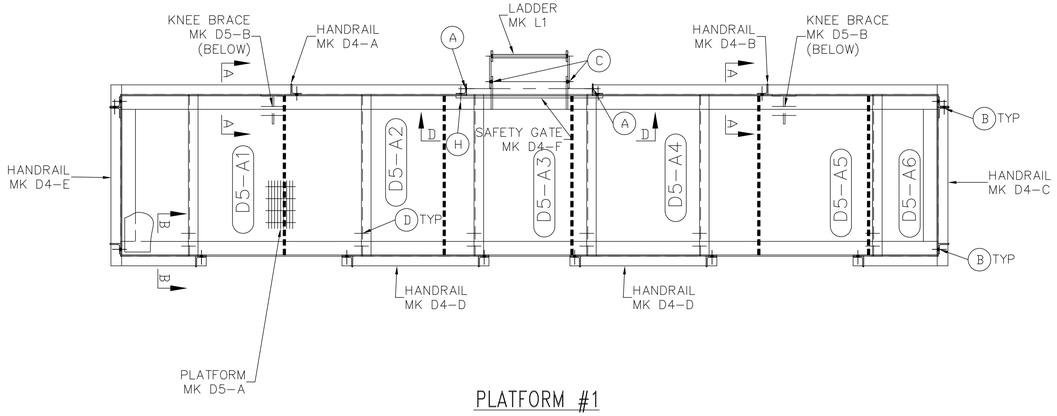
PLATFORM #2
EL. 32'-6" T/G



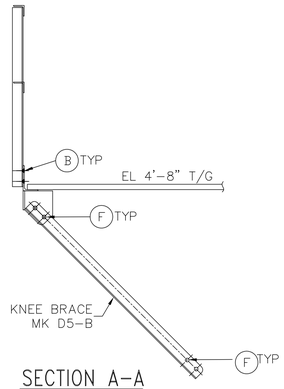
SECTION C-C



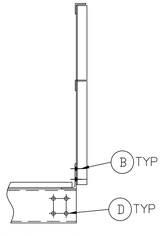
LADDER DETAIL



PLATFORM #1
EL. 4'-8" T/G



SECTION A-A



SECTION B-B

AS BUILT

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BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

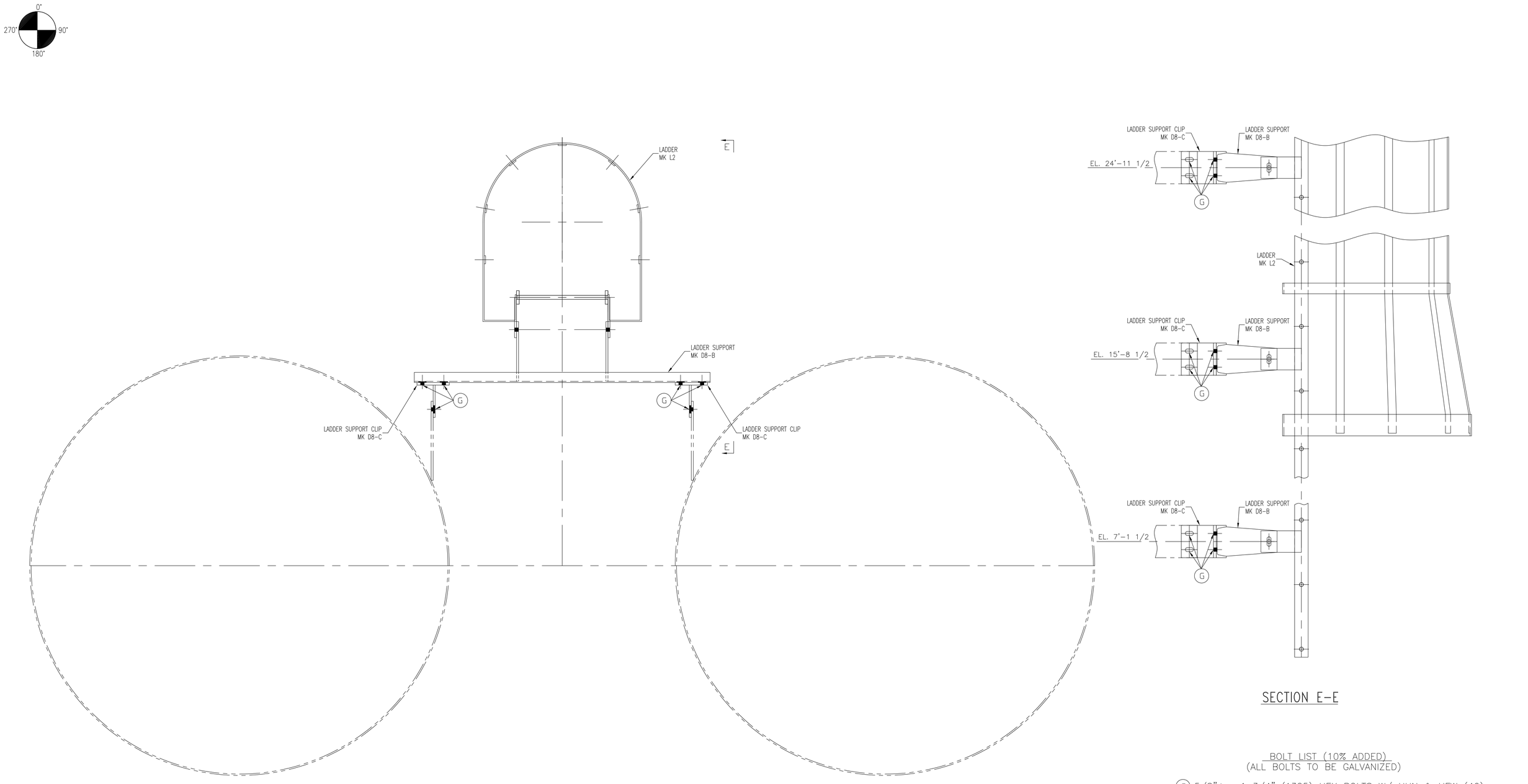
CLIENT: BOARDMAN INC. 61237/61238

PLATFORM ERECTION DRAWING

ELEVATIONS AS NOTED

6805

TDOKC	9/23/13	R W	NTS	EI	–	0
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.



SECTION E-E

BOLT LIST (10% ADDED)
(ALL BOLTS TO BE GALVANIZED)

(G) 5/8"ø x 1 3/4" (A325) HEX BOLTS W/ HHN & HFW (40)

AS BUILT

THIS DRAWING IS THE PROPERTY OF BIXBY FABCO, INC. 8900 EAST 171ST STREET SOUTH, BIXBY, OK. 74008 AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OR EQUIPMENT EXCEPT WITH WRITTEN PERMISSION & AGREEMENT FROM:
BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN INC. 61237/61238

PLATFORM ERECTION DRAWING

ELEVATIONS AS NOTED

6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	E2	–	0

Since 1910
BOARDMAN
1135 South McKinley Ave * Oklahoma City, Oklahoma 73108
(405) 634-5434 * Fax (405) 632-6948
STEEL & ALLOY PLATE FABRICATION * PRESSURE VESSELS AND FCCU COMPONENTS

DATA RECORD BOOK

FOR

UOP RUSSELL LLC

PURCHASE ORDER NUMBER: 4500754152
PROJECT NUMBER: J447XX
ITEM NUMBER: V-443
DESCRIPTION: 78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR

MANUFACTURER:

BOARDMAN, LLC.
1135 SOUTH McKINLEY
OKLAHOMA CITY, OK.

BOARDMAN LLC ORDER NUMBER: 70699
BOARDMAN LLC SERIAL NUMBER: 70699-B
NATIONAL BOARD NUMBER: 3980

BOARDMAN, INC.

V-443

TABLE OF CONTENTS

1. Code Data Report
2. Nameplate
3. Inspection Test Plan
4. Hydrostatic Test Report
5. PWHT
6. Non-Destructive Examination
7. Material Test Reports/Certs
8. Design Calculations
9. Vessel Drawings
10. L&P Drawings

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: Boardman, LLC 1135 South McKinley Oklahoma City, OK 73108
(Name and address of Manufacturer)

2. Manufactured for: UOP Russell LLC 7050 South Yale, Suite 210 Tulsa, Oklahoma 74136
(Name and address of Purchaser)

3. Location of installation: UOP Russell LLC 5380 Arkansas Road Port of Catoosa, Oklahoma 74015
(Name and address)

4. Type: Vertical (Horizontal or vertical, tank) | 70699-B (Manufacturer's serial number) | n/a (CRN) | 21564 (Drawing number) | 3980 (National Board number) | 2017 (Year built)

5. ASME Code, Section VIII, Division 1: 2015, No Addenda [Edition and Addenda, if applicable (date)] | ----- (Code Case numbers) | ----- [Special service per UG-120(d)]

6. Shell: SA516-70N (Material spec. number, grade) | 2.375" (Nominal thickness) | 0.0625" (Corr. allow.) | 6'-6" (Inner diameter) | 24'-4" Tangent/Tangent [Length (overall)]

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

7. Seams: Welded, Dbl-Butt [Long. (welded, dbl., sngl., lap, butt)] | Full [R.T. (spot or full)] | 100 (Eff., %) | 1,150° F. (H.T. temp.) | 2.25 (Time, hr) | Welded, Dbl-Butt [Girth (welded dbl., sngl., lap, butt)] | Full [R.T. (spot or full)] | 100 (Eff., %) | 3 (No. of courses)

8. Heads: (a) Material: SA516-70N (Spec. no., grade) (b) Material: SA516-70N (Spec. no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	Top	2.2752"	0.0625"	-----	-----	2:1	-----	-----	-----	Concave
(b)	Bottom	2.2752"	0.0625"	-----	-----	2:1	-----	-----	-----	Concave

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)												
(b)												

9. MAWP: 1,095 psig (Internal) | n/a (External) at max. temp. 600° F. (Internal) | n/a (External)
Min. design metal temp. (-)20° F. at 1,095 psig. Hydro., ~~pneu., or comb.~~ test pressure 1,424 psig
Proof test n/a.

10. Nozzles, inspection, and safety valve openings:

Purpose (Inlet, Outlet, Drain etc.)	No.	Diameter or Size	Type	Material: Nozzle	Material: Flange	Nozzle Thickness: Nom.	Nozzle Thickness: Corr.	Reinforcement Material	Attachment Details: Nozzle	Attachment Details: Flange	Location (Insp. Open.)
B - Outlet	1	8" CL. 600	RF/WN	*	SA350-LF2	Sch. 80	0.0625"	SA516-70N	UW-16(e)	Full Pen.	-----
C - Fill / Manway	1	18" CL. 600	RF/V2	SA350-LF2	SA350-LF2	-----	0.0625"	-----	UW-16(e)	-----	Top Head
D - Dump	1	18" CL. 600	RF/V3	SA350-LF2	SA350-LF2	-----	0.0625"	-----	UW-16(e)	-----	-----
E1~2 - TI	2	3/4" 6000#	CPLG	SA105	-----	-----	0.0625"	-----	UW-16(a)	-----	-----

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

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: Partial Data Reports from P & M Industries, Inc. for shells with S/N 1701033-4 and 1701033-6
(Name of part, item number, Manufacturer's name and identifying stamp)

* - SA350-LF2/SA234-WPB/SA106-B Mol Sieve Dehydrator S/N 70699-B. Yes, Charpy Impact Tests req'd per UG-84 to (-)20° F. on heads, shells, and repad. SA350-LF2 nozzles are tested per UCS-66(g). SA105 nozzles are exempt per UCS-66(b)(3). SA106-B pipe exempt per Fig. UCS-66, Curve B. Customer shall provide this vessel with an overpresure protective device per UG-125 through UG-136 prior to placing vessel in service.

FORM U-1A (Back)

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 2847 expires Oct. 25, 2019 .

Date 6-1-17 Co. name Boardman, LLC (Manufacturer) Signed (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Boardman, LLC at Oklahoma City, Oklahoma 73108

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 5-16-17 , 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 6-1-17 Signed (Authorized Inspector) Commissions NB-7936 A/IS OK# 263 [National Board (incl. endorsements)]

(07/13)

NAT'L BD. NO. NB 3980
CERTIFIED BY
BOARDMAN
OKLAHOMA CITY, OK
U
W
RT-1
HT
1095 P.S.I.G. AT 600 °F
MAX. ALLOW. WORK PRESS.
-20 °F AT 1095 P.S.I.G.
MIN. DESIGN METAL TEMP.
S/N 70699-B YEAR BUILT 2017
ITEM NO V-443
MOL SIEVE DEHYDRATOR
PO NO 4500754152
PROJECT J-7XX

BOARDMAN Since 1910

INSPECTION PLAN

JOB NO. 70699-B VESSEL UOP ITEM NO. V-443 N.B. NO. _____

P.O. NO. 4500754152

A.I. REVIEW 2-24-17 MH. BgR

DESCRIPTION	BOARDMAN	DATE	CUST.	A.I.
Per-fab Meeting				
*1. Material and MTRs/CERTs received.				
2. Impact test received.				
*3. Drawing and design cals received. *				
4. Are welders and welding operators qualified *(Welders to stencil their identification at welds)*				
5. Have edges been properly prepared, cleaned and visually accepted.				
6. Have shells and heads been properly fitted *(Alignment Tolerances UG-80, UW-31, 32 & 33)*				
7. Back-up passes complete and visually examined.				
8. Back-gouge and or back-grinding of vessel long seams visually examined and accepted as required.				
9. Back-gouge and or back-grinding of vessel girth seams visually examined and accepted as required				
10. Long seam final welds visually examined and accepted.				
11. Girth seam fianl welds visually examined and accepted.				
12. Roundness of shell checked (UG-79,80)				
*13. Radiographs accepted (full, part ____other _____) RT-1				
14. Nozzle layout checked. Shell_____Heads_____				
15. Nozzle fit-up and weld preparation examined and accepted.				
16. Back-gouge and or back-gringing nozzles visually examined and accepted as required.				
17. Final nozzle welds visually examined and accepted.				
18. Fit-up of reinforcing pads examined and accepted.				
19. Final reinforcing pad welds visually examined and accepted.				
**20. Air test of reinforcing pads accepted.				
*21. Internal inspection UG 97 (1) *				
22. Visual inspection of final welds.				
23. Final Dimensional				
24. Vessel Released for Heat Treat				
**25. Vessel received after heat treat w/chart				
**26. M.T. of lifting lugs				
*27. Vessel hydrostatic tested and accepted. *				
*28. Sign and date data report. *				
**29. Blast examined and accepted prior to coating.				
30. Fianl paint examined and accepted.				
31. Proper name and test plates attached to vessel				
**32.Verification of final shipping.				

UOPR 5/24/17 MH QC 5-16-17 5-16-17 6-1-17

*MANDATORY CHECK POINTS FOR CODE INSPECTION

**BOARDMAN Q.C.

Note: Columns under Boardman heading left blank for inital and date of acceptance.

Note: Other checks not indicated for Boardman Q.C. may be by foreman or leadman.

H = Hold Point

W = Witness Point

I = Inspect

R = Report

RV = Review

BOARDMAN Since 1900

INSPECTION PLAN

JOB NO. 70699-B VESSEL UOP ITEM NO. V-443 N.B. NO. _____

P.O. NO. 4500754152

A.I. REVIEW _____

DESCRIPTION		BOARDMAN	DATE	CUST.	A.I.
Per-fab Meeting					
*1. Material and MTRs/CERTs received.			3-31-17		
2. Impact test received.			4-7-17		
*3. Drawing and design cals received.	*		1-16-17		
4. Are welders and welding operators qualified *(Welders to stencil their identification at welds)*			2-27-17		
5. Have edges been properly prepared, cleaned and visually accepted.			4-1-17		
6. Have shells and heads been properly fitted *(Alignment Tolerances UG-80, UW-31, 32 & 33)*			4-28-17		
7. Back-up passes complete and visually examined.			5-1-17		
8. Back-gouge and or back-grinding of vessel long seams visually examined and accepted as required.		N/A			
9. Back-gouge and or back-grinding of vessel girth seams visually examined and accepted as required			5-1-17		
10. Long seam final welds visually examined and accepted.			5-10-17		
11. Girth seam fianl welds visually examined and accepted.			5-10-17		
12. Roundness of shell checked (UG-79,80)			5-10-17		
*13. Radiographs accepted (full) part ____other _____) RT-1			5-4-17		
14. Nozzle layout checked. Shell 4-6-17 Heads 2-27-17			5-10-17		
15. Nozzle fit-up and weld preparation examined and accepted.			4-7-17		
16. Back-gouge and or back-gringing nozzles visually examined and accepted as required.			4-10-17		
17. Final nozzle welds visually examined and accepted.			5-10-17		
18. Fit-up of reinforcing pads examined and accepted.			5-5-17		
19. Final reinforcing pad welds visually examined and accepted.			5-10-17		
**20. Air test of reinforcing pads accepted.			5-16-17		
*21. Internal inspection UG 97 (1)	*		5-10-17		
22. Visual inspection of final welds.			5-10-17		
23. Final Dimensional			5-10-17	H	
24. Vessel Released for Heat Treat			5-10-17		
**25. Vessel received after heat treat w/chart			5-12-17		
**26. M.T. of lifting lugs			5-12-17		
*27. Vessel hydrostatic tested and accepted.	*		5-16-17	H	
*28. Sign and date data report.	*		6-1-17		
**29. Blast examined and accepted prior to coating.			5-19-17		
30. Fianl paint examined and accepted.			5-22-17		
31. Proper name and test plates attached to vessel			5-22-17		
**32.Verification of final shipping.			5-24-17		

*MANDATORY CHECK POINTS FOR CODE INSPECTION

**BOARDMAN Q.C.

Note: Columns under Boardman heading left blank for inital and date of acceptance.

Note: Other checks not indicated for Boardman Q.C. may be by foreman or leadman.

H = Hold Point

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R = Report

RV = Review

since 1970

BOARDMAN

FINAL INSPECTION COMPLETION

This order has been confirmed to be ready for shipment by Boardman QA/QC
Note: This is not release for shipment. Shipping release may need to be obtained from the customer.

Boardman P.O.# 4500754152	Customer: UOP RUSSELL	Project# J447XX	Boardman Job# 70699-A & 70669-B
Item # V-442 and V-443	Vessel Decription: MOL SIEVE DEHYDRATOR		

ITEM/ TAG No.	QUANTITY	FINAL INSPECTION ACCEPTED	DESCRIPTION
V-442	1	A	MOL SIEVE DEHYDRATOR
V-443	1	A	MOL SIEVE DEHYDRATOR

BOARDMAN INSPECTOR'S NAME: JAMES JOHNSON DATE: 5/24/2017

BOARDMAN INSPECTORS SIGNATURE AND DATE: James Johnson 5-24-17

CUSTOMER INSPECTOR SIGNATURE AND DATE: 5/24/17

EXCEPTANCE STATUS: BY SIGNING ABOVE, I acknowledge that the fabricated equipment has been inspected and accepted. The equipment is ready for shipping on the agreed upon date between the buyer and seller.

A. NO APPARENT DEFECTS NOTED: BOARDMAN QA/QC HAS COMPLETED FINAL INSPECTION. THIS ORDER IS NOW READY TO SHIP.

B. MINOR DEFECTS NOTED: BOARDMAN TO REMEDY DEFECTS. BOARDMAN QA/QC SHALL CONFIRM THAT DEFECTS HAVE BEEN REMEDIED BY SIGNING BELOW ON THIS FORM. A COPY OF THE SIGNED FORM SHALL BE SAVED IN BOARDMAN QA/QC FILES AND A COPY SENT TO CUSTOMER, BOARDMAN ACCOUNTING, PROJECT MANAGER, MANUFACTURING MANAGER, QA/QC MANAGER AND SHIPPING & RECEIVING FOR FINAL ACCEPTANCE.

MINOR DEFECTS NOTED IF ANY:

:

BOARDMAN QA/QC CONFIRMS THAT DESCRIBED MINOR DEFECTS HAVE BEEN REMEDIED AND REQUESTS AUTHORIZATION TO SHIP THE SPECIFIC ITEMS LISTED ABOVE.

BOARDMAN QA/QC SIGNATURE: _____ TITLE: _____

PRINT NAME: _____ DATE: _____

BOARDMAN

HYDROSTATIC TEST CERTIFICATION

DATE: 5/16/2017

JOB NO. 70699-B

CUSTOMER: UOP RUSSELL

SER. NO. 70699-B

P.O. NUMBER: ~~4500751S2~~ 4500754152

F. TEST 1,424 PSI

CUSTOMER ITEM NO. V-443

This vessel was Hydrostatic tested for a period of 1 hour minimum to the above listed pressure using

Gauge No. 2011 and 2013 Calibrated 7/15/2017 No leaks were found.

MANAGER, QUALITY CONTROL

NATIONAL BOARD INSPECTOR

187936
COMMISSIONS

NOTE: GAUGES ARE CALIBRATED PERIODICALLY OR ANYTIME A GAUGE IS NOT FUNCTIONING PROPERLY.

BOARDMAN Since 1910

HYDROSTATIC TEST CERTIFICATION

DATE: 5/17/2017

JOB NO. 70699-B DC-2

CUSTOMER: UOP RUSSELL

SER. NO. 70699-B DC-2

P.O. NUMBER: 4500754152

F. TEST 1,643 PSI

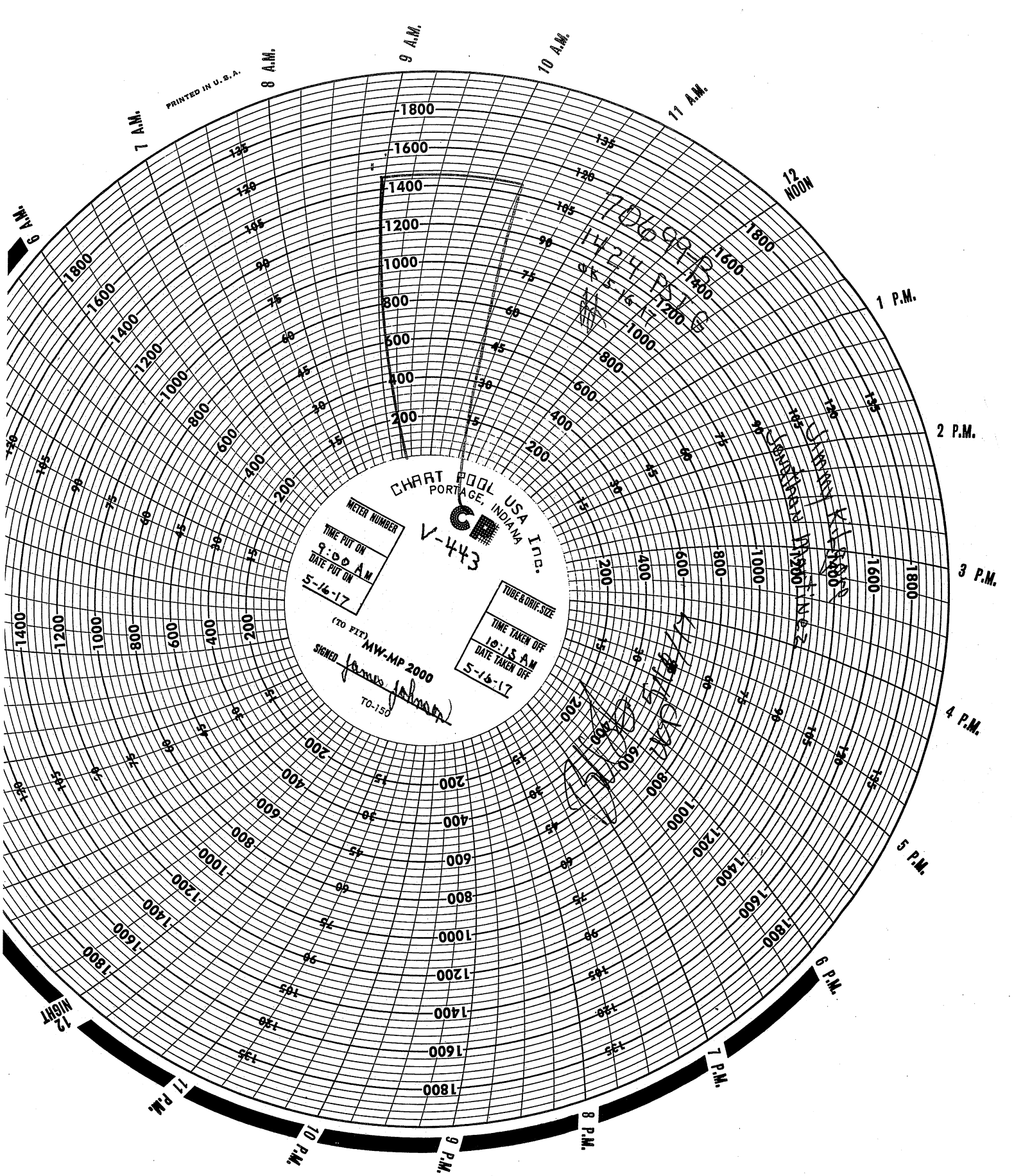
CUSTOMER ITEM NO. V-443

This vessel was Hydrostatic tested for a period of 1 hour minimum to the above listed pressure using

Gauge No. 2011 and 2013 Calibrated 7/15/2017 No leaks were found.

MANAGER, QUALITY CONTROL

NOTE: GAUGES ARE CALIBRATED PERIODICALLY OR ANYTIME A GAUGE IS NOT FUNCTIONING PROPERLY.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4 P.M.
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6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
12 NIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
CHART POOL USA Inc.
PORTAGE, INDIANA
METER NUMBER
V-443
TIME PUT ON
9:00 AM
DATE PUT ON
5-16-17
TUBE & ORIF. SIZE
TIME TAKEN OFF
10:15 AM
DATE TAKEN OFF
5-16-17
(TO FIT) MW-MP 2000
SIGNED
TO-150

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3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
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4 P.M.
5 P.M.
6 P.M.
7 P.M.
PRINTED IN U.S.A.
CHART POOL
PORTAGE, INDIANA USA
V-443
METER NUMBER
TIME PUT ON
8:30 AM
DATE PUT ON
5-17-17
TIME TAKEN OFF
9:45 AM
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TORR & ORIFICE SIZE
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(TO P.I.T.) MAY-MAR 2000
(TO 150)
Jimmy Kilgore
Southern Natural Gas
DC 2 1643 PSIA 20
5-17-17
1600
7069-8

Bodycote

Shipment: 55-76531

Shipment

From:	Sold To:	Shipped To:
Division: 55 **Bodycote Thermal Processing - Pine** 1520 North 170th East Avenue Tulsa, OK 74116	**Customer: 55-2426** **Boardman, Inc. (H)** 1135 S. Mckinley Ave. Oklahoma City, OK 73108 (Fax) 1 (405) 632-6948 (Voice) 1 (405) 634-5434	**Ship To: 55-2426-1** **Boardman, Inc. (H)** 1135 S. Mckinley Ave. Oklahoma City, OK 73108 (Fax) 1 (405) 632-6948 (Voice) 1 (405) 634-5434
Ship Date **5/11/2017 3:48:48 PM**		Bill Of Lading
Shipment Method **CUSTOMER PICK UP**		
Message		
Container(s) =	**1 WP**	
Required Process =	**1150 +/-25 STRESS**	

Order No. 75806 P.O. No. SN 70699 Recv'd 5/10/2017 4:44:04 AM Shipment COMPLETE

Qty	Part Number	Part Name	Wgt
1	**S/N 70699 V-443** Material and Description **Low Carbon Steel**	**MOL SIEVE DEHYDRATOR** Flange	**68000**

Totals...

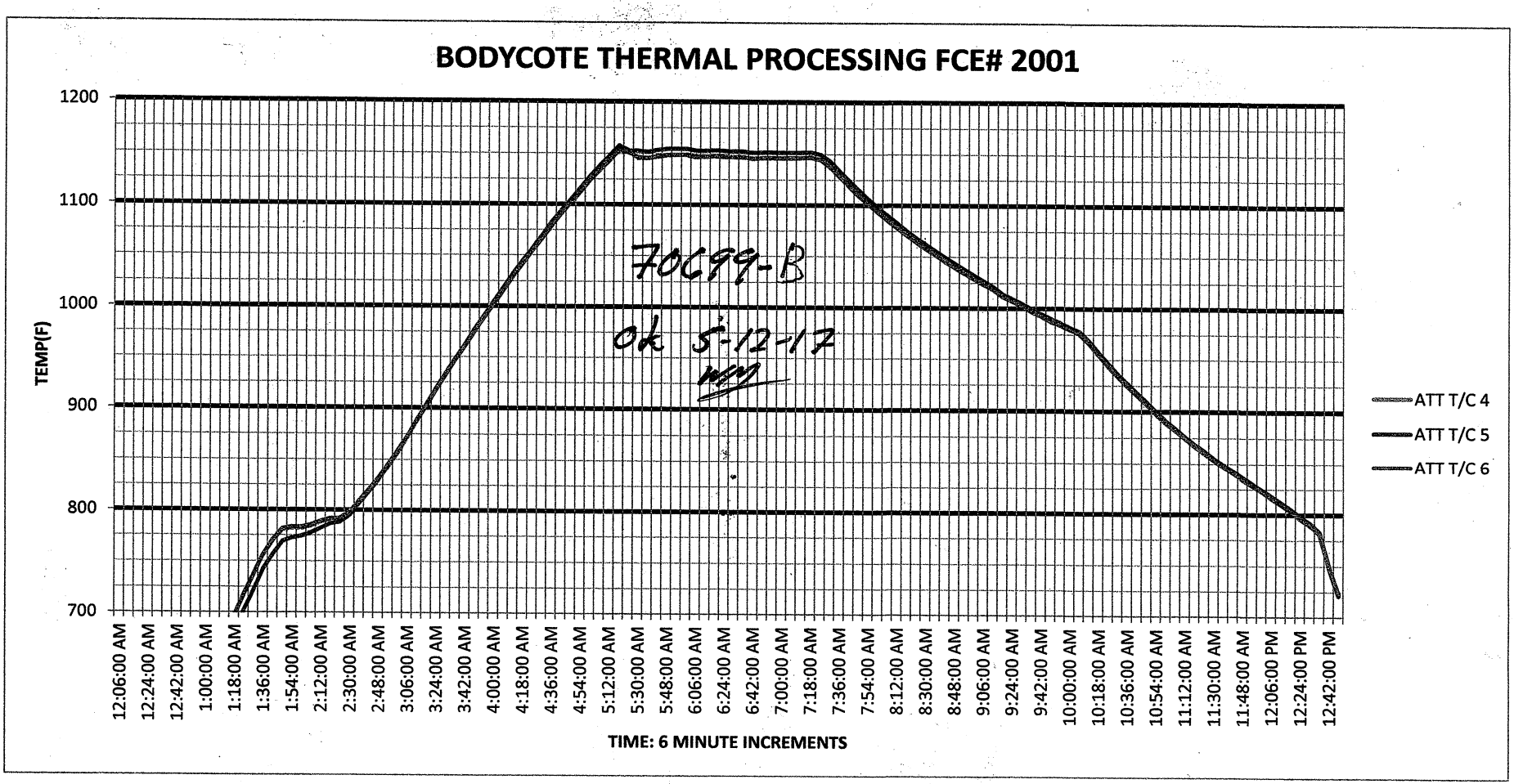
Ttl Qty	Signed For By / Date	Ttl Wgt
1	_____ _____	**68000**

CUSTOMER COPY

BOARDMAN
JOB# 75806
P.O.# 70699

70699 V-443

5/11/17



CALIBRATION DATE 4/6/17
CALIBRATION DUE DATE 7/6/17

SIGNED BY KEN DUVAL

BOARDMAN

QUALITY CONTROL DEPARTMENT

MAGNETIC PARTICLE TEST REPORT

PROCEDURE NO: MT-1 REVISON: 8 JOB NO: 70699-B ITEM NO: V-443

DATE TEST PERFORMED: 05/12/17 TIME TEST PERFORMED: 11:00 A.M.

TESTING PERFORMED IN ACCORDANCE WITH: 2015 ASME SECTION V - ARTICLE 7

IF OTHER, WHICH CODE WAS TESTING PERFORMED IN ACCORDANCE WITH: N/A

MAGNETIC PARTICLE TYPE: VISIBLE MAGNETIC PARTICLE COLOR: YELLOW

WET OR DRY PARTICLES: DRY MAGNETIC YOKE USED: MAGNAFLUX Y-7 AC/DC YOKE

CURRENT TYPE USED ON TEST: AC LIGHTING EQUIPMENT USED: FLASH LIGHT

MATERIAL TYPE: SA-516 GRADE 70 IF OTHER, WHAT MATERIAL TYPE:

MATERIAL THICKNESS (IN INCHES): 1-1/2 IF OTHER, WHAT MATERIAL THICKNESS: 1/2"

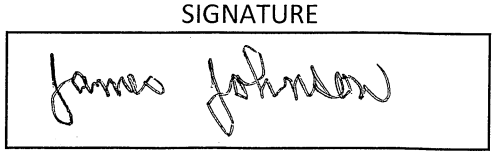
ITEMS CHECKED: Lifting lug and lift lug pad, MK 2-32 and MK 2-31.

RESULTS: MT acceptable per. ASME SECTION VIII - APPENDICES 6 2015

I, THE UNDERSIGNED, CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE WELDS AND/OR PIECES WERE EXAMINED IN ACCORDANCE WITH THE REQUIREMENTS OF THE ABOVE FABRICATION CODE AND ACCEPTANCE STANDARDS.

TECHNICIAN: JAMES JOHNSON LEVEL: II

SIGNATURE



DATE: 5/12/2017

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

CUSTOMER: *AMERICAN PIPING INSPECTION*
Code: *ASME SEC VIII*
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-B
Date 3/2/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 12 Rep. Film

Source	Ir192 ■ Co60 □	Dev. Process: Man. □ Auto ■		Unsharpness	<.020
Curies	59	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.146	Source to Film	4.313 "	Mat. Type	P1
Film Type	Fuji- 80	Minimum Source to Object	3.688 "	Mat. Thickness	0.500
Film Class	I	(Source side of object to film distance	0.625 "	Weld Reinforcement	0.125 "
Film Size	3 1/2 X 17	at min. S.T.O)		Total Pene. Thickness	0.625 "

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Density	Discontinuities	Accept	Reject
1	DCA1 W1	T - 2	1		BF	X														✓	
2		2 - 3																		✓	
3		3 - T																		✓	
4	DCA1 W2	T - 2																		✓	
5		2 - 3																		✓	
6		3 - T																		✓	
7	DCA1 W3	T - 2																		✓	
8		2 - 3																		✓	
9		3 - T																		✓	
10	DCA1 W4	T - 2																		✓	
11		2 - 3																		✓	
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RADIOGRAPHER *Chris Burgett* Lev. II

INTERPRETER; ACCEPTANCE; NDT LEVEL: Lev. II Date: 3-3-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

CUSTOMER: *AMERICAN PIPING INSPECTION*
Code: *ASME SEC VIII*
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-B
Date 3/3/2017
Page 1 **Page** 1
No. of Radiographs: **Original Film** 12 **Rep. Film**

Source	Ir192 ■ Co60 ☐	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	94	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.146	Source to Film	4.313 "	Mat. Type	P1
Film Type	Fuji- 80	Minimum Source to Object	3.688 "	Mat. Thickness	0.500
Film Class	I	(Source side of object to film distance	0.625 "	Weld Reinforcement	0.125 "
Film Size	3 1/2 X 17	at min. S.T.O)		Total Pene. Thickness	0.625 "

No. of film J	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Density	Discontinuities	Accept	Reject
1	DCA2 W5	T - 2	1		BF	X														✓	
2		2 - 3																		✓	
3		3 - T																		✓	
4	DCA2 W6	T - 2																		✓	
5		2 - 3																		✓	
6		3 - T																		✓	
7	DCA2 W9	T - 2																		✓	
8		2 - 3																		✓	
9		3 - T																		✓	
10	DCA2 W10	T - 2																		✓	
11		2 - 3																		✓	
12		3 - T																		✓	
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RADIOGRAPHER *Chris Burgett* Lev. II

INTERPRETER; ACCEPTANCE; NDT LEVEL: Lev. LII Date: 3-6-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

CUSTOMER: *AMERICAN PIPING INSPECTION*
Code: *ASME SEC VIII*
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-B
Date 3/17/2017
Page 1 **Page** 1
No. of Radiographs: Original Film 6 **Rep. Film**

Source	Ir192 ■ Co60 □	Dev. Process: Man. □ Auto ■		Unsharpness	<.020
Curies	52	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.146	Source to Film	8.625 "	Mat. Type	P1
Film Type	Fuji- 80	Minimum Source to Object	8.000 "	Mat. Thickness	0.500
Film Class	I	(Source side of object to film distance	0.625 "	Weld Reinforcement	0.125 "
Film Size	3 1/2 X 17	at min. S.T.O)		Total Pene. Thickness	0.625 "

J/T

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Density	Discontinuities	Accept	Reject
1	DC2A W7	T - 2	1		BF	X														✓	
2		2 - 3																		✓	
3		3 - T																		✓	
4	DC2A W8	T - 2																		✓	
5		2 - 3																		✓	
6		3 - T																		✓	
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RADIOGRAPHER *Chris Burgett* Lev. II

INTERPRETER; ACCEPTANCE; NDT LEVEL: Lev. II Date: 3-18-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

	Advanced Inspection Technologies	**Job No.**	70699-B
Code:	***ASME SEC VIII***	**Date**	3/6/2017
Spec.:	UW 51 100% RADIOGRAPHY	**Page**	1 Page 1
		No. of Radiographs:	**Original Film** 3 Rep. Film

Source	Ir192 ■ Co60 ☐	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	92	RT Technique	DWR/SWV	Screens	Pb. .010
Focal Spot	0.146	Source to Film	2.375 "	Mat. Type	P1
Film Type	Fuji- 29	Minimum Source to Object	1.907 "	Mat. Thickness	0.343
Film Class	I	(Source side of object to film distance	0.468 "	Weld Reinforcement	0.125 "
Film Size	70mm X 6	at min. S.T.O)		Total Pene. Thickness	0.468 "

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Density	Discontinuities	Accept	Reject
1	DCA2 W11	T - 2	1		BF	X														✓	
2		2 - 3																		✓	
3		3 - T																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETER; ACCEPTANCE; NDT LEVEL: Lev. II Date: 3-7-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

AMERICAN PIPING INSPECTION

Code: ASME SEC VIII DIV 1
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-B
Date 4/27/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 19 **Rep. Film**

Source	Ir192 ☐ Co60 ■	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	115	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.212	Source to Film	41.500 "	Mat. Type	P1
Film Type	Fuji- 100	Minimum Source to Object	39.000 "	Mat. Thickness	2.375
Film Class	II	(Source side of object to film distance	2.500 "	Weld Reinforcement	0.125 "
Film Size	7 X 17	at min. S.T.O)		Total Pene. Thickness	2.500 "

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No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Densities	Discontinuity	Accept	Reject
1	G1	1 - 2	1		C	X														✓	
2		2 - 3																		✓	
3		3 - 4																		✓	
4		4 - 5																		✓	
5		5 - 6																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETATION / ACCEPTANCE BY Lev. II Date: 4-28-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

AMERICAN PIPING INSPECTION

Code: ASME SEC VIII DIV 1
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-B
Date 4/26/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 19 **Rep. Film**

Source	Ir192 ☐ Co60 ■	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	115	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.212	Source to Film	41.500 "	Mat. Type	P1
Film Type	Fuji- 100	Minimum Source to Object	39.000 "	Mat. Thickness	2.375
Film Class	II	(Source side of object to film distance	2.500 "	Weld Reinforcement	0.125 "
Film Size	7 X 17	at min. S.T.O)		Total Pene. Thickness	2.500 "

55/2

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Densities	Discontinuity	Accept	Reject
1	G2	1 - 2	1		C	X														✓	
2		2 - 3																		✓	
3		3 - 4																		✓	
4		4 - 5																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETATION / ACCEPTANCE BY James J Shanahan Lev. II Date: 4-27-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

AMERICAN PIPING INSPECTION

Code: ASME SEC VIII DIV 1
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-B
Date 4/26/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 19 **Rep. Film**

Source	Ir192 ☐ Co60 ■	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	115	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.212	Source to Film	41.500 "	Mat. Type	P1
Film Type	Fuji- 100	Minimum Source to Object	39.000 "	Mat. Thickness	2.375
Film Class	II	(Source side of object to film distance	2.500 "	Weld Reinforcement	0.125 "
Film Size	7 X 17	at min. S.T.O)		Total Pene. Thickness	2.500 "

55/N

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Densities	Discontinuity	Accept	Reject
1	G3	1 - 2	1		C	X														✓	
2		2 - 3																		✓	
3		3 - 4																		✓	
4		4 - 5																		✓	
5		5 - 6																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETATION / ACCEPTANCE BY James Johnson Lev. II Date: 4-27-17

Boardman, LLC.

Identification & Interpretation of Radiographic Indicators

AMERICAN PIPING INSPECTION

Code: ASME SEC VIII DIV 1
Spec.: UW 51 100% RADIOGRAPHY

Job No. 70699-B
Date 5/3/2017
Page 1 Page 1
No. of Radiographs: **Original Film** 19 **Rep. Film**

Source	Ir192 ☐ Co60 ■	Dev. Process: Man. ☐ Auto ■		Unsharpness	<.020
Curies	115	RT Technique	SWR/SWV	Screens	Pb. .010
Focal Spot	0.212	Source to Film	41.500 "	Mat. Type	P1
Film Type	Fuji- 100	Minimum Source to Object	39.000 "	Mat. Thickness	2.375
Film Class	II	(Source side of object to film distance	2.500 "	Weld Reinforcement	0.125 "
Film Size	7 X 17	at min. S.T.O)		Total Pene. Thickness	2.500 "

55/cc

No. of film	Seam No.	Film No.	No. Of Film per cass.	Composite Film	Pentrameter(s)	Shim or Block	Surface Defects	Rounded Indication(s)	Slag Inclusions	Crack(s)	Incomplete Fusion	Incomplete Penetration	Tungsten Incl.	Undercut	Burn Through	Concavity	Film Artifacts	Densities	Discontinuity	Accept	Reject
1	G4	1 - 2	1		C	X														✓	
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3		3 - 4																		✓	
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RADIOGRAPHER Chris Burgett Lev. II

INTERPRETATION / ACCEPTANCE BY Lev. II Date: 5-4-17

BOARDMAN

JOB NO. 70699-B	Contract #	PO: 4500754152		DATE: 5/19/2017
INSPECTOR: BILLY SKILES		JOB NAME: MOL SIEVE DEHYDRATOR		
Description of Work: BLAST AND PAINT		ITEM # V-443	PROJECT: # J447XX	
SPECIFICATION: SSPC-SP10	1.5 - 3 MILS DFT			

PREBLAST

INSPECT FOR WELD SPLATTER, SHARP EDGES					
INSPECT FOR SURFACE GREASE & OILS					

Testex PRESS-O-FILM™ HT X-Coarse
www.testextape.com
2.5
C 20 | (C+XC)/2 38 | XC 64 | 115 µm
0.8 | 1.5 | 2.5 | 4.5 mil
1.5 to 4.5 mil
38 to 115 µm
Made in USA

BLASTING			PAINTING		
					PRIMER
COMPRESSED AIR CLEANLINESS	ok		PAINT type	zinc clad	
ANCHOR PATTERN	2		brand	sherwin williams	
SURFACE TEMPERATURE	53		batch #	6303234	
AMBIENT TEMPERATURE	53		pot life	8 hours	
RELATIVE HUMIDITY	77%		THINNER type	n/a	
WORKPLACE CLEANED OF SAND & DUST	ok		brand	n/a	
DEW POINT	42		SURFACE TEMPERATURE		53
			AMBIENT TEMPERATURE		53
			RELATIVE HUMIDITY		77%
			DRY FILM THICKNESS		2
			DEW POINT		42

Testex PRESS-O-FILM™ HT X-Coarse
www.testextape.com
2.0
C 20 | (C+XC)/2 38 | XC 64 | 115 µm
0.8 | 1.5 | 2.5 | 4.5 mil
1.5 to 4.5 mil
38 to 115 µm
Made in USA

Testex PRESS-O-FILM™ HT X-Coarse
www.testextape.com
2.0
C 20 | (C+XC)/2 38 | XC 64 | 115 µm
0.8 | 1.5 | 2.5 | 4.5 mil
1.5 to 4.5 mil
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2.5
C 20 | (C+XC)/2 38 | XC 64 | 115 µm
0.8 | 1.5 | 2.5 | 4.5 mil
1.5 to 4.5 mil
38 to 115 µm
Made in USA

QC BOARDMAN, LLC.

BOARDMAN

JOB NO.	70699-B	Contract #	PO: 4500754152		DATE: 5/20/2017
INSPECTOR:	BILLY SKILES	JOB NAME:	MOL SIEVE DEHYDRATOR		
Description of Work:	TOP COAT	ITEM #	V-443	PROJECT: #	J447XX

SPECIFICATION: 2 - 4 MILS ZINC 1 - 2 MILS ALUMINUM

PREBLAST

INSPECT FOR WELD SPLATTER, SHARP EDGES		
INSPECT FOR SURFACE GREASE & OILS		

BLASTING		PAINTING	ZINC	ALUMINUM
COMPRESSED AIR CLEANLINESS	N/A	PAINT type	hi-temp aluminum	
ANCHOR PATTERN	N/A	brand	sherwin williams	
SURFACE TEMPERATURE	N/A	batch #	600201032	
AMBIENT TEMPERATURE	N/A	pot life	8 hours	
RELATIVE HUMIDITY	N/A	THINNER type	n/a	
WORKPLACE CLEANED OF SAND & DUST	N/A	brand	n/a	
DEW POINT	N/A	SURFACE TEMPERATURE		71
		AMBIENT TEMPERATURE		71
		RELATIVE HUMIDITY		42%
		DRY FILM THICKNESS		1.5
		DEW POINT		45

QC, BOARDMAN, LLC.

Top and Bottom Heads MK 1-1

QM-System: Certification as per ISO 9001

DILLINGER HÜTTE

Erläuterungen siehe Rückseite/Explications voir au verso/See reverse for explanations (www.dillinger.de/certificate)

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004
INSPECTION CERTIFICATE 3.1 AS PER ISO 10474:2013
MATERIAL TEST REPORT (MTR)

A10 Advice of dispatch No./ Date of dispatch: 525222-24.03.15

A08/ A03 Manufacturer's order/ Certificate No.: 401717-002 Sheet: 1/...

A05 Established inspecting body: DH

A06 Purchaser: EDMONTON STEEL, EDMON A07.1 No. ED10664-J1010ER

Final receiver: EDMONTON STEEL, EDMON A07.2 No.

B01 Product: HEAVY PLATES

19728

B02/ Steel design. SA516-70 SA20-S5

B03 Any suppl. requirements ASME-IIA:2013
DIL-HUE-16:R23-2014-04-04

B01-B99 Description of the product

B14 Item No.	B08 Number of pieces	B09 Thickness	B10 Width	B11 Length	B12 Theoretical mass KG	B04 Product delivery condition	B07.2 Heat No.	B07.1 Rolled plate No./ Test No.	A09 Purchaser article number
			INCH						
01	1	2,5000 x	97,00000 x	482,00000	15036	N	418124	73722-01	
02	1	2,5000 x	121,00000 x	482,00000	18756	N	418120	73571-01	
02	1	2,5000 x	121,00000 x	482,00000	18756	N	418120	73572-01	
**	2				37512				
***	3				52548				

RECEIVED
FEB 13 2017
ZUS
SEESE

B04 Product delivery condition

ITEM NO.: 01-02
N: HT: 1670 GR.F +36 -27 GR.F
SOAKING TIME TO ATTAIN THE TARGET TEMPERATURE OVER THE WHOLE SECTION: 1-1,75 MIN/MM (25-45 MIN/INCH)
COOLING IN STILL AIR

B06 Marking of the product

ITEM NO.: 01-02
STEEL DESIGNATION SA516 70 MTLTV SA516 60 MTLTV
HEAT NO. / TRADEMARK / ROLLED PLATE NO.-TEST NO. / INSPECTOR'S STAMP

B07-B99 Further information about the product

ITEM NO.: 01-02
THICKNESS REDUCTION RATIO >= 3,0 IS EULFILLED (CF. A/SA20 PAR. 5.3)

A04 D H Manufacturer's mark

Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

B. BALDAUF
Test House Manager

AHB Inspector's stamp

A01 AG der Dillinger Hüttenwerke
Postfach 1580, D-66748 Dillingen/Saar
Inspection department

Date 24.03.15 PP 1

Top 4

Top and Bottom Heads MK 1-2 2 of 4

QM-System: Certification as per ISO 9001

DILLINGER HÜTTE

Erläuterungen siehe Rückseite/Explications voir au verso/See reverse for explanations (www.dillinger.de/certificate)

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1 AS PER ISO 10474:2013 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 525222-24.03.15	A08/ Manufacturer's order/ A03 Certificate No. 401717-002 Sheet 2/...
A05 Established inspecting body DH	A06 Purchaser Final receiver EDMONTON STEEL, EDMON EDMONTON STEEL, EDMON	A07.1 No. ED10664-J1010ER A07.2 No.	B01 Product HEAVY PLATES
B02/ Steel design. SA516-70 SA20-S5 B03 Any suppl. requirements ASME-IIA:2013 DIL-HUE-16:R23-2014-04-04			

RECEIVED
FEB 1 9 2017
AVS
2 SEESE

C10-C29 Tensile test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/ C01	C03 Temp. GR.F	C10 KSI RP02	C11 RM	C12	C13 A % L0=2IN	C14-C15
01	418124	73722		K1	QV	RT	49,6	74,8		36	
02	418120	73571		K1	QV	RT	50,5	75,7		35	
02	418120	73572		K1	QV	RT	48,4	75,5		36	

C30-C39 Hardness test

B14 Item. No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/C01	C03 Temp. GR.F	C30 Method of test	C35	C31 Individual values			C32 Mean value
01	418124	73722		K1	O	RT	HBW 10/3000	HB	145	146	146	146
02	418120	73571		K1	O	RT	HBW 10/3000	HB	142	143	143	143
02	418120	73572		K1	O	RT	HBW 10/3000	HB	142	141	141	141

C40-C49 Impact test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/ C01	C03 Temp. GR.F	C41 Width of test piece	C40 Type of test piece	C44 Testing method	C46 Energy	C45	C42 Individual values AV=FT.LBF			C43 Mean value
01	418124	73722		K1	LV	-51		CHP-V			AV	8 119	114	50	94
02	418120	73571		K1	LV	-51		CHP-V			AV	8 44	105	111	87
02	418120	73572		K1	LV	-51		CHP-V			AV	8 127	94	108	110

C70-C99 Chemical composition % - Heat analysis

B07.2 Heat	C70	C	SI	MN	P	S	N	CU	MO	NI	CR	V	NB	SN	TI
418120	Y	0,182	0,383	1,18	0,010	0,0011	0,0082	0,016	0,004	0,020	0,220	0,001	0,000	0,002	0,003
418124	Y	0,175	0,385	1,18	0,009	0,0008	0,0052	0,017	0,008	0,026	0,220	0,001	0,001	0,001	0,002

A04 Manufacturer's mark

Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

B. BALDAUF
Test House Manager

Inspector's stamp

A01
AG der Dillinger Hüttenwerke
Postfach 1580, D-66748 Dillingen/Saar
Inspection department

Date 24.03.15 PP 1

Top and Bottom Heads - MK1-1

3 of 4

QM-System: Certification as per ISO 9001

DILLINGER HÜTTE

Erläuterungen siehe Rückseite/Explications voir au verso/See reverse for explanations (www.dillinger.de/certificate)

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004
INSPECTION CERTIFICATE 3.1 AS PER ISO 10474:2013
MATERIAL TEST REPORT (MTR)

A10 Advice of dispatch No./ Date of dispatch: 525222-24.03.15

A08/ Manufacturer's order/ A03 Certificate No.: 401717-002 Sheet: 3/...

A05 Established Inspecting body: DH

A06 Purchaser: EDMONTON STEEL, EDMON A07.1 No. ED10664-J1010ER

Finel receiver: EDMONTON STEEL, EDMON A07.2 No.

B01 Product: HEAVY PLATES

B02/ Steel design.: SA516-70 SA20-S5

B03 Any suppl. requirements: ASME-IIA:2013
DIL-HUE-16:R23-2014-04-04

C70-C99 Chemical composition % - Heat analysis

B07.2 Heat	C70	B	CA	AL-T
418120	Y	0,0002	0,0021	0,032
418124	Y	0,0000	0,0016	0,034

C94 Heat analysis Carbon equivalent / Alloying restrictions

B07.2 Heat										
418120	FO-02=	0,43	FO-51=	0,001	FO-55=	0,26	FO-78=	0,22	FO-91=	6,5
418124	FO-02=	0,42	FO-51=	0,002	FO-55=	0,27	FO-78=	0,23	FO-91=	6,7

C95 Ladle treatment

ITEM NO.: 01-02
HEAT OF THE INDICATED ITEM: VACUUM DEGASSED / SULPHIDE SHAPE CONTROL

C95 Further information about ladle treatment

ITEM NO.: 01-02
CALCIUM TREATED

C70-C99 Chemical composition % - Product analysis

B07.2 Heat	B07.1 Test No.	C01	C	SI	MN	P	S	N	CU	MO	NI	CR	V	NB	SN	TI
418120	73575	K1	0,180	0,375	1,17	0,008	0,0011	0,0069	0,014	0,004	0,020	0,213	0,000	0,000	0,001	0,002
418124	73722	K1	0,171	0,379	1,19	0,009	0,0006	0,0051	0,023	0,011	0,032	0,206	0,000	0,001	0,000	0,002

B07.2 Heat	B07.1 Test No.	C01	B	CA	AL-T
418120	73575	K1	0,0000	0,0020	0,031
418124	73722	K1	0,0000	0,0011	0,041

A04 Manufacturer's mark: D H

Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

B. BALDAUF
Test House Manager

A H B
Inspector's stamp

A01 AG der Dillinger Hüttenwerke
Postfach 1580, D-66748 Dillingen/Saar
Inspection department

Date 24.03.15 PP 1

Top and Bottom Heads MK1-1

4 of 4

QM-System: Certification as per ISO 9001

DILLINGER HÜTTE

Erläuterungen siehe Rückseite/Explications voir au verso/See reverse for explanations (www.dillinger.de/certificate)

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1 AS PER ISO 10474:2013 MATERIAL TEST REPORT (MTR)	A10 Advice of dispatch No./ Date of dispatch 525222-24.03.15	A08/ Manufacturer's order/ A03 Certificate No. 401717-002	Sheet 4
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON	A07.1 No. ED10664-J1010ER	B01 Product HEAVY PLATES
	Final receiver EDMONTON STEEL, EDMON	A07.2 No.	
B02/ Steel design. SA516-70 SA20-S5 B03 Any suppl. requirements ASME-IIA:2013 DIL-HUE-16:R23-2014-04-04			

C94 Product analysis Carbon equivalent / Alloying restrictions

B07.2 Heat	B07.1 Test No.	C01				
418120	73575	K1	FO-02=	0,42	FO-55=	0,25
418124	73722	K1	FO-02=	0,42	FO-55=	0,27

C94 Carbon equivalent formula / Alloying restrictions

FO-02 = C+(MN/6)+(CR+MO+V)/5+(NI+CU)/15
FO-51 = V +NB
FO-55 = CU+MO+NI+CR
FO-78 = CR+MO
FO-91 = MN/C

D01 Marking and identification, surface appearance, shape and dimensional properties

ITEM NO.: 01-02
EXAMINATION OF MARKING, SURFACE, SHAPE AND DIMENSIONS: THE RESULTS MEET THE REQUIREMENTS.

SURFACE	AS PER ASME-SA20
THICKNESS	AS PER ASME-SA20
LENGTH AND WIDTH	AS PER ASME-SA20
FLATNESS	AS PER 1/2-ASME-SA20

EDMONTON EXCHANGER MTR APPROVED

A04 D H Manufacturer's mark

Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

B. BALDAUF
Test House Manager

AHB Inspector's stamp

Date 24.03.15

AG der Dillinger Hüttenwerke
Postfach 1580, D-66748 Dillingen/Saar
Inspection department

A01

PP 1

FORM U-2A MANUFACTURER'S PARTIAL DATA REPORT (ALTERNATIVE 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 P & M Industries, Inc. 4450 South Mingo Tulsa OK 74146-4703 USA
(Name and address of Manufacturer)

2. Manufactured for American Alloy Steel, Inc. 6350 North Erie Ave. Tulsa, OK 74117
(Name and address of Purchaser)

3. Location of installation Unknown
(Name and address)

4. Type Rolled & welded cylinder | 1701033-4 thru 6 | N/A
[Description of vessel part (shell, two-piece head, tube bundle)] | (Manufacturer's serial number) | (CRN)

N/A | N/A | P & M Industries, Inc. | 2017
(National Board number) | (Drawing number) | (Drawing prepared by) | (Year built)

5. ASME Code, Section VIII, Div. 1 2015 Edition | N/A | None
[Edition and Addenda, if applicable (date)] | (Code Case number) | [Special service per UG-120(d)]

6. Shell: (a) Number of course(s) 1 (b) Overall length 8'-0"

Course(s)			Material	Thickness		Long. Joint (Cat. A)			Circum. Joint (Cat. A, B & C)			Heat Treatment	
No.	Diameter	Length	Spec./Grade or Type	Nom.	Corr.	Type	Full, Spot, None	Eff.	Type	Full, Spot, None	Eff.	Temp.	Time
1	78" ID	8'-0"	SA516-70NORM	2-3/8"	N/A	1	Full	*	-	-	-	None	None
2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-

Body Flanges on Shells

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

7. Heads: (a) None (b) None
(Material spec. number, grade or type) (H. T. - time and temp.) | (Material spec. number, grade or type) (H. T. - time and temp.)

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min.	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot, None	Eff.
(a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(b)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Body Flanges on Heads

									Bolting			
	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Num & Size	Bolting Material	Washer (OD, ID, thk)	Washer Material
(a)	-	-	-	-	-	-	None	-	-	-	-	-
(b)	-	-	-	-	-	-	-	-	-	-	-	-

8. MAWP - (Internal) - (External) at max. temp. - (Internal) - (External) . Min. design metal temp. - at - .

9. Impact test Yes at test temperature of -20 Deg F .
[Indicate yes or no and the component(s) impact tested]

10. Hydro., ~~pneu.~~, ~~or~~ ~~comb.~~ test pressure - Proof test -

11. 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	
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-

12. Identification of part(s)

Name of Part	Quantity	Line No.	Mfr's. Identification No.	Mfr's. Drawing No.	CRN	National Board No.	Year Built
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

13. Supports: Skirt No (Yes or no) Lugs None (Number) Legs None (Number) Other None (Describe) Attached - (Where and how)

14. Remarks WPS Qualifed With & Without PWHT, No Design Calculations Performed

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. 25978 Expires 11/25/18

Date 3-31-17 Name P & M Industries, Inc. (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 OneCIS Insurance Co. of Lynn, MA have inspected the pressure vessel part described in this Manufacturer's Data Report on 3-31-17 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 3-31-17 Signed G. Stout (Authorized Inspector) Commissions NB, 8432-A [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 P & M Industries, Inc. 4450 South Mingo Tulsa OK 74146-4703 USA
(Name and address of Manufacturer)

2. Manufactured for American Alloy Steel, Inc. 6350 North Erie Ave. Tulsa, OK 74117
(Name and address of Purchaser)

3. Location of installation Unknown
(Name and address)

4. Type Rolled & Welded Cylinder (Horizontal, vertical, or sphere) | Unknown (Tank, separator, heat exch., etc.) | 1701033-4 thru 6 (Manufacturer's serial number)

N/A (CRN) | N/A (Drawing number) | N/A (National Board Number) | 2017 (Year built)

Data Report Item Number	Remarks
#14	Meets Requirements of ASME Section VIII Div 1, UG-79, UCS-79, UG-80
#14	*RT per UW-11(a)
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-

Certificate of Authorization: Type U No. 25978 Expires 11/25/18

Date 3-31-17 Name P & M Industries, Inc. (Manufacturer) Signed (Representative)

Date 3-31-17 Name (Authorized Inspector) Commissions NB. 8432 [National Board (incl. endorsements)]

P & M INDUSTRIES INC.
4450 S. MINGO TULSA, OK 74146-4703
P O BOX 471069 TULSA, OK 74147-1069

INSPECTION REPORT - SHELLS

S/O# 1701033
DATE 1-2-3 3/29/17 4-5-6 3/31/17

CUSTOMER P.O.# Am Quon 110424-OK
~~JOB~~/TAG # 70699

DESCRIPTION	P&M PF U2A S/N	HEAT #	DIMENSIONS				ROUNDNESS
			CIRCUMFERENCE	ID/OD	THICKNESS	LENGTH	
2 3/8 x 78" ID x 96	1701033-1	S22952 06B	21'-8 1/4"	78 1/16"		96"	W/N 1/8"
do	-2	S22952 08B	21'-8 1/4"	78 1/16"		96 1/8"	
do	-3	S22947 07C1	21'-8 1/8"	78"		96"	
do	-4	S22907 04B4	21'-8 3/16"	78 1/16"		95 15/16"	W/N 1/8"
do	-5	S22952 06A	21'-8 1/8"	78"		96"	
do	-6	S22952 08A	21'-8 1/4" 21'-8 3/16"	78 1/16"		95 15/16"	

PART CERT BY:
P&M IND INC
SER 1701033
BUILT 2017
JSW
S2290T
04B
SA516-70M
PO 110427-0K
TAG 170699

U

PART CERT BY

P&M IND. INC

SER 170133-6

BUILT 2017

J.S.W.

S22952

08A

SA516-70N

PO 110424-0K

TAG 70699

(U)
PART CERT BY
P&M IND. INC.
SER 170103-3
BUILT 2017
JSW
S2295Z
06A
SA516-70N
PO 1625-0K
TAG 70699

P & M INDUSTRIES INC.

4450 S. MINGO
TULSA, OK 74146-4703
918-660-0055

P.O. BOX 471069
TULSA, OK 74147-1069
FAX 918-660-0595

SERVICE IS OUR PRODUCT

RT DATE 3-27-17
ORIGINAL FILM X REPAIR
CUSTOMER AmBuoy
CUSTOMER PO 110424-OK

RADIOGRAPHIC TESTING DATA AND REVIEW REPORT

SHOP ORDER NUMBER 1701033 | MATERIAL SA516-70N | THICKNESS-BM 2 3/8 | REINFORCEMENT 5/32 | WELD 2 17/32
RT QUALITY SPEC - ASME SECTION V, ARTICLE 2 | FILM MANUFACTURER FUJI | TYPE 100 | SIZE 7X17
RT REQUIREMENTS (RT 1) RT 2 RT 3 | #FILM PER CASSETTE 1
ACCEPTANCE CRITERIA ASME SECT VIII, DIV 1 (UW 51) UW 52 | FILTER | Pb BACKING
X-RAY MACHINE | ISOTOPE Co60
Kv Ma | CIS 70
EFF DIMENSION .218

SCREENS		PROCESSING		
FRONT	BACK	MAN-6BF	AUTO	TEMP
.005	.010		X	30C

Seam Number	View #	# of Exposures SW= Single wall DW= Double Wall	Viewing SW= Single wall DW= Double Wall	Penetrameter Size (IQI) Selection	Source to weld distance	Source side of weld to film	UG (if req'd)	Exposure time (if req'd)	Densities	Lack of Penetration	Gas Porosity	Lack of Fusion	Undercut	Slag Inclusion	Crack	Remarks	Acceptable	Reject
LS-1	1-2	1SW	SW	1C	22 3/8"	2 17/32											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	
		"	"	"	"	"												
LS-2	1-2	"	"	"	"	"											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	
		"	"	"	"	"												
LS-3	1-2	"	"	"	"	"											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	
		"	"	"	"	"												
LS-4	1-2	"	"	"	"	"											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	

Capital X-Ray Tech Mike McKeown II Level: II Date 3-27-17
P & M Interpretation Level: II Date (1-2-3/3-29-17)(4/3-30-17)
Client Rep Date

P & M INDUSTRIES INC.

4450 S. MINGO TULSA, OK 74146-4703 918-660-0055
P.O. BOX 471069 TULSA, OK 74147-1069 FAX 918-660-0595

SERVICE IS OUR PRODUCT

RT DATE 3-29-17
ORIGINAL FILM X REPAIR
CUSTOMER Am Nucy
CUSTOMER PO 110424-OK

RADIOGRAPHIC TESTING DATA AND REVIEW REPORT

SHOP ORDER NUMBER 1701033 | MATERIAL SA516-70N | THICKNESS-BM 2 3/8 | REINFORCEMENT 5/32 | WELD 2 17/32
RT QUALITY SPEC - ASME SECTION V, ARTICLE 2 | FILM MANUFACTURER Fuji | TYPE 100 | SIZE 7X17
RT REQUIREMENTS (RT 1) RT 2 RT 3 | #FILM PER CASSETTE 1
ACCEPTANCE CRITERIA ASME SECT VIII, DIV 1 (UW 51) UW 52 | FILTER | Pb BACKING
X-RAY MACHINE | ISOTOPE Co60
Kv Ma | CIS 70
EFF DIMENSION .218

SCREENS: FRONT .005 | BACK .010
PROCESSING: MAN-6BF | AUTO X | TEMP 30C

Seam Number	View #	# of Exposures SW= Single wall DW= Double Wall	Viewing SW= Single wall DW= Double Wall	Penetrameter Size (IQI Selection	Source to weld distance	Source side of weld to film	UG (If req'd)	Exposure time (If req'd)	Densities	Lack of Penetration	Gas Porosity	Lack of Fusion	Undercut	Slag Inclusion	Crack	Remarks	Acceptable	Reject
LS-5	1-2	1 SW	SW	LC	22 1/8	2 17/32											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	
LS-6	1-2	"	"	"	"	"											✓	
	2-3	"	"	"	"	"											✓	
	3-4	"	"	"	"	"											✓	
	4-5	"	"	"	"	"											✓	
	5-6	"	"	"	"	"											✓	
	6-7	"	"	"	"	"											✓	
	7-8	"	"	"	"	"											✓	

Capital X-Ray Tech [signature] Level: II Date 3-29-17
P & M Interpretation Level: II Date
Client Rep Date

Page ____ of ____

METALLURGICAL SERVICES, L.L.C.
10982 W. 71st Street South
P.O. Box 908 • Sapulpa, OK 74067
Phone: 918-224-7221 •Fax: 918-224-7231

Lab No. 17-24010
Page 1 of 1
P.O.

Mechanical Test Report

Organization P & M INDUSTRIES **Contact** MARK PARKER

Address 4450 S MINGO RD. TULSA, OK. 74146

Base Metal Type SA516-70N HT: **TO** SA516-70N

Coupon Thickness 2-1/4" **PWHT** 3 HRS. @ 1150 DEG. F.

WPS No. A1087 CIT REV. 2 **PQR No.** N/A

Weld Process SAW **Filler** N/A

Welder's Name N/A **I.D. No.** N/A

Bends

Specimen Number	Bend Type	Results / Comments
1	NONE	
2		
3		
4		

Tensile Tests

Specimen Number	Specimen Size	Specimen Area sq. in.	Load at Failure PSI	Yield 2% offset PSI	Ultimate Tensile PSI	Break Location	Percent Elongation in 2 inches
1	NONE x						
2	x						
3	x						
4	x						

Hardness In BHN

Material 1			Heat Affected Zone			Weld Metal		
1	2	3	1	2	3	1	2	3
NONE								

Material 2			Heat Affected Zone		
1	2	3	1	2	3

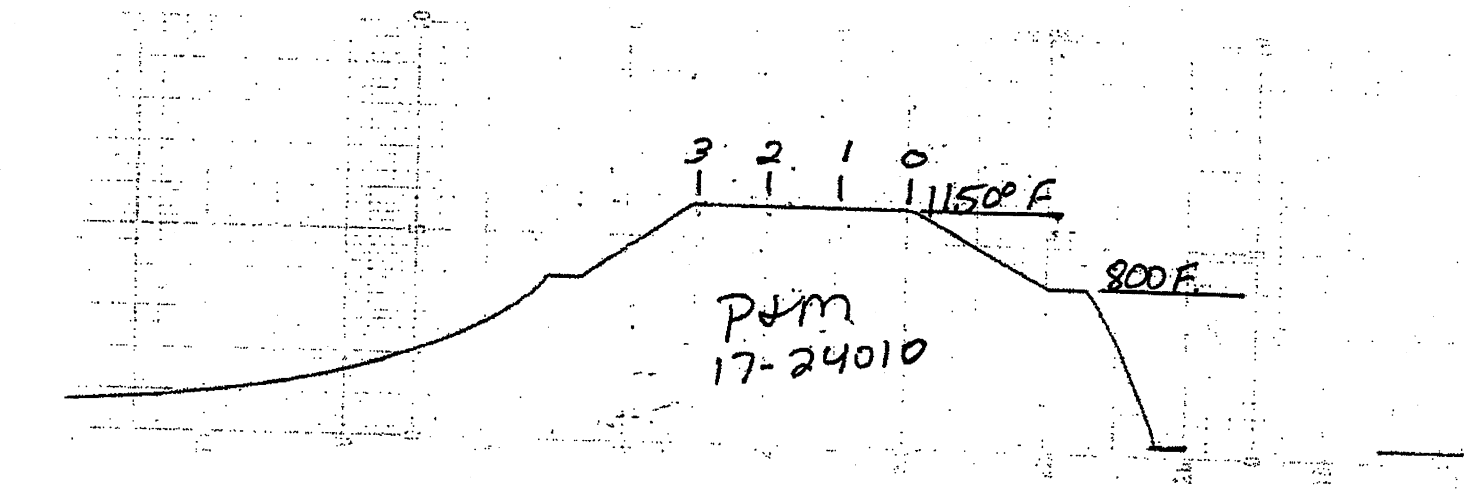
Charpy V-Notch Impact Testing

Specimen Number	Specimen Type	Specimen Size	Temp. F.	Value Ft./Lbs.	Lateral Expansion	Percent Shear
1	WM	10mm x 10mm	-20º F	50	44	20
2	WM	10mm x 10mm	-20º F	48	42	20
3	WM	10mm x 10mm	-20º F	54	49	20
4	CENTER WM	10mm x 10mm	-20º F	60	52	20
5	CENTER WM	10mm x 10mm	-20º F	56	46	20
6	CENTER WM	10mm x 10mm	-20º F	58	46	20
7	HAZ-CAP	10mm x 10mm	-20º F	80	67	40
8	HAZ-CAP	10mm x 10mm	-20º F	82	70	40
9	HAZ-CAP	10mm x 10mm	-20º F	79	65	40
10	HAZ-ROOT	10mm x 10mm	-20º F	85	73	40
11	HAZ-ROOT	10mm x 10mm	-20º F	81	69	40
12	HAZ-ROOT	10mm x 10mm	-20º F	83	70	40

OTHER TESTS PERFORMED: NONE

All tests performed in accordance to methods specified in ASME SA-370 & ASTM A-370.

Signature Kevin E. Stanley Jr. Date 1/12/2017


3
2
1
0
1150° F
800 F
P&M
17-24010

561259-2

Shell MK1-2

03/31/2017 From:AMERICAN ALLOY STEEL, INC. To: BOARDMAN, INC
P.O.#: 00608303 S.O.#: 561259 AA PL#: 561259-2
Item: 2 (1 PC) 2-3/8" X CYL 78" ID X 96" X 96" X 260"

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

METALLURGICAL TEST REPORT

MET - 05
2/6/2017

Bulletin	Order Item	Heat	PO No.	Shipping Mode		Order Dimensions	Slab Origin	TC No.
T010642	JSW07233-01	S22907	110425-OK-SD	TRUCK		2.375x96x260		T010642-2907-1

Special Instructions

Plates Certified for the Following grades	Specifications	Marking Instructions
ASME-SA516-70 PN LCVN 2015 EDITION	"PLATE NORMALIZED AT 1650 °F FOR 71 MINS."	Stencil in 2 location(s): X Loc. 18 Y Loc. 30; CUST; MADEINUSA PN PO; DIM GRADE; FREIGHT ORDERITEM PLATEID SHIPWEEK SLABID TRANSMODE Stamp in 2 location(s); X Loc. 18 Y Loc. 12; Slab ID; Slab ID; Slab ID
Hot Rolled Carbon Steel Plates Plates Manufactured in the USA		

Sold To: AMERICAN ALLOY STEEL INC. 6230 NORTH HOUSTON - ROSSLYN HOUSTON, TX 77091
Ship To: AMERICAN ALLOY 4450 S MINGO TULSA, OK 74146

Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Nb	Ca	CE
LADLE	0.23	1.15	0.007	0.002	0.19	0.006	0.003	0.017	0.000	0.000	0.035	0.0034	0.006	0.0002	0.002	0.003	0.0025	0.43

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

Plate	Slab Identity	Gauge Tested	Test Cond	Test Dir.	Yield Point	Tensile Stgth.	Elong in 2"	YS/UTS Ratio	Yield Strenght Determind At	Charpy Impact Test (LCVN) Full Energy in FULb °F								
										Temp	Test1	Test2	Test3	Avg	Test1	Test2	Test3	Avg
1026582A	0484	2.3750	PN	T	44	76	30.0%	0.58	0.2%	-20	100	60	105	88				

Plates Certified For The Above Tests

Material	Thick(IN)	Width (IN)	Len(IN)	Wgt(LB)	Material	Thick(IN)	Width(IN)	Len (IN)	Wgt(LB)	Material	Thick(IN)	Width(IN)	Len(IN)	Wgt(LB)
1026582A	2.3750	96.000	260.00	16812										

RECEIVED
MAR 31 2017
Dawson

MTR CERTIFIED 2-15-17
P & M INDUSTRIES, INC.
2-1701033

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
J.L 3/21/17

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

Jackie Tamayo 281-383-5326 Jackie.Tamayo@jswsteel.us

03/31/2017 From:AMERICAN ALLOY STEEL, INC. To: BOARDMAN, INC
P.O.#: 00608303 S.O.#: 561259 AA PL#: 561259-3
Item: 3 (2 PC) 2-3/8" X CYL 78" ID X 96" X 96" X 260"

Shell MK1-3

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

METALLURGICAL TEST REPORT

MET - 05
1/30/2017

Bulletin	Order Item	Heat	PO No.	Shipping Mode		Order Dimensions	Slab Origin	TC No.
T010521	JSW07233-01	S22852	110425-OK-SD	TRUCK		2.375x96x260		T010521-2952-1

Special Instructions

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

Sold To: AMERICAN ALLOY STEEL INC. 6230 NORTH HOUSTON - ROSSLYN HOUSTON, TX 77091
Ship To: AMERICAN ALLOY 4450 S MINGO TULSA, OK 74146

Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Nb	Ca	CE
LADLE	0.24 ✓	1.12 ✓	0.008	0.001 ✓	0.19 ✓	0.003	0.002	0.021	0.000	0.000	0.032	0.0033	0.004	0.0000	0.001	0.000	0.0028	0.43

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

Plate	Slab Identity	Gauge Tested	Test Cond	Test Dir.	Yield Point	Tensile Sigth.	Elong in 2"	YS/UTS Ratio	Yield Strenght Determind At	Charpy Impact Test (LCVN) Full Energy in Ft/Lb °F								
										Temp	Test1	Test2	Test3	Avg	Test1	Test2	Test3	Avg
1026583A	08A	2.3750	PN	T	41	76	31.0%	0.54	0.2%	-20	51	46	50	50				
1026585A	08A ✓	2.3750	PN	T	43 ✓	76 ✓	32.0%	0.57	0.2%	-20	65	38	40	48				

Plates Certified For The Above Tests

Material	Thick(IN)	Width (IN)	Len(IN)	Wgt(LB)
1026583A	2.3750	96.000	260.00	16812

Material	Thick(IN)	Width(IN)	Len (IN)	Wgt(LB)
1026585A	2.3750	96.000	260.00	16812

Material	Thick(IN)	Width(IN)	Len(IN)	Wgt(LB)

RECEIVED
MAR 31 2017
L. Dawson

MTR CERTIFIED 2-15-17
P & M INDUSTRIES, INC.
1701033

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

Bedelia Roberson

Bedelia Roberson 832-840-4614 bedelia.roberson@jswsteelusa.com

03/31/2017 From: AMERICAN ALLOY STEEL, INC. To: BOARDMAN, INC
P.O.#: 00608303 S.O.#: 561259 AA PL#: 561259-3
Item: 3 (2 PC) 2-3/8" X CYL 78" ID X 96" X 96" X 260"

Shell MR1-4

-3

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

METALLURGICAL TEST REPORT

MET - 05
1/30/2017

Bulletin	Order Item	Heat	PO No.	Shipping Mode		Order Dimensions	Slab Origin	TC No.
T010521	JSW07233-01	S22952	110425-OK-SD	TRUCK		2.375x96x260		T010521-2952-1

Special Instructions

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

Sold To: AMERICAN ALLOY STEEL INC. 6230 NORTH HOUSTON - ROSSLYN HOUSTON, TX 77091
Ship To: AMERICAN ALLOY 4450 S MINGO TULSA, OK 74146

Test	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	N	V	B	Ti	Nb	Ca	CE
LADLE	0.24	1.12	0.008	0.001	0.19	0.003	0.002	0.021	0.000	0.000	0.032	0.0033	0.004	0.0000	0.001	0.000	0.0028	0.43

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

Plate	Slab Identity	Gauge Tested	Test Cond	Test Dir.	Yield Point	Tensile Stgth.	Elong In 2"	YS/UTS Ratio	Yield Strenght Determind At	Charpy Impact Test (LCVN) Full Energy in Ft/Lb °F								
										Temp	Test1	Test2	Test3	Avg	Test1	Test2	Test3	Avg
1026583A	08A	2.3750	PN	T	41	76	31.0%	0.54	0.2%	-20	51	48	50	50				
1026585A	08A	2.3750	PN	T	43	76	32.0%	0.57	0.2%	-20	65	38	40	48				

Plates Certified For The Above Tests

Material	Thick(IN)	Width (IN)	Len(IN)	Wgt(LB)
1026583A	2.3750	96.000	260.00	16812

Material	Thick(IN)	Width(IN)	Len (IN)	Wgt(LB)
1026585A	2.3750	96.000	260.00	16812

Material	Thick(IN)	Width(IN)	Len(IN)	Wgt(LB)

RECEIVED
MAR 3 1 2017
L. Dawson

[illegible] CERTIFIED 2-1-17
P & M INDUSTRIES, INC.
[signature]
[illegible] 176633

Certified a true copy of the
original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
JF 3/31/17

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

Bedelia Roberson

Bedelia Roberson 832-840-4514 bedelia.roberson@jswsteelusa.com

7

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JAN 17 2017
L. Dawson

CERTIFICATE OF INSPECTION & TEST (EN 10204 3.1)

ST&H CORPORATION
74, Jwadongsunhwan-ro, Haeundae-gu, Busan, Korea
Tel : +82.51.744-4680(5 line) Fax : +82.51.744-4670
E-mail :qm@sinhcorp.com

Certificate No. MJW9095D-16/18 Date : OCT. 06. 2015
Customer INDUSTRIAL PIPING SPECIALISTS.
Contract No. TP476391-4TH
Certified to ISO9001:2008, ISO14001:2004,PED97/23/EC by LRQA
Spec. For Material ASTM/ASME A/SA350 LF2 CL1-14,NACE MR0175-2009/ISO15156-1:2015,NACE MR0103-2012
Heat Treatment 930℃ NORMALIZED & A.C
Dimensional Inspection ASME B16.5 - 2013

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen D mm	Size of Test Specimen GL mm	Tension Test	Y.S MPa	T.S MPa	E.L %	R.A %	Hardness Test (HB)		Charpy Impact Test (10X10mm Specimen Size) Indiv. 16J	Ave. 20J	Notch V	Temp. -46℃
						Max		655			197		Test Result (J)			Ave.(J)
				12.5	50.0	Min	250	485	22.0	30.0						
CA150WRSTD10	150LBS WN RF STD 10"	8	103343B	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA300WRSTD10	300LBS WN RF STD 10"	40	103343C	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA600WRXH10	600LBS WN RF XH 10"	60	103343D	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA600WRXH8	600LBS WN RF XH 8"	35	103343D	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA300WRSTD8	300LBS WN RF STD 8"	60	103343D	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA600WRXH8	600LBS WN RF XH 8"	52	103343E	12.5	50.0		383	544	36	73	155	157	166	52	100	106
CA600WRXH8	600LBS WN RF XH 8"	38	103343F	12.5	50.0		383	544	36	73	155	157	166	52	100	106
BLANK			BLANK				BLANK				BLANK					

Heat No./ Batch No.		Chemical Composition (%) C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	Nb						CE	NDE UT	MT	PT
	Max	0.300	0.300	1.350	0.035	0.040	0.400	0.300	0.120	0.400	0.080	0.020									
	Min		0.150	0.600																	
103343B		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			
103343C		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			
103343D		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			
103343E		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			
103343F		0.174	0.196	1.300	0.021	0.009	0.020	0.150	0.005	0.013	0.003	0.004						0.424			

REMARK * PRODUCT OF KOREA

We hereby certify that the material herein has been made and tested in accordance with the above specification and also with the requirements called for by the above order.

Witnessed by / H. J. LEE

Manager of Q.A Dept. / J. W. PARK

801-14-01

ST&H CORPORATION

Nozzle A and B Flange MK 1-7

| 00608321 | | 103343D | | LN: 7 | ER020791-2 | FK860RFWNXHL2 |

[| 00608321 | | | H8566] | [LN: 34] | ER020791-6 | *FLG |

FEDERAL FLANGE

MATERIAL TEST REPORT

FFI-QACON-F0003
Revision: 05, 01/19/2016

FID: H8566 ✓

INDUSTRIAL PIPING SPECIALISTS PO BOX 581270 TULSA, OK 74158	PO:	ELP48494X	SO:	023327 001	
	Item Code:	FFI-FGRFW-00903 0		Qty:	1
	Item Desc:	FLG REDWN RF 18X8 600 80 ✓			
	Supplier:	FORGED COMPONENTS INC	Supplier Heat:	W430	
Material Grade:	A/SA 350 LF2 CL1 ✓		Country of Origin:	USA	

Element		Ladle	Element		Ladle
C	Carbon	0.1500 ✓	N	Nitrogen	0.0083
Mn	Manganese	1.2400 ✓	Mo	Molybdenum	0.0290 ✓
P	Phosphorous	0.0070 ✓	V	Vanadium	0.0200 ✓
S	Sulphur	0.0009 ✓	CbNb	Columbium/Niobium	0.0030
Si	Silicon	0.2200 ✓	Ti	Titanium	0.0020
Cu	Copper	0.1700 ✓	Al	Aluminum	0.0260
Ni	Nickel	0.0700 ✓	B	Boron	0.0000
Cr	Chromium	0.0800 ✓	Sn	Tin	0.0070

Melting Practice		Reduction Ratio	

Additional Chemicals
CA 4 PPM

Mechanical Test Results				Heat Treatment Information	
Tensile (PSI)	72,600 ✓			NORMALIZING TEMPERATURE (°F)	1650
Yield (PSI)	50,700 ✓			NORMALIZING TIME (HRS)	1/2 HR/IN THK MIN
Elong (%)	35.80				
Red (%)	69.70				
CE	0.3980				
PCM					
HBW	152	to	156		
CVN Test Temperature			°F		
Ft/Lbs.					
Shear (%)					
MLE					
Tensile Test Size					
QTC Type & Size					

RECEIVED
FEB 14 2017
L. Dawson

Additional Comments

Bradford, WA
YVETTE BRADFORD - Quality Representative

2/1/2017
Date

Unless other wise stated, yield stress is 0.2% offset, gauge length is 2" for 1/2" bars or 1" for 1/4" bars.
Unless other wise stated, charpy impact specimens are V-notch 10 x 10 mm
We certify this material meets the requirements of NACE MR-0175/ISO 15156-1 Dated Oct 15, 2009 and is EN 10204 Type 3.1 compliant
This product is free of mercury contamination and has had no weld repair.

4014 Pinemont Dr | Houston, TX 77018 | MTR Dept. Phone: (713) 600-2131 | Fax: (713) 681-3005

Nozzle A Reducing Flange MK 1-15

[| 00608321 | | | C1069BN] | [LN: 4] | ER020791-7 | *FLG |

FVC
an AFGlobal Company

Material Test Report

Heat Code: C1069BN

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: ELP48435X	Sales Order: 157599	Line: 1
P.O. Box 581270	Item Code: V2N180600170A004A1	Qty Shipped: 2	
Tulsa, OK 74158-1270	Item Desc: V2N,SA350LF2,600#,18"x17",RF		
	Supplier: ARCELORMITTAL	Supplier Heat: 217A558	
Spec: ASTM A350(15)/ASME SA350(15)Section II Part A, - LF2 CL1			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18			
Mn	Manganese	1.11		✓	7439-96-5
P	Phosphorous	0.010			
S	Sulphur	0.002			
Si	Silicon	0.23			
Cu	Copper	0.18		✓	7440-50-8
Ni	Nickel	0.10		✓	7440-02-0
Cr	Chromium	0.06		✓	7440-47-3
Mo	Molybdenum	0.031			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
V	Vanadium	0.02			
Cb	Columbium	0.00			
B	Boron	0.0002			
Ti	Titanium	0.002		✓	7440-02-0
Al	Aluminum	0.023			
C.E.		0.40			
CuNiCrMoV		0.39			
CrMo		0.09			

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Mechanical Testing

Test Lab	AFG
HBW	144 - 145
Elg (%)	36
RA (%)	66
Tensile Specimen Size (in)	.494
Tensile (ksi)	71.4
Yield (ksi)	45.1
Gauge Length (in)	2
Charpy Temp(F)	-50
Charpy (ft lbs)	77 - 55 - 62
Avg Energy 3 Specimens (ft-lbs)	65
Min Energy 1 Specimens (ft-lbs)	55
% Shear	30 - 20 - 20
Lat. Exp.(in)	.064 - .048 - .053

Heat Treat

Norm. Temp. (F)	1675
Norm. (Hrs)	4:45
Norm. Cooling Type	AIR
Norm. Location	FVC HT 300-16

Other

Country of Melt	USA
VD	Y
EF	Y
Fully Killed	Y
Made to Fine Grain Practice	Y

The recording of false, fictitious, or fraudulent statement or entries on this document may be punishable as a felony under federal statute.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1272780
Certification Date: 2/14/2017
Issued By: Angie Mendoza

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

Nozzle C MK 1-14

1 of 2

[| 00608321 | | | C1069BN] | [LN: 4] | ER020791-7 | *FLG |

Material Test Report

Heat Code: C1069BN

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: ELP48435X	Sales Order: 157599	Line: 1
P.O. Box 581270	Item Code: V2N180600170A004A1	Qty Shipped: 2	
Tulsa, OK 74158-1270	Item Desc: V2N,SA350LF2,600#,18"x17",RF		
	Supplier: ARCELORMITTAL	Supplier Heat: 217A558	
Spec: ASTM A350(15)/ASME SA350(15)Section II Part A, - LF2 CL1			

Product compliant with NACE MR0175/ISO 15156-2:2009 Annex A (A.2.1.2, A2.1.3).
Product compliant with NACE MR0103-2012, Section 2.1.2 and 2.1.4.

YIELD STRENGTH CALCULATED AT 0.2% OFFSET.
FVC STANDARD MANUFACTURING PRACTICES:
1) FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
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

The recording of false, fictitious, or fraudulent statement or entries on this document may be punishable as a felony under federal statute.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1272780
Certification Date: 2/14/2017
Issued By: Angie Mendoza

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

Rina Sane - Metallurgical Lab Manager

Nozzle C MK1-14 2of2

[| 00608321 | | | C1069BN] | [LN: 5] | ER020791-8 | *FLG |

FVC
an AFGlobal Company

Material Test Report

Heat Code: C1069BN

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: ELP48435X	Sales Order: 157599	Line: 2
P.O. Box 581270	Item Code: V3N180600161A004A9	Qty Shipped: 2	
Tulsa, OK 74158-1270	Item Desc: 18-600-16.1875-6R-1-4 RF V3N SA350LF2CL1		
	Supplier: ARCELORMITTAL	Supplier Heat: 217A558	
Spec: ASTM A350(15)/ASME SA350(15) Section II Part A, - LF2 CL1			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18			
Mn	Manganese	1.11		✓	7439-96-5
P	Phosphorous	0.010			
S	Sulphur	0.002			
Si	Silicon	0.23			
Cu	Copper	0.18		✓	7440-50-8
Ni	Nickel	0.10		✓	7440-02-0
Cr	Chromium	0.06		✓	7440-47-3
Mo	Molybdenum	0.031			

Element	(%wt)	Ladle	Product	EPCRA	CAS#
V	Vanadium	0.02			
Cb	Columbium	0.00			
B	Boron	0.0002			
Ti	Titanium	0.002		✓	7440-02-0
Al	Aluminum	0.023			
C.E.		0.40			
CuNiCrMoV		0.39			
CrMo		0.09			

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Mechanical Testing	
Test Lab	AFG
HBW	144 - 145
Elg (%)	36
RA (%)	66
Tensile Specimen Size (in)	.494
Tensile (ksi)	71.4
Yield (ksi)	45.1
Gauge Length (in)	2
Charpy Temp(F)	-50
Charpy (ft lbs)	77 - 55 - 62
Avg Energy 3 Specimens (ft-lbs)	65
Min Energy 1 Specimens (ft-lbs)	55
% Shear	30 - 20 - 20
Lat. Exp.(in)	.064 - .048 - .053

Heat Treat	
Norm. Temp. (F)	1675
Norm. (Hrs)	4:45
Norm. Cooling Type	AIR
Norm. Location	FVC HT 300-16
Other	
VD	Y
EF	Y
Fully Killed	Y
Made to Fine Grain Practice	Y

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Certification No.: 1273664
Certification Date: 2/21/2017
Issued By: John Sauceda

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

Nozzle D MK1-20 1 of 2

[| 00608321 | | | C1069BN] | [LN: 5] | ER020791-8 | *FLG |

Material Test Report

Heat Code: C1069BN

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: ELP48435X	Sales Order: 157599	Line: 2
P.O. Box 581270	Item Code: V3N180600161A004A9	Qty Shipped: 2	
Tulsa, OK 74158-1270	Item Desc: 18-600-16.1875-6R-1-4 RF V3N SA350LF2CL1		
	Supplier: ARCELORMITTAL	Supplier Heat: 217A558	
Spec: ASTM A350(15)/ASME SA350(15)Section II Part A, - LF2 CL1			

Product compliant with NACE MR0175/ISO 15156-2:2009 Annex A (A.2.1.2, A2.1.3).
Product compliant with NACE MR0103-2012, Section 2.1.2 and 2.1.4.

YIELD STRENGTH CALCULATED AT 0.2% OFFSET.
FVC STANDARD MANUFACTURING PRACTICES:
1) FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
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

The recording of false, fictitious, or fraudulent statement or entries on this document may be punishable as a felony under federal statute.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1273664
Certification Date: 2/21/2017
Issued By: John Sauceda

Rina Sane - Metallurgical Lab Manager

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

Nozzle D MK 1-20 2 of 2

[| 00608321 | | | TL10010165] | [LN: 3] | ER020791-4 | *FLG |

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3

TRILAD Flanges and Fittings, Inc.
7260 MYKAWA RD.
HOUSTON, TX, USA 77033
(PHONE) 800-498-2136
(FAX) 888-727-7982
www.tri-lad.com

CERTIFIED MATERIAL TEST REPORT

Certificate No. 16237269	EN 10204 3.1	Date of Report 6/ 08/ 2016	
Customer: ALLIED HOUSTON, 7200 MYKAWA ROAD, HOUSTON TX 77033		Customer Order No. 60216-3STK	Quantity 12
		Tri-Lad Order No. 733156	Line No. 1

Specification A350-14 LF2 CL1 ✓	Heat Treatment NORMALI SED
Item Description 18 600 BL RF ✓ (886895)	Temperature Init 1925 F 1051 C
Shop Order/Trace No.	Time N=5HRS / Lot Definition
Lot No.	
Heat Code TL10010165 ✓	
C.E. .41 / Melt Practice EF	

Chemical Composition

	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V
Heat Product	.19 ✓	1.09 ✓	.020 ✓	.003 ✓	.23 ✓	.05 ✓	.11 ✓	.11 ✓	.01 ✓	.01 ✓
Heat Product	Nb .00									
Heat Product										

Mechanical Properties

Yield	Tensile	Elongation	Reduction of Area	Hardness	Impact Test Temperature	Impact Values			Shear Fracture
Ksi 43 ✓ Mpa 293 ✓	Ksi 81 ✓ Mpa 559	31 %	67 %	HBW 154 HBW 156	M50 F M46 C	Ft-lbs 56 50 40			
						Joules 76 68 54			

Tensile Specimen	Lateral Expansion	Impact Type	Impact Orientation	Starting Material	Impact Specimen
STD RD		VNOTCH	TANGENTIAL		FULL SIZE

Notes

NACE MR0103 LATEST ED.
NACE MR0175/ISO15156-09

Material is in accordance with the applicable Standard to which it is ordered including:
ASME Sect II, ASME B16.5, B16.9, B16.36, B16.47, CSA, MSS, AWWA C-207.
NO WELD REPAIR MERCURY FREE
Material conforms to both ASTM (A) and ASME (SA) applicable specifications.
We hereby certify that all information presented on this CMTR conforms to the above specification.
We hereby certify the results to be a true copy of the records of the company.

Troy Gorrell
Q.C. Inspector

Nozzle D Blind MK 1-21

[| 00608321 | | | A2S] | [LN: 9] | ER020791-3 | *MISC |

TEST REPORT

1¾ X .467 SA105 A2S A4S 8-13-15

MST SEAMLESS TUBE & PIPE

5315 MICHIGAN SEAMLESS TUBE SOUTH LYON, MICHIGAN 48178 SHIPMENT 001

ORDER NUMBER	CUSTOMER ORDER NUMBER	DATE	OPC	COM		DIV/I	NET SLS	GR SLS	ACCOUNT NUMBER	US		PAGE
065176	214171	10/06/14	21	00		15	05	01	06587000000		2ME	1

* SPECIAL METALS INC
P O BOX 94670

OKLAHOMA CITY OK USA 73143

SHIP TO: SPECIAL METALS INC
2009 SOUTH BROADWAY STREET
MOORE OK 71360

SN 2
TR 3
INV 3

ROUTING
COIL/O-T/TARPED/FOB S LYON MI/GBOYD@SPECIALMETALSINC.COM CUST PU

ANALYSIS	SHAPE	PRODUCT	PO	ANNEAL	REQUESTED
1026	ROUND	COLD DRAWN		NORMALIZED	10/31/14
SEAMLESS	SPECIFICATION: A105/A519	CUST	DESCRIPTION: CD CARBON MECHANICAL		PROMISE 10/31/14

SPECIAL INSTRUCTIONS
DIL S-0.020 MAX.CHEM/PHYS ASTM A105/ASME SA105.MUST MEET NACE MR0 175-97,NACE MR0 103-2010 SEC 2.1.1-2.1.7,ISO 15156-2 A.2 & EN 10204 SEC 3.1,3.2,4.1,4.2.MK W/MST,SIZE,GR,CUST NAME,PO#,SPEC & HT#. T/R TO INCL COMPLETE CHEM(INCL UNSPECIFIED ELEMENTS)PHYS, HBW & GRAIN SIZE. GUARANTEED FINISH BORE SIZE 0.921".

ITEM	QUANTITY	O.D.	I.D.	WALL	LENGTH	WT/FT	WEIGHT	
		1.750		.467 AVG		6.399		13:46:46 02/04/15

ITM NUM	BALE NUM	BALE PCS	BALE FTG	HEAT NO.	LENGTH	ITM STATUS	PART NUMBER
1	1 2	42	633	00A145044	RAND 12'-17'	COM	705787
1	5 2	42	636	00A145044	RAND 12'-17'	COM	705787
1	2 2	44	665	00A145042	RAND 12'-17'	COM	705787
1	3 2	44	667	00A145042	RAND 12'-17'	COM	705787
1	4 2	44	667	00A145042	RAND 12'-17'	COM	705787

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HEAT NO.	C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Al	REMARKS
00A145044	.240	.750	.007	.015	.210	.060	.140	.020	.120	.019	EF SDI GS 7
00A145042	.240	.750	.007	.017	.250	.060	.130	.030	.130	.017	EF SDI GS 7

HEAT NO.	ULT. STR. PSI	YIELD, PSI	% ELONG 8D	HARDNESS	HYDRO TEST PSI	ULTRA SONIC %	EDDY CURRENT	EXPANSION
00A145044	73,266	45,942	34.4	HRB 78-81			OK	
00A145042	73,574	50,505	34.4	HRB 79-81				

BEND	FLATTEN	FLARE	REV. FLATTEN	FLANGE

IPS TP530 740X 3/4"-6000"X4½" Full Compl

	V	SN	NB	SE	AG	
A145042	.002	.009	.000	.002	.004	Ni
A145044	.002	.009	.000	.002	.00	

MELTED AND MANUFACTURED IN USA HEAT CODE A2S, A4S
MTR REVISED 2/4/15

Reduction of area HT A145042 55.84 %
" " " A145044 57.69 %
MTR Revised 8/12/2015

We hereby certify that the reported data are correct according to Michigan Seamless Tube tests and those of its suppliers.

6.2.P8.F9 Rev 2

Nozzles E1 and E2 MK 1-22

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20,21,22,23,24,25,26 FSBOL8XH HR056624

Nozzle Necks MK1-10, MK1-13, MK5-95, MK5-97, MK5-98, MK5-110 and MK5-111

[| 00608321 | | 14E100695 | [LN: 20] | ER020791-4 | FSBOL8XH |

BOLY PIPE CO., LTD. MILL TEST CERTIFICATES

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

EN10204/3.1

CUSTOMER		PRODUCT	NEW PRIME SEAMLESS STEEL PIPE
PURCHASER		ORDER NO.	2014001-23
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/ / API Cert. NO. 5L-0956
Grade	X42/B PSL1	L/C NO.:	/ / DATE 2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55418.94	Total Bundles	445.	Order Quantity (MT)	1112		
Total Joints	1321	Total Weight (MT)	1112.944	Delivery Condition		CHAMFER		Making Method		Hot Finished, Seamless	

No.	Heat No.	- 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000														Batch No.	Mechanical Properties			Impact Test (Temperature 0o C)					Hardness	Quantity		Length	Weight
			- 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	2 Mo	3 V	3 Ti	3 Nb	3 Al		- 3	- 4	Y.S.	T.S.	E.L.%	Size (mm)	1	2	3	AVG	HB	Bundle	Jts	FT	MT
	min																	min	Mpa	290	415	29.5						<225				
	max			28		130	30	30										max													
1	14E100689		H	17	25	105	14	4	35	2	4.2	6	20				YLJ21405042			370	545	32						162	32	96	4024.71	80.506
			P	16	23	103	13	3	33	2	3.9	5	16																			
			P	15	24	104	12	2	34	1	4.1	4	19																			
2	14E100690		H	17	25	104	13	2	34.3	2.1	4	5	20				YLJ21405050			340	520	42						153	28	84	3521.65	70.786
			P	15	23	103	11	1	34.3	2.1	2	4	17																			
			P	16	24	102	12	2	34.2	1.9	3	3	18																			
3	14E100691		H	17	28	106	13	2	36.4	2.1	5	5	20				YLJ11405049			345	525	41.5						153	25	74	3108.37	62.476
			P	15	28	106	11	1	36.2	2.1	3	4	17																			
			P	16	27	107	12	2	36.3	1.9	4	4	19																			
4	14E100691		H	17	28	108	13	2	36.4	2.1	5	5	20				YLJ21405051			350	530	40.5						156	7	20	827.38	16.57
			P	15	26	108	11	1	36.2	2.1	3	4	17																			
			P	16	27	107	12	2	36.3	1.9	4	4	19																			

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS
Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/								

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30±5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES: G.L.=Gauge Length "1 Process.C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm

INSPECTORS TO: WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED. TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009,MEETS HARDNESS FOR NACE MR-0103.

Q.A Signature: He Tianheng

Shan xiu Zang

1 of 6

Nozzle Necks MK1-10, MK1-13, MK5-95, MK5-97, MK5-98, MK5-110 and MK5-111

[| 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

BOLY PIPE CO., LTD.

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng, Rayong, 21140,Thailand

Phone Number:+66-33-010-907,+66-33-010-909

MILL TEST CERTIFICATES

EN10204/3.1

| | | |

Nozzle Necks MK1-10, MK1-13, MK5-95, MK5-97, MK5-98 MK5-110 and MK5-111

3 of 6

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng, Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	NEW PRIME SEAMLESS STEEL PIPE
PURCHASER		ORDER NO.	2014001-23
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/ API Cert. NO. 5L-0956
Grade	X42/B PSL1	L/C NO.:	/ DATE 2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55418.94	Total Bundles	445	Order Quantity (MT)	1112
Total Joints	1321	Total Weight (MT)	1112.944	Delivery Condition		CHAMFER		Making Method	Hot Finished, Seamless

No.	Heat No.	- 1	- 2	C	Si	Mn	P	S	Cr	Ni	Cu	Mo	V	Ti	Nb	Al	Batch No.	- 3	- 4	Y.S.	T.S.	E.L.%	Impact Test (Temperature 0o C) Size (mm)	1	2	3	AVG	Hardness HB (AVG)	Quantity Bundle	Jts	Length FT	Weight MT
	min																min			290	415	29.5						<225				
	max			28		130	30	30									max		Mpa														
			H	16	22	104	11	1	34.6	2.3	4.6	7	20																			
9	14E100694		P	15	20	103	9	1	34.3	2.1	4.4	6	17				YLJ21405054			380	564	31						165	5	15	624.48	12.572
			P	14	21	102	10	1	34.2	2.2	4.3	5	19																			
			H	15	24	107	11	1	34.3	2.1	4.5	5	20																			
10	14E100695		P	14	22	105	9	1	34.1	2.1	4.2	4	17				YLJ11405047			400	540	38						158	31	93	3906.02	78.028
			P	15	23	104	10	1	34.2	1.9	4.3	3	19																			
			H	18	23	106	11	1	34.5	2.3	5.3	5	20																			
11	14E100696		P	16	21	106	9	1	34.4	2.1	5.1	4	18				YLJ11405057			395	570	39						170	2	5	199.08	3.992
			P	15	22	105	10	1	34.3	2.2	5.2	3	19																			
			H	18	23	106	11	1	34.5	2.3	5.3	5	20																			
12	14E100696		P	16	21	106	9	1	34.4	2.1	5.1	4	18				YLJ21405046			375	585	38.5						175	31	93	3905.68	78.556
			P	15	22	105	10	1	34.3	2.2	5.2	3	19																			

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS	Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30~5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES: G.L.=Gauge Length "1 Process C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm

INSPECTORS TO: WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.MEETS HARDNESS FOR NACE MR-0103.

Q.A Signature

Shu Xiu Fang

He Tianhang

[| 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	NEW PRIME SEAMLESS STEEL PIPE
PURCHASER		ORDER NO.	2014001-23
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/ API Cert. NO. 5L-0956
Grade	X42/B PSL1	L/C NO.:	/ DATE 2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55416.94	Total Bundles	445	Order Quantity (MT)	1112
Total Joints	1321	Total Weight (MT)	1112.924	Delivery Condition		CHAMFER		Making Method	Hot Finished, Seamless

No.	Heat No.	- 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000														Batch No.	Mechanical Properties				Impact Test (Temperature 0o.C)					Hardness	Quantity		Length	Weight
			- 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	3 Mo	3 V	3 Ti	3 Nb	3 Al		- 3	- 4	Y.S.	T.S.	E.L.%	Size (mm)	1	2	3	AVG	HB (AVG)	Bundle	Jts	FT	MT
	min																															
	max			28		130	30	30											Mpa	290	415	29.5						<225				
13	14E100697		H	17	26	107	15	1	34.4	1.9	3.5	7	20				YLJ21405045			405	540	35.5						160	30	86	3696.27	74.45
			P	15	24	106	13	1	34.2	1.5	3.3	6	17																			
			P	16	25	105	14	1	34.3	1.6	3.2	6	18																			
14	14E100697		H	17	26	107	15	1	34.4	1.9	3.5	7	20				YLJ21405055			410	530	34						156	3	8	328.66	6.582
			P	15	24	106	13	1	34.2	1.5	3.3	6	17																			
			P	16	25	105	14	1	34.3	1.6	3.2	6	18																			
15	14E100698		H	16	24	102	10	1	34	2	4.5	7	20				YLJ11405044			410	550	38						165	30	88	3698.12	74.436
			P	15	22	100	8	1	32	2	4.2	6	17																			
			P	14	23	101	9	1	33	1	4.3	5	19																			
16	14E100698		H	16	24	102	10	1	34	2	4.5	7	20				YLJ21405056			405	555	39						166	3	8	332.35	6.694
			P	15	22	100	8	1	32	2	4.2	6	17																			
			P	14	23	101	9	1	33	1	4.3	5	19																			

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS	Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30+5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES: G.L.=Gauge Length *1 Process C= Electric Furnace & Continuous Casting *2 Chemical Composition H=Heat(ladle)Analysis *3 Sampling Position P=Pipe Body *4 Size 2= StripTX38mm

INSPECTORS TO: WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.MEETS HARDNESS FOR NACE MR-0103.

Q.A Signature: He Jianliang

Shm d-U Form

NOZZLE NECKS MK1-10, MK1-13, MK5-95, MK5-97, MK5-98, MK5-110 and MK5-111

4 of 6

[| 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

Nozzle Necks MK1-10, MK1-13, MK 5-95, MK5-97, MK 5-96, MK 5-10 and MK 5-11

[| 00608321 | | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER	:	PRODUCT	NEW PRIME SEAMLESS STEEL PIPE
PURCHASER		ORDER NO.	2014001-23
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/ API Cert. NO. 5L-0956
Grade	X42/B PSL1	L/C NO.:	/ DATE 2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55416.94	Total Bundles	445	Order Quantity (MT)	1112		
Total Joints	1321	Total Weight (MT)	1112.944	Delivery Condition		CHAMFER		Making Method		Hot Finished, Seamless	

No.	Heat No.	- 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000														Batch No.	Mechanical Properties				Impact Test (Temperature 0o C)					Hardness	Quantity		Length	Weight
			- 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	3 Mo	3 V	3 Ti	3 Nb	3 Al		- 3	- 4	Y.S.	T.S.	E.L.%	Size (mm)	1	2	3	AVG	HB (AVG)	Bundle	Jts	FT	MT
	min																			280	415	29.5						<225				
	max			28		130	30	30											Mpa													
17	14E100699		H	17	23	105	14	1	34.5	2	4.9	7	20				YLJ11405043			410	555	38.5						163	38	113	4740.93	95.33
			P	15	21	103	12	1	34.4	2	4.6	6	17																			
			P	16	22	104	13	1	34.3	1	4.5	5	18																			
18	14E100700		H	18	24	105	10	1	34.7	2.2	5.1	7	20				YLJ11405041			430	560	38						166	47	141	5921.19	118.626
			P	16	23	103	8	1	34.5	2.1	4.9	6	18																			
			P	17	22	104	9	1	34.6	2.2	5.1	7	19																			
19	14E100701		H	17	22	104	12	2	34.9	2.2	5.1	8	20				YLJ21405040			395	535	38						157	16	48	2015.80	40.522
			P	16	20	103	10	2	34.5	2.1	4.7	7	17																			
			P	15	21	102	11	1	34.6	1.9	4.8	6	19																			
20	14E100702		H	17	25	104	15	1	33.3	2.2	5.4	5	20				YLJ21405039			405	545	38						162	26	77	3232.62	65.272
			P	15	23	103	13	1	33.1	2.2	5.2	4	19																			
			P	16	24	102	14	1	33.2	2.1	5.1	3	19																			

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS
Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	PASS								

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30+5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES: G.L=Gauge Length "1 Process C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm

INSPECTORS TO: Shan xin fang

WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED. TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.MEETS HARDNESS FOR NACE MR-0103.

Q.A Signature: He Tianliang

5 of 6

Nozzle Necks MK1-10, MK1-13, MK5-95, MK5-97, MK5-98, MK5-110 and MK5-111

[| 00608321 | | 14E100695] | [LN: 20] | ER020791-4 | FSBOL8XH |

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng, Rayong. 21140,Thailand
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	NEW PRIME SEAMLESS STEEL PIPE
PURCHASER	\	ORDER NO.	2014001-23
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	/ / API Cert. NO. 5L-0956
Grade	X42/B PSL1	L/C NO.:	/ / DATE 2014-6-25

Size	8"XH(0.500")	Length range	DRL	Total Length (FT)	55416.94	Total Bundles	445	Order Quantity (MT)	1112
Total Joints	1321	Total Weight (MT)	1112.944	Delivery Condition		CHAMFER		Making Method	Hot Finished, Seamless

No.	Heat No.	- 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000 - 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	3 Mo	3 V	3 Ti	3 Nb	3 Al	Batch No.	Mechanical Properties - 3	- 4	Y.S.	T.S.	E.L.%	Impact Test (Temperature 0o C) Size (mm)	1	2	3	AVG	Hardness HB (AVG)	Quantity Bundle	Jts	Length FT	Weight MT
	min																	min										<225				
	max			28		130	30	30										max	Mpa	290	415	29.5										
21	14E100702	H	17	25	104	15	1	33.3	2.2	5.4	5	20					YLJ21405052			409	550	39						164	2	6	243.31	4.988
		P	15	23	103	13	1	33.1	2.2	5.2	4	19																				
		P	16	24	102	14	1	33.2	2.1	5.1	3	19																				
		H																														
		P																														
		P																														
		H																														
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		P																														
		H																														
		P																														
		P																														

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS	Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30+5)°	Heat Treatment	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES: G.L.=Gauge Length "1.Process C= Electric Furnace & Continuous Casting "2 Chemical Composition H=Heat(ladle)Analysis "3 Sampling Position P=Pipe Body "4 Size 2= StripTX38mm

INSPECTORS TO: Shu Xin Zong

WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED,SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENT THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE. MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.MEETS HARDNESS FOR NACE MR-0103.

Q.A Signature: He Tianhong

6 of 6

1, 2

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L. Dawson

Nozzle B Elbow MK 1-12
Downcomer Elbow MK 5-96

ernefittings	**erne fittings gmbh** A-6824 Schlins Hauptstrasse 48 Austria/Europe Telefon +43/5524 501-0 Telefax +43/5524 501-930 Reg. No. 12 100 3054	**Abnahmeprüfzeugnis** **Inspection Certificate** **EN 10204 - 3.1**

Zeugnis Nr. *[cert. no.]*	Rev.	Datum *[date]*
036271/16-PD		24/10/2016

Code-Nr. *[code no.]*: 51T94
Ident Nr. *[ident no.]*:
Unsere Auftrags.Nr./Art.Nr. *[our order no./item no.]*: 184223DM-0321 / 003337
Ihre Bestell Nr. *[your order no.]*: HP244020
Menge *[quantity]*: 200

Artikelbezeichnung *[designation]*
elbows
LR-90-S-WPB-8"-XS

Anforderungen der Bestellung *[requirements of the order]*
ASME B16.9-2012 LR, material:WPB, TR-fitting:ASTM A 234/A 234M-15, ASME SA-234/SA-234M-15, TR-addit fitting:NACE MR0175/ISO15156-2:2009A.2, NACE MR0103-2012 2.1 and 4, certificate:EN 10204/3.1, rust protection:Millstandard, execution:Seamless

Kunde *[customer]*
Industrial Piping Specialists

Box 581270
USA-74158-1270 Tulsa, OK

Vormaterial *[base material]*: seamless pipe

Analyse *[analysis]* — Schmelze Nr. [heat no.] — Erschmelzungsart *[melting process]* — **1 = Schmelzanalyse** *[heat analysis]*

J-Faktor *[J-Factor]*: (Si + Mn) * (P + Sn) * 10000
CEQ *[CEQ]*: C + (Mn / 6) + (Cr + Mo + V) / 5 + (Cu + Ni) / 15

Index		C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	Nb	Al	B	Ti	N	Ceq	Ca		
1	410921	0.15	0.23	1.08	0.013	0.003	0.04	0.01	0.03	0.07	<0.01	<0.01	0.031	<0.0005	<0.01	0.0077	<0.35	0.0024		

Mech.-technologische Prüfung *[mech. technological test]*

Proben Nr. *[test no.]*	Zugversuch *[tensile test]*						Kerbschlagbiegeversuch *[notched bar impact test]* Form:				Härteprüfung *[hardness test]*
	Pr.-Lage *[pos. of sample]*	Temp.	Dehngr. *[yield str.]* ReH	Dehngr. *[yield str.]* Rp 0,2	Zugfestigkeit [tensile str.] Rm (MPa)	Dehnung *[elongation]* 2" (%)	PR-Lage *[pos. of sample]*	Temp.	Querschnitt *[cross sec.]* (mm²)	Kerbschlagarbeit *[impact values]* (J)	140-149 HB
502_12	L	+20 °C	363	339	503	32					

Wärmebehandlung *[heat treatment]*
formed under normalizing cond.
temperature 840 °C - 890 °C
Cooling in still air

Kennzeichnung *[marking]*: CE QS AUSTRIA / A / SA234 / WPB / 51T94 / 8" / XS

Besichtigung und Ausmessung *[visual inspection and dimensional check]*: o.B./o.K.

Bemerkungen *[remarks]*
hot formed over mandrel

Zusatzmarkierung *[add. mark.]*

Die gelieferten Produkte erfüllen die in der Bestellung festgelegten Anforderungen.
[The products supplied are in compliance with the requirements of the order].
The products were manufactured, sampled, tested and inspected in accordance with the specifications and were found to meet the requirements.

Abnahmebeauftragter *[inspection representative]*
24/10/16 Pape Dijana ☎ - 323

Dieses Dokument wurde elektronisch erstellt und ist ohne Unterschrift gültig. *[The certificate is issued by the computerized system and is valid without signature.]*

Zertifiziert nach DGRL 2014/68/EU Anhang I - Absatz 4.3 durch TÜV SÜD Industrie Service, Benannte Stelle 0036,Zertifikat Nr. DGR-0036-QS-W 129/2002/MUC *[Certified acc. to PED 2014/68/EU Annex I, Paragraph 4.3 by TÜV SÜD Industrie Service. Notified Body 0036. Certificate No. DGR-0036-QS-W 129/2002/MUC]*

00608321			51T94]	[LN: 1]	ER020791-1	FA8XH90

6

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JAN 17 2017
L. Dawson

CERTIFICATE OF INSPECTION & TEST (EN 10204 3.1)

ST&H CORPORATION
74, Jwadongsunhwan-ro, Haeundae-gu, Busan, Korea
Tel : +82.51.744-4680(5 line) Fax : +82.51.744-4670
E-mail :qm@stnhcorp.com

CE
RPS 0160308 / 01

Certificate No. MJW8896B Date : MAY. 26. 2015
Customer INDUSTRIAL PIPING SPECIALISTS.
Contract No. TP455658-2ND
Spec. For Material ASTM A105N-14/ASME SA105N-13/NACE MR0175 & NACE MR0103/ISO 15156-1:2001
Heat Treatment 910℃ NORMALIZED & A.C

Certified to ISO9001:2008, ISO14001:2004,PED97/23/EC by LRQA
Dimensional inspection ASME B16.5 - 2013

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen D mm	Size of Test Specimen GL mm	Tension Test	Y.S MPa	T.S MPa	E.L %	R.A %	Hardness Test (HB)		Charpy Impact Test (10X10mm Specimen Size) Indiv.	Ave.	Notch	Temp.
						Max					187					
				12.5	50.0	Min	250	485	22.0	30.0			Test Result (J)			Ave.(J)
BA600BR1	600LBS BL RF 1"	55	5A756H	12.5	50.0		313	549	36	73	143	143				
BA600KR1601	600LBS SW RF S160 1"	45	5A756H	12.5	50.0		313	549	36	73	143	143				
BA600KRXH1	600LBS SW RF XH 1"	40	5A756H	12.5	50.0		313	549	36	73	143	143				
BA600KRXH0.75	600LBS SW RF XH 3/4"	30	5A756H	12.5	50.0		313	549	36	73	143	143				
BA600WR1602	600LBS WN RF S160 2"	750	5A756K	12.5	50.0		339	528	33	75	143	144				
BA600WRXH2	600LBS WN RF XH 2"	105	5A756L	12.5	50.0		304	527	32	71	141	143				
BA600BR2	600LBS BL RF 2"	150	5A756M	12.5	50.0		306	508	31	66	143	144				
BA900WRXH4	900LBS WN RF XH 4"	150	103997B	12.5	50.0		285	529	34	73	141	143				
	BLANK		BLANK				BLANK				BLANK					

Heat No./ Batch No.		Chemical Composition (%) C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	CE	NDE UT	MT	PT
	Max	0.350	0.350	1.050	0.035	0.040	0.400	0.300	0.120	0.400	0.080				
	Min		0.100	0.600											
5A756H		0.204	0.312	0.930	0.013	0.004	0.007	0.022	0.003	0.010	0.004	0.365			
5A756K		0.204	0.312	0.930	0.013	0.004	0.007	0.022	0.003	0.010	0.004	0.365			
5A756L		0.204	0.312	0.930	0.013	0.004	0.007	0.022	0.003	0.010	0.004	0.365			
5A756M		0.204	0.312	0.930	0.013	0.004	0.007	0.022	0.003	0.010	0.004	0.365			
103997B		0.200	0.269	0.980	0.020	0.004	0.013	0.119	0.002	0.014	0.002	0.389			

REMARK * PRODUCT OF KOREA

We hereby certify that the material herein has been made and tested in accordance with the above specification and also with the requirements called for by the above order.

Witnessed by / H. J. LEE

Manager of Q.A Dept. / J. W. PARK

T-801-14-01

ST&H CORPORATION

Downcomer Flange MK 5-100

| 00608321 | | 5A756K 1 | [IN: 6] | ER020791-1 | FK260RFWN160 |

8

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JAN 17 2017
L. Dawson

CERTIFICATE OF INSPECTION & TEST (EN 10204 3.1)

ST&H CORPORATION
74, Jwadongsunhwan-ro, Haeundae-gu, Busan, Korea
Tel : +82.51.744-4680(5 line) Fax : +82.51.744-4670
E-mail :qm@stnhcorp.com

CE
KPS 0160308 F01

Certificate No. MJW9095D-04/18 Date : OCT. 06. 2015
Customer INDUSTRIAL PIPING SPECIALISTS,
Contract No. TP476391-4TH
Spec. For Material ASTM/ASME A/SA105N-14,NACE MR0175-2009/ISO15156-1:2015,NACE MR0103-2012
Heat Treatment 930℃ NORMALIZED & A.C

Certified to ISO9001:2008, ISO14001:2004,PED97/23/EC by LRQA
Dimensional inspection ASME B16.5 - 2013

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen D mm	Size of Test Specimen GL mm	Tension Test	Y.S MPa	T.S MPa	E.L %	R.A %	Hardness Test (HB)	Charpy Impact Test (10X10mm Specimen Size) Indiv.	Ave.	Notch	Temp.
						Max					187				
						Min	250	485	22.0	30.0		Test Result (J)			Ave.(J)
BA600WRXH8	600LBS WN RF XH 8"	200	108305A	12.5	50.0		371	550	30	70	158 159				
BA600WRXH8	600LBS WN RF XH 8"	100	108305B	12.5	50.0		371	550	30	70	158 159				
BA600WRXH8	600LBS WN RF XH 8"	100	108305C	12.5	50.0		371	550	30	70	158 159				
BA600WRXH8	600LBS WN RF XH 8"	130	108305D	12.5	50.0		371	550	30	70	158 159				
BA600WRXH8	600LBS WN RF XH 8"	230	108305E	12.5	50.0		371	550	30	70	158 159				
	BLANK		BLANK				BLANK				BLANK				

Heat No./ Batch No.	Max / Min	Chemical Composition (%) C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	CE	NDE UT	MT	PT
	Max	0.350	0.350	1.050	0.035	0.040	0.400	0.300	0.120	0.400	0.080				
	Min		0.100	0.600											
108305A		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			
108305B		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			
108305C		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			
108305D		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			
108305E		0.183	0.206	0.990	0.025	0.006	0.016	0.122	0.011	0.012	0.003	0.377			

REMARK * PRODUCT OF KOREA

We hereby certify that the material herein has been made and tested in accordance with the above specification and also with the requirements called for by the above order.

Witnessed by / H. J. LEE

Manager of Q.A Dept. / J. W. PARK

-801-14-01

ST&H CORPORATION

Downcomer flange MK 5-9

| 00608321 | | 108305B] | [LN: 8] | ER020791-1 | FK860RFWNXH |

[| 00608321 | | | 59667] | [LN: 29] | ER020791-1 | D2X8-6160WOL |

CERTIFIED MILL TEST REPORT

The Best Value - Price, Quality, Service All The Time.

29

LOG NO. F00000000065756 Page 1 of 3

BONNEY FORGE CORPORATION
P.O. BOX 330 • 14496 CROGHAN PIKE • MOUNT UNION, PA 17066-0330
(814) 542-2545 • (800) 345-7546 • FAX (814) 542-4906
www.bonneyforge.com

CUSTOMER: INDUSTRIAL PIPING SPECIALISTS

DATE 11/12/2014

CUSTOMER ORDER NO.: ELP12623

BONNEY ORDER NO. B000177601

SHIP TO: INDUSTRIAL PIPING SPECIALISTS (EL RENO)
1301 TRAIL BLVD
EL RENO OK 73036
United States

RECEIVED JAN 17 2017 L. Dawson

ITEM	QUANTITY	LOT NO.	GRADE OR SPECIFICATION NO. CHEMICAL ANALYSIS, PHYSICAL PROPERTIES, REMARKS:
1	20	59577	36-8X2 XS A105 FLEX B SA/A105 Al 0.027 C 0.210 Cb 0.000 Co 0.004 Cr 0.040 Cu 0.050 Mn 1.020 Mo 0.006 Nb 0.014 Ni 0.013 P 0.006 S 0.021 Si 0.210 V 0.004 CE(Long Formula) = 0.39 T/S(PSI) 74,222 Y/S(PSI) 51,763 EL(%) 34.45 RA(%) 63.23 Brinell 137 BHN 135 BHN
2	25	59667	8 -6 X 2 S160 A105 WELD B SA/A105 Al 0.030 C 0.210 Co 0.000 Cr 0.040 Cu 0.050 Mn 1.020 Mo 0.006 N 0.003 Nb 0.013 Ni 0.030 P 0.006 S 0.022 Si 0.210 V 0.003 CE(Long Formula) = 0.40 T/S(PSI) 76,479 Y/S(PSI) 48,362 EL(%) 32.90 RA(%) 61.19 Brinell 139 BHN 139 BHN
3	500	6678 MALE	1 3000 A105 UNAR T SA/A105 Al 0.028 C 0.200 Co 0.004 Cr 0.040 Cu 0.060 Mn 1.000 Mo 0.006 N 0.004 Nb 0.012 Ni 0.020 P 0.006 S 0.019 Si 0.220 V 0.004 CE(Long Formula) = 0.38 T/S(PSI) 75,600 Y/S(PSI) 43,700 EL(%) 26.00 RA(%) 51.60 Brinell 163 BHN 163 BHN
		6881 FEMALE	1 3000 A105 UNAR T SA/A105 Al 0.033 C 0.200 Co 0.003 Cr 0.030 Cu 0.020 Mn 1.040 Mo 0.004 N 0.002 Nb 0.015 Ni 0.020 P 0.004 S 0.018 Si 0.220 V 0.003 CE(Long Formula) = 0.38 T/S(PSI) 76,200 Y/S(PSI) 48,700 EL(%) 27.00 RA(%) 52.30 Brinell 152 BHN 151 BHN

/e certify that the data on this sheet is a true copy taken from our records of material rnished us by the production mill, or as obtained by additional laboratory checks.

by Kenzie Grove
Kenzie Grove
QUALITY PROCESS MANAGER

MTR: REV2

Downcomer Weldolet MK 5-99

[| 00608321 | | | 10/K] | [LN: 28] | ER020791-3 | *MISC |

06Feb15 9:59 **T E S T C E R T I F I C A T E** No: 1 113287

2-10-15

KREHER STEEL COMPANY, LLC.
1550 NORTH 25TH AVENUE
MELROSE PARK, IL 60160
Tel: 708-345-8180 Fax: 708-345-8293

P/O No 3269
Rel
S/O No 1 272541-001
B/L No 1 221072-001
Inv No
Shp 06Feb15
Inv

Sold To: (7811)
PRODUCTION MANUFACTURING CO., INC.
5909 EAST 13TH STREET
TULSA OK 74112

Ship To: (1)
PRODUCTION MANUFACTURING CO., INC.
5909 EAST 13TH STREET
TULSA OK 74112

Tel: 918-836-3585 Fax: 918-835-9681

CERTIFICATE of ANALYSIS and TESTS Cert. No: 1 113287
06Feb15

Part No
TURN & POLISH ROUNDS A105
1.3750 X 16'R/L

1 3/8 Ø SA105
10/K

0

ASTM A105-
ASME SA105
HEAT NUMBER 145020
Cu .21 , V .034 AND Cb/Nb .001
LOT NUMBER 71494 WEIGHT 14524
TENSILE 89,400
YIELD 62,900
ELONGATION 24 %
REDUCTION OF AREA 45 %
HARDNESS 176 - AT SURFACE
MADE IN THE USA

RECEIVED
JAN 23 2017
ZVS
SEESE

Heat Number *** Chemical Analysis ***
145020 C=0.2200 Mn=0.9300 P=0.0140 S=0.0310 Si=0.2300 Cu=0.2100
Ni=0.0860 Cr=0.1430 Mo=0.0300 Al=0.0030 Cb=0.0010 V=0.0340
Sn=<.007> B=<.0003> Ti=<.0002> N=<.0124> Ca=<.0021>

I hereby certify that this data is correct as contained in the records of this company.
I hereby certify that no mercury came in contact with or no weld repair was done to this product while in our possession.

BGapp

PRODUCTION MFG, TULSA, OKLA.
CUSTOMER IPS
P.O.# TP530740X
ITEM 3/4"-3000# x 3½" Full Coupling
HEAT CODE 10/K

Page: 1 .... Last

Downcomer Coupling MK 5-101

5501549 01 ID#3207

3

NUCOR
PLATE MILL

P.O.Box 279
Winton, NC 27986
(252) 356-3700

Mill Test Report

Page 6

NUCOR
It's Our Nature

Issuing Date : 03/20/2015 B/L No. : 411932 Load No. : 417535 Our Order No. : 125433/12 Cust. Order No. : 143884-9

Vehicle No: ALY 91710

Specification: 2.0000" x 120.000" x 480.000"
ASTM A516 70/65/60-10/ASME SA516-70/65/60 PVQ 2010/2011a
Addenda, 2013 Normalized Plate NACE MR0175 Annex 2.1.2, MR0103
Section 2.1.2 Compliant

Sold To: SUPERIOR SUPPLY AND STEEL
PO BOX 2388
SULPHUR ,LA 70664

Ship To: SUPERIOR SUPPY AND STEEL (CATOOSA)
C/O PTCATOOSA
TULSA PORT AUTHORITY
TULSA PORT AUTHORIT,OK 74016

Marking :

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
5501549	0.22	1.06	0.013	0.002	0.22	0.20	0.07	0.07	0.01	0.023	0.005	0.002	0.002	0.0075	0.0000	0.0000	0.010	0.43	0.30

			Tensile Test					Heat Treat			Charpy Impacts											
											Absorbed Energy (Ft-lbs)					Shear (%)						
Plate Serial No	Pieces	Tons	Dir.	Yield (psi)	Tensile (psi)	Elong. % in 2"	Elong. % in 8"	Norm °F	Time (min)	Temper °F	Time (min)	Dir.	1	2	3	Ave	Min	1	2	3	Ave	Min	Temp °F	Size
5501549-01	2	32.67	T	46,400	76,900	55.0		1650	76			H-L	87.3	70.1	116.0	91.1	15						-40	10mm

ELITE TOWERS	HT#5501549
PO#5242109	SL#01
SO#320749	ITEM#1 1PCS

FEB 0 1 2017
L. Dawson

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast discrete plate, unless otherwise noted in Specification. For Mexico shipments: nhc-SalesMX@Nucor.com
Yield by 0.5EUL method unless otherwise specified. Ceq = C+(Mn/6)+((Cr+Mo+V)/5)+((Cu+Ni)/15)
Pcm = C+(Si/30)+(Mn/20)+(Cu/20)+(Ni/60)+(Cr/20)+(Mo/15)+(V/10)+5B
Melted and Manufactured in the USA. ISO 9001:2008 certified (#010940) by SRI Quality System Registrar (#0685-09). PED 97/23/EC 7/2 Annex 1, Para. 4.3 Compliant. DIN 50049 3.1.B/EN 10204 3.1B(2004), DIN EN 10204 3.1(2005) compliant. For ABS grades only; Quality Assurance certificate 14-MMPQA-723.

We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications, including customer specifications.

T. A. Depretis, Metallurgist

3/20/2015 8:01:45 AM

Q.A. APPROVED
By [illegible] Date 5/18/2015

NOZZLE B REPAIR MK-1-11

17

AMERICAN ALLOY
PLATE # 5176513

NUCOR
PLATE MILL

P.O.Box 279
Wilson, NC 27986
(252) 358-3700

Mill Test Report

Page 1

1505 River Rd
Cofield, NC 27922
(252) 358-3700

NUCOR
It's Our Nature

Issuing Date : 07/07/2016 S/L No. : 448664 Load No. : 456646 Our Order No. : 138090/24 Cust. Order No. : 108415-OK

Vehicle No: NOKL 726193

Specification: 1.5000" x 120.000" x 480.000"
ASTM A516 70-10(2015)/ASME SA516 70 PVQ 2013/2015 Cu .15 Max, Sn .020 Max Normalized Test Coupons at 1650 F NACE MR0175 Annex 2.1.2, MR0103 (2010) Section 2.1.2 (2015) 13.1.1, 13.1.2)Compliant .

Marking : 108415-OK

Sold To: AMERICAN ALLOY STEEL INC
6230 N HOUSTON ROSSLYN RD
PO BOX 40469
NORTH HOUSTON,TX 77091

Ship To: AMERICAN ALLOY STEEL
6350 N ERIE AVE
C/O SKOL TRACK #21
OWASSO,OK 74055

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
6504179	0.19	1.03	0.011	0.004	0.20	0.12	0.13	0.08	0.01	0.029	0.005	0.002	0.004		0.0019	0.0002	0.007	0.38	0.26

Tensile Test								Charpy Impacts										
Plate Serial No	Pieces	Tons	Dir.	(psi) Yield	(psi) Tensile	Elongation % in 2"	Elongation % in 8"	Dir.	1 (%) shear	2 (%) shear	3 (%) shear	Ave.	(%) shear	Size	Temp	Min Ave.
6504179-01	1	12.26	T	51,200	87,400		27.2									
			T	44,600	70,900		29.3 N									

ELITE TOWERS	HT#6504179
PO#5242109	SL#01
SO#320749	ITEM#2 1PCS

RECEIVED
FEB 0 1 2017
L. Dawson

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

HOT ROLLED CARBON STEEL PLATE
Test coupons only, normalized 30 minutes per inch of thickness at 1650 F ±25 F. Hold 30 minutes minimum. ;

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast discrete plate as-rolled, unless otherwise noted in Specification. For Mexico shipments: nhc-SalesMX@Nucor.com
Yield by 0.5EUL method unless otherwise specified. Ceq = C+(Mn/6)+((Cr+Mo+V)/5)+((Cu+Ni)/15)
Pcm = C+(Si/30)+(Mn/20)+(Cu/20)+(Ni/60)+(Cr/20)+(Mo/15)+(V/10)+5B
Melted and Manufactured in the USA. ISO 9001:2008 certified (#010640) by SRI Quality System Registrar (#0565-09). PED 97/23/EC 7/2 Annex 1, Para. 4.3 Compliant. DIN 50049 3.1.B/EN 10204 3.1B(2004), DIN EN 10204 3.1(2005) compliant. For ABS grades only, Quality Assurance certificate 14-HMPQA-723

We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications, including customer specifications.

T. A. Deoretis, Metallurgist

7/7/2016 8:10:28 AM

Q.A. APPROVED
By: Date 12/2/2016

12/02/2016 From: AMERICAN ALLOY STEEL, INC. To: PORT CITY METAL SERVICES
P.O.#: 101403 S.O.#: 559272 AA PL#: 5176513
Item: 2 (2 PC) 1-1/2" X 120" X 480"

1.5" Lug plate MK 2-32

02/14/2017 From: AMERICAN ALLOY STEEL, INC. To: BOARDMAN, INC
P.O.#: 00608356 S.O.#: 561564 AA PL#: 5180481
Item: 1 (1 PC) 3/8" X 62" X 258-13/16", PER BEVEL DTL #
TAG: 70699

ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE
REPORT OF TEST AND ANALYSES

US HWY 12 Burns Harbor, Indiana

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.		PAGE
804-06100	01-23-17	CSS-CHGO-BNSF	BVRY 062134	1

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

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

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

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC, ASTM A516-06 GR 65 PVQ, ASME SA516 GR 70 PVQ 2015 EDITION, ASME SA516 GR 65 PVQ 2015 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL --- TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# 110190 GH 354-5373C

E540856	821V11050	4	.375	96	360	14700	56200	78400	8	25
							51100	74800	8	28
(M55)MFST REF#:4										
E540857	821V11050	4	.375	96	360	14700	56700	79000	8	24
							52800	75700	8	24
(M55)MFST REF#:4										

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FEB 17 2017
L. Dawson

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

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

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
J.F 2.9.2017

HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MOLD GRAIN SIZE
821V11050	.17	1.12	.014	.006	.327	.019	.01	.13	.082	.002	.002	.033	.0002	.002	.005	.004	

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

BHPLTRPT.TIF

R. SPANGLER II PER LSS
SUPV. QUALITY ASSURANCE

AMERICAN ALLOY PLATE #5180481

Miscellanius Skirt Plate MK 1-6

ELITE TOWERS	HT#821U02690
PO#5242109	SL#C051159
SO#320749	ITEM#5 1PCS

2, 5, 6, 8, 12, 13, 15, 18, 19

559700 Burns Harbor Plate
Quality Department
250 West US Highway 12
Burns Harbor, IN 46304

Report of tests and analyses

ArcelorMittal

Shipment no.	Date shipped	Car or vehicle no.	
803-00267	09-16-16	AMERICAN COMMERCIAL	PAGE 3

Sold to:
SENTRY SUPPLY INC
DBA SUPERIOR SUPPLY & STEEL CO
PO BOX 2388
SULPHUR LA 70664

Ship to:
SUPERIOR SUPPLY & STEEL CO
C/O RICHWAY STEVEDORING
CITY DOCKS PORT OF HOUSTON
111 E LOOP NORTH
HOUSTON TX 77092

Serial number	Piece no.	Heat no.	Size and quantity: No pcs	Thickness	Width or dia.	Length	Weight	Yield point	Tensile strength	Elong. in	Elong. %	Red. %
				INCHES	INCHES	INCHES	POUNDS	PSI	PSI	IN	%	

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.

PLATES - ASTM A516-06 GR 70 PVQ KLD FINE
GRAIN PRAC, ASME SA516 GR 70 PVQ
2015 EDITION, FIRST TST AS
ROLLED-ADD'L TENSION PER TST PC
HEAT TREATMENT --- MILL TEST PCS
NORM 1650F FOR 1HR/IN AIRCL
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# P0170744-04 GH 816-5811L

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

C051159	821U02690	1	1/2	120	480	8168	47500	73800	8	26	
							50000	71600	8	26	
(M55)MFST REF#:LN 14											
C051160	821U02690	1	1/2	120	480	8168	50500	75800	8	28	
							50000	72000	8	28	
(M55)MFST REF#:LN 14											

RECEIVED
FEB 0 1 2017
L. Dawson

Q - quench temperature T - temper temperature 1100 N - normalize temperature

Serial number	Piece no.	Heat number	Hard.	Bend	Thickness	Type	Size	Dir.	Test temp. F	Charpy impact Energy FT. LBS. 1	2	3	Shear % 1	2	3	Lat. exp. MILS 1	2	3
					INCHES													

SUBSCRIBED AND SWORN TO BEFORE ME
THIS 19TH DAY OF OCT YR 2016
NOTARY PUBLIC RYAN D. NEWBERN
PORTER COUNTY, INDIANA
MY COMMISSION EXPIRES DECEMBER 7, 2023
COUNTY OF RESIDENCE, PORTER

Heat number	Chemical analysis C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	McQuaid-Ehn grain size
821U02690	.17	1.06	.011	.006	.333	.223	.17	.03	.005	.002	.002	.037	.0002	.002			

Q.A. APPROVED
By [signature] Date 11/22/2016

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

Robert K Youngblood
Quality manager

Per [signature]

Miscellanius Plate MK 2-31, MK 2-40, MK 3-51, MK 3-52 MK 3-53, MK 3-64, MK 3-70, MK 3-74, MK 4-81, MK 4-82 and MK 4-86

Miscellaneous Plate MK 5-103 and MK 5-112

Cust: ELITE TOWERS INC. ORD#: 35-45198-03 Date: 12192016 Time: 141023 To: OCJWM Page 1 of 1

SSAB 7,14

Test Certificate

Form TC1: Revision 2: Date 23 Apr 2014

12400 Highway 43 North, Axis, Alabama 36505, US

Customer: RYERSON INC. P.O. BOX 91602 LUBBOCK TX 79490-1601	Customer P.O. No.: M3574934	Mill Order No.: 41-427710-01	Shipping Manifest : AT204219
	Product Description: ASTM A516-70(10)/ASME SA516-70(13) AS-ROLLED, TENSILE COUPON NORMALIZED 1650F+/-25F/1HR/"	Ship Date: 28 Apr 15 Cert Date: 28 Apr 15	Cert No: 081504877 (Page 1 of 1)
	Size: 0.375 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	BDWTT %Shr
D157	E06	0.371 (DISCRT)	L	54	79		24		T														
D157	E06*	0.371 (DISCRT)	L	54	78		26		T														

Heat Id	Chemical Analysis C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	ORGN
D157	.20	1.12	.009	.001	.25	.025	.023	.31	.16	.11	.05	.001	.004	.008	.0008	USA

KILLED STEEL
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE
RESULTS OF TESTS PERFORMED ON NORMALIZED TEST COUPONS ARE LABELED ABOVE WITH *
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
PRODUCTS SHIPPED:
E5D157 E06 PCES: 9, LBS: 44109

RECEIVED FEB 0 1 2017 L. Dawson

(U) Cust Part # : 35852

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

Justin Ward
SENIOR METALLURGIST - PRODUCT

ELITE TOWERS	HT#821T02570
PO#5242109	SL#B060377
SO#320749	ITEM#4 1PCS

1

ArcelorMittal Burns Harbor Plate — US HWY 12 Burns Harbor, Indiana

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.			PAGE
803-05823	05-13-16	CSS-CHGO-UP	UP	262080	7

SOLD TO
SENTRY SUPPLY INC
DBA SUPERIOR SUPPLY & STEEL CO
PO BOX 2388
SULPHUR LA 70664-2388

SHIP TO
SUPERIOR SUPPLY & STEEL CO
C/O RICHARDSON STEEL YARD
PTRA 20-702
8615 CLINTON DR
HOUSTON TX 77029

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

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ KLD FINE
GRAIN PRAC, ASME SA516 GR 70 PVQ
2015 EDITION, FIRST TST AS
ROLLED-ADD'L TENSION PER TST PC
HEAT TREATMENT --- MILL TEST PCS
NORM 1650F FOR 1HR/IN AIRCL
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

CO# P0165743-04 GH 816-5624G
TEST SPECIMENS LABORATORY HEAT TREATED AND YIELD STRENGTH @ .5% E.U.L.

B060377	821T02570	1	1	120	480	16335	46900	77500	8	26
							51000	75900	8	28

(M55)MFST REF#:LN#8

PLATES - ASTM A709-15 GR 50 MOD SI.04 MAX AL
KLD FINE GRAIN PRAC TYPE 3, ASTM
A572-15 GR 50, CH-V A673 FREQ (H) L
26/18 FTLBS AT -22F

CO# P0165743-04 GH 816-5624H

812837150	2	1/4	120	480	8168	85000	88300	8	15

(M55)MFST REF#:LN#9

SUBSCRIBED AND SWORN TO BEFORE ME
THIS 16 DAY OF [illegible] YR [illegible]
NOTARY PUBLIC [illegible]
LA PORTE COUNTY INDIANA
MY COMMISSION EXPIRES DECEMBER 20, 2017
COUNTY OF RESIDENCE, LA PORTE

Q-QUENCH TEMPERATURE T-TEMPER TEMPERATURE

FEB 0 7 2017
16
L. Dawson

SERIAL NUMBER	PAT NO.	HEAT NUMBER	HARD BHN	BEND	THICKNESS INCHES	TYPE	SIZE	DIR	TEST TEMP F	CHARPY IMPACT ENERGY FT LBS 1	2	3	SHEAR(%) 1	2	3	LAT. EXP MILS 1	2	3
		812837150			.250	V	1/2	L	-22	43	79	46						

HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MOLARD GRAIN SIZE
821T02570	.18	1.15	.017	.004	.315	.012	.01	.13	.082	.003	.002	.029	.0002	.003	.004	.002	
812837150	.09	1.25	.012	.005	.011	.026	.02	.04	.006	.048	.017	.030	.0002	.032	.007	.005	

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

R. SPANGLER II PER LSS
SUPV, QUALITY ASSURANCE

B#PLTRPT.TIF

KMG	HT#821T02570
PO#174-5	SL#B060377
SO#319857	ITEM#7 2PCS
	19 2PCS
	28 2PCS
	29 2PCS

Q.A. APPROVED
By [illegible] Date 11/17/2016

Miscellanius Plate MK 4-84

22Dec16 11:38 T E S T C E R T I F I C A T E No: TU 279030

4, 10

Sold To: (24222)
BOYD METALS OF OKLAHOMA CITY INC
ATTN SHELIA HARRINGTON
PO BOX 819
FORT SMITH AR 72902

Ship To: (1)
BOYD METALS OF OKLAHOMA CITY INC
6060 SOUTHWEST 44TH ST
OKLAHOMA CITY OK 73179

CERTIFICATE of ANALYSIS and TESTS Cert. No: TU 279030
22Dec16

Part No	Pcs	Wgt
HR SHEET COMM. STEEL TYPE B		
10 GA. X 96.0000" X 242.0000"	3	2,723

ASTM A1011-12

Heat Number	Tag No	Pcs	Wgt
1378C4	951760	3	2,723

YIELD=41/TENS=56/ELONG=36/MILL=<ESSAR>/VESSL=<CN136929>
CNTRY=<USA>/MELT=<CANADA>/MFG=<CANADA>

Heat Number 1378C4

*** Chemical Analysis ***
*=0.0000 C=0.0900 Mn=0.3500 P=0.0070 S=0.0080 Si=0.0300
Cu=0.0100 Al=0.0380 Ti=0.0020 V=0.0000 Nb=0.0000 Ca=0.0021
Mo=0.0000 Cr=0.0100 Ni=0.0100 Sn=0.0000 N=0.0039

ELEMENTS NOT LISTED TEST BELOW DETECTABLE LEVELS
ALL ASTM PLATE PRODUCTS ARE PRODUCED FROM COIL

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS SAMPLED AND TESTED IN ACCORDANCE WITH THE SPECIFICATION, TO OUR KNOWLEDGE, AND FULFILLS REQUIREMENTS IN SUCH RESPECT.
ALL PRODUCT IS PRODUCED FROM COIL. ELONGATION IS MEASURED FROM A TWO INCH GAGE LENGTH UNLESS OTHERWISE NOTED.

FEB 0 1 2017
L. Dawson

Miscellaneous Plate MK1-29 and MK1-27

01/13/2017 From: AMERICAN ALLOY STEEL, INC. To: ELITE TOWERS INC.
P.O.#: 5242097 S.O.#: 561746 AA PL#: 5177802
Item: 12 (1 PC) 1/4" X 72 X 96

9

ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE
REPORT OF TEST AND ANAYLSES

US HWY 12 Burns Harbor, Indiana

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.		
803-08502	07-20-16	CSS-CHGO-BNSF	CSS 019001	PAGE 8

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

SHIP TO
AMERICAN ALLOY STEEL INC
C/O SKOL TRACK #21
6350 N ERIE AVE
OWASSO OK

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

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC, A516-06 GR 65 PVQ, ASME SA516 GR 70 PVQ 2015 EDITION, ASME SA516 GR PVQ 2015 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTE MIN), AIRCOOL --- TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1 CORD WITH PROCEDURES OUTLINED EN
10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# 108591-OK GH 354-5169F

C041704	813T72930	1	.25	96	360	2450	57800	82700	8	21
							56300	77200	8	26
(M55)MFST REF#:1										
C041697	823T69840	2	.25	96	360	4900	53700	82900	8	21
							61600	79200	8	23
→ C041698	823T69840	2	.25	96	360	4900	52500	82300	8	20
(M55)MFST REF#:1							56700	78000	8	23

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

FEB 01 2017
L. Dawson

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

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
JR 8/3/2016

HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	MIXED GRAIN SIZE
813T72930	.18	1.13	.013	.005	.320	.021	.01	.13	.08	.003	.002	.030	.0002	.003	.006	.002	
823T69840	.18	1.16	.016	.005	.328	.020	.01	.13	.08	.003	.002	.032	.0002	.002	.006	.004	

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

BHPLTRPT.TIF

R. SPANGLER II PER LSS
SUPV. QUALITY ASSURANCE

AMERICAN ALLOY PLATE # 5177802

Miscellanius Plate MK 1-28

01/06/2017 From: AMERICAN ALLOY STEEL, INC.
P.O.#: 101458 S.O.#:
Item: 6' (1 PC) 1-1/4" X 96" X 480"

ELITE TOWERS HT#813U73010
PO#5242109 SL#C061564
SO#320749 ITEM#3 1PCS

20

ArcelorMittal Burns Harbor Plate
QUALITY ASSURANCE
REPORT OF TEST AND ANALYSES
US HWY 12 Burns Harbor, Indiana

SHIPMENT NO.	DATE SHIPPED	CAR OR VEHICLE NO.		PAGE
803-12431	10-21-16	CSS-CEGO-BNSF	LMIC 066050	4

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

SHIPPED TO:
AMERICAN ALLOY STEEL INC
C/O SKOL TRACK #21
6350 N ERIE AVE
OWASSO OK

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

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC, ASTM A516-06 GR 65 PVQ, ASME SA516 GR 70 PVQ 2015 EDITION, ASME SA516 GR 65 PVQ 2015 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL --- TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# 109611-OK GH 354-5293B

C061560	811U09890	1	1.25	96	480	16335	44100	72600	8	28
							47600	73100	8	29
(M55)MFST REF#:3										
C061563	813U73010	1	1.25	96	480	16335	46400	75100	8	28
							48800	74000	8	29
(M55)MFST REF#:3										
→ C061564	813U73010	1	1.25	96	480	16335	45000	74500	8	28
							48800	73600	8	30
(M55)MFST REF#:3										

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L. Dawes

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

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

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
JT 12·1·2016

HEAT NUMBER	CHEMICAL ANALYSIS: C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Ti	Al	B	Cb	N	Sn	GRAIN SIZE
811U09890	.17	1.07	.015	.006	.310	.020	.01	.12	.078	.002	.002	.031	.0002		.002	.007	.003
813U73010	.17	1.12	.014	.004	.354	.026	.01	.12	.086	.002	.002	.038	.0002		.003	.007	.005

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

R. SPANGLER II PER LSS

BHPLTRPT.TIF SUPV. QUALITY ASSURANCE

QA APPROVED
By _____ Date 1/6/2017

AMERICAN ALLOY
PLATE #C061564

Miscellanious Plate MK 2-38

[| 00608321 | | | 232AA] | [LN: 11] | ER020791-4 | D.75HXPLUG |

Capitol Manufacturing
1125 Capitol Avenue
Crowley, LA 70526

10, 11

Commanding a Higher Standard℠

Phoenix * Capitol * Camco

CapProducts

Certified Mill Test Report

Printed: 2/25/2016
Customer
INDUSTRIAL PIPING SPECIALISTS
P.O. BOX 581270
TULSA, OK 74158

Certified: 02/18/2016
P.O. ELP32345
Tag

Heat No 144343
Heat Code 232AA
Phoenix Order # 1186190
Material ASTM A105-2011a / ASME SA105-2010 Edition

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L. Dawson

Part Number
12203407

Description
3/4" FS HEX HD PLUG

Chemical Properties

C	Mn	P	S	Si	Cu	Ni	Cr
0.2000	0.9400	0.0060	0.0240	0.2300	0.1900	0.0660	0.1060

C Eq. Long
0.4055

Mo	V	Co	Al	Cb	N	Pb	Sn	Ta	Ti
0.0160	0.0370								

Additional Chemical Properties

Cr + Cu + Ni
0.3620

Mechanical Properties

Tensile (PSI)	Yield (PSI)	Elong. % in 2 in. or 4D	R of A	HBW	HBW2
87,000	58,500	26.0%	60.0%	179	167

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 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.

Miscellanius Plugs MK 1-23 and MK 5-102

[| 00608321 | | | 30303K] | [LN: 12] | ER020791-4 | FSNH1.5STD |

12 FSNH 1.5STD

TÜV CERT EN ISO 9001:2008 / EN ISO 14001:2004 Certificate Reg. No. 01 100 035041-004, 04 104 990140-024

ArcelorMittal

A02 **Inspection certificate "3.1" (EN 10 204)**

A03 Document No.: **01879/11**

A07	Customer's Order (P.O.) No./Item No.: **HR033045/10078223 IPS**	A08	Manufacturer's Works Order No.: **40874/0/11**
A11	Supplier's Order No.: **NH 3150035991**	A10	Advice - Note No.: **503781, 503783, 503870.**
B08, B12/13	Quantity delivered: pcs / bdls: **1164**; mtrs / feet: **24550.525**; B13 Actual mass kgs / lbs: **31144**	A06	Customer / Consignee: **ARCELORMITTAL INTERNATIONAL AMERICA, 1 S.DEARBORN STREET, 60603-9888 CHICAGO, USA**
B09-11	Dimensions: **1.1/2" x 3.70 mm (1.1/2" x 0.145")**		
B02	Steel designation: **B / X42**		

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B01, B03, B04 Product, conditions and terms of delivery:
Seamless steel pipes acc. to API 5L 44th edit. 2007 PSL-1 / ASTM A 53/A53M-07 / ASME SA 53/SA 53M-10 / ASTM A 106/A 106M-08 / ASME SA 106-10 / NACE MR 0175-03 / NACE MR 0103-05, GRADE B / X42, in lengths SRL, with square cut ends, ends protected with plastic caps, lacquered as finished, certified acc. to EN 10204/3.1-2004. Hot finished as rolled.

A04, B06 Marking: Manufacturer's mark, mill inspector's stamp
AMTP OSTRAVA (2) (1)

C71-92, B07 Heat (H) and product (P) chemical analyses (%) | C70 Steel made by basic oxygen process, fully killed, strand cast.

B07 Heat No.:		C	MN	P	S	V	NB	TI	SI	CU	NI	CR	MO	CEQ
30303K	H	0.17	0.70	0.010	0.007	<0.002	<0.003	<0.003	0.193	0.05	0.03	0.04	0.005	0.30
	P	0.16	0.68	0.007	0.004	<0.003	<0.003	<0.003	0.204	0.04	0.02	0.04	0.005	0.28
	P	0.16	0.69	0.007	0.005	<0.003	<0.003	<0.003	0.209	0.04	0.02	0.04	0.005	0.29

Z99 continues on appendix

B07 Heat No.	C00 Specimen No.	C11 Yield Point psi	C12 Tensile Strength psi	C13 Elongation % 2"	C40-43 Impact test J °C Ø / min	C30-32 Hardness HRB
C04 Requirements:	B	min. 35500	min. 60200	min. 21		max. 99
	X42	min. 42100	min. 60200	min. 21		
		Longitudinal strip specimen 3/4"				
30303K		52504	74114	26.2		68.7
		52939	74259	27.8		
		50328	73534	28.0		

Z99 continues on appendix

D01	Visual and dimensional inspection with satisfactory results	X	D51 Hydraulic test - min. test pressure psi / sec.	2970 / 5
C50	Flattening test - satisfactory		D02 The pipes tested on tightness by NDT in acc. to	
C51	Expanding test - satisfactory			
C52	Bending test - satisfactory	X		
C53	Ring expanding test (DIN EN 10236) - satisfactory		D03 Nondestructive Elektromagnetic Testing	
C54	Ring tensile test (DIN EN 10237) - satisfactory			

22 HRC = 99 HRB max.
MSNA Order No.: HR033045/10078223 Customer name : IPS Vessel name : JANA

Z01 All pipes conform to the above mentioned standards and ordering requirements and agreements.

Z02 Date of issue 31.12.2011/Vo

Tel.:++420 595683644 / Fax:++420 595682062

ArcelorMittal
ArcelorMittal Tubular Products Ostrava a.s.
Vratimovská 689, 707 02 Ostrava 7
Řízení jakosti
35

Dipl. Ing. Pekař
Work's Inspector
Z02 Validation

A01 ArcelorMittal Tubular Products Ostrava a.s.
A05 QA Department
Vratimovská 689
707 02 Ostrava-Kunčice
Czech Republic

E.z. 2575/16/15/P

Miscellanius Pipe MK 2-35

13

[| 00608321 | | | 860399] | [LN: 13] | ER020791-4 | FSHB18STD |

FSHB18STD

HUTA BATORY
Sp. z o.o.
UL. Dyrekcyjna 6
41-506 Chorzów
POLAND

ŚWIADECTWO ODBIORU No 3548/EXP/R/12

CERTYFICAT DE RECEPTION INSPECTION CERTIFICATE
ABNAHMEPRÜFZEUGNIS СЕРТИФИКАТ
Acc. to EN 10204:2006 type 3.1
/nr normy/

Zamawiający ALCHEMIA S.A. 00 - 842 WARSZAWA UL.ŁUCKA 7/9
Le client-Ordered by-Besteller-Заказчик

Adres wysyłkowy COUTINHO & FERROSTAAL HOUSTON, TX 77060
Adresse-Address-Versandadreesse-Адрес получателя

Nr i data zamówienia klienta No et date la commande Order No and date No und Datum der Bestellung No и число заказа	Nr zlecenia Ordre No Manuf. Order No Auftrag No No наряда	Nr awiza Avis No Advice No Versandanzeige No No извещения	Nr wagonu Wagen No Car No Wagon No No вагона
PL/ABR/12/00701 1040325300	4249046/12		

Wyszczególnienie zamówienia:
Specyfication de la commande-Order Specification-Spizifikation der Bestellung-Спецификация заказа

Przedmiot i wykonanie (stan obr. Termicz.,mech. Itp.) L'objet et l'execution (traitement thermique et l'usinage) Item and specification (Heat and mechanical treatment etc.) Gagenstand und Ausführung (therm und mechan. Bearbeitung usw.) Предмет и исполиение (состояние терм. и механобраб. и пр.)	Wymiar lub rysunek Dimensions ou dessin Dimesions or drawing Abmessung order Zeichnung Размер чертеж	Marka Marque Steel type Marke Марка	Wytop Coulée Heat Abstich Плавка	Sztuk Piéces Pieces Stück Штук	mb. ft (c. mtr.) c. mtr. 1. M. пог. м	Kg lb (kg) кг
Seamless steel pipes acc. to ASTM A106/A106M/10/A53/A53M/10/ ASME SA106/SA53/ SEC.II.P.A/10. Outside diameter tolerances +/- 1 %. Tolerances wall of thicknes +22,5/-12,5%. Outside surface double lacquered. Bevelled ends. Pipes hot finished > 850 degree C and cooled in still air. Melting proces: Electric furnace-Fully killed. No Mercury, Mercury compounds or Mercury bearing instruments and or equipment have been used in any manner which might cause contamination in manufacture, assembly or test of material. No weld repair. Fine grain practice.Country of melt and manufacture: Poland.	**18" x 0,375" (457 x 9,53 mm) 37 - 44 ft (11,28 - 13,41 m)**	**B/C**	**860399**	**10**	**412,2 (125,70)**	**30996 (14061)**

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Kontrolę techniczną powyższego zamówienia przeprowadził Oddział Technicznej Kontroli. Wyniki badań podano niżej.
Le controle technique de la été exécute par le Service de Controle. Les resultats des essais sont indiqués ci-aprés.
The technical investigation of this order has been executed by the Works Control. Results of tests are as follows.
Die technische Prüfung obiger Bestellung wurde von der Fabrikationskontrolle durchgeführt. Die Ergebnisse der Proben sind nachstehend angeführt.
Технический контроль вышеупомянутого заказа произвел Отдел Технического Контроля. Результат испытания представлен ниже.

1. **SKŁAD CHEMICZNY** - ANALYSE CHIMIQUE – CHEMICAL COMPOSITION – CHEMISCHE ZUSAMMENSETZUNG ХИМИЧЕСКИЙ СОСТАВ

Wytop Coulée Heat Abstich Плавка	C	Mn	Si	P	S	Cr	Ni	Cu
860399	0,17	0,98	0,23	0,010	0,009	0,09	0,08	0,16
control anal.	0,20	0,99	0,23	0,010	0,012	0,10	0,08	0,17
	0,19	0,97	0,23	0,009	0,009	0,10	0,08	0,17
	Mo	V	Ceq					
	0,02	0,00	0,37					
	0,02	0,00	0,41					
	0,02	0,00	0,39					

Miscellanius Pipe MK 2-37

2. BADANIA MECHANICZNE – ESSAIS MECANIQUES – MECHANICAL TESTS – MECHANISCHE UNTERSUCHUNGEN
МЕХАНИЧЕСКИЕ ИСПЫТАНИЯ

Nr wytopu lub próby No de la coulée ou De l'eprouvette Heat No Or. Tests No Abstich Oder Probe No No плавки или пробы	Stan obróbki Termicznej Traitement thermique Heat treatement Therm. Bearbeitung Термич. обработка	Yield Re PSI MPa min 275	Tensile Rm PSI MPa min 485	A 2" % min 30,0	Z %	U	Twardość Dureté Hardness Härte Твердость
Test size:1 1/2" longitudinal 860399/20496		53083 (366)	77595 (535)	33,9			Hardness guarantee - max 22 HRC. Pipes in accordance with NACE MR 0175/ ISO - 15156-2/03 AN.A.p.A 2.1.2 and NACE MR 0103/2005 P.2.1

3.BADANIA TECHNOLOGICZNE – ESSAIS TECHNOLOGIQUES – TECHNOLOGICAL TESTS – TECHNOLOGISCHE PRÜFUNGEN
Flattening test - positive results

4. INNE BADANIA – AUTRES ESSAIS – OTHER TESTS – ANDERE UNTERSUCHUNGEN – ДРУГИЕ ИСПЫТАНИЯ

Each pipes has been hydrostatically tested by pressure 1015 PSI - positive results time 5 s

5. UWAGI DODATKOWE – ADDITIONAL REMARKS – AUTRESOBSERVATIONS – ANDERE BEMERUNGEN
Huta Batory Sp.z o.o. has Quality Management System accordance with Directive 97/23/EC (PED) – Annex I – par. 4.3 –cert.TÜV no 07-202-3537 WP/WZ 0888/10.

Powierzchnię i wymiary zbadano w 100% - Surface et dimensions ont éte controlés et 100% - Surface and dimensions tested at 100%
Oberfläche und Abmessungen geprüft zu 100% - Наружный осмотр и проверка измерений произведены в 100% - **positive results**

Niniejszym potwierdzam, że wyżej wymieniony materiał został zbadany i spełnia warunki potwierdzenia zamówienia - Par la presente je confirme que le materiel susmentionne a ete examine et il remplit les conditions de la confirmation de commande.- We hereby certify, that the material described above has been tested and complies with the terms of the order.- Es wird bestaetigt, dass das oben genannte Material geprueft wurde und den Bedingungen der Bestellung entspricht.- Подтверждаем, что вышеуказанный материал был протестирован и соответствует условиям подтверждения договора.

Material oznaczono – La material est marqué – Material marked – Das Material wurde bezeichnet – Материал обозначен
Acc.to A106/A53/SA106/SA53/B/C.

B

Na podstawie wyżej przeprowadzonych prób material zwolniono – Sur la base des essais si-dessus le material est dliv-According to the carried out tests the material released – Untersuchungen wurde das Material freigegeben – На основании вушенменованных Испытаний признан годным.

Kontrola Jakości Contrôle de Fabrication Control of Manufacture Fabrikationskontrolle Технический контроль	Dyrekcja Huty Direction de l'Usine Works Management Hütten - Direktion Дирекция Завода	
SPECJALISTA Z ZAKRESU KONTROLI JAKOŚCI *mgr Barbara Czyż*	Kierownik Działu Kontroli Jakości i Technologii inż. Jerzy Nowaczyk	dn. 30.08. 2012 r.

KJ 21/631

Miscellanius Pipe MK 2-37

[| 00608321 | | | 1014364396] | [LN: 17] | ER020791-4 | FSVAT4120 |

voestalpine Tubulars GmbH & Co KG

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

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

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

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FSVAT 4120

INSPECTION - CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

No. 105797

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

Hersteller: Manufacturer: Producteur:	voestalpine Tubulars GmbH & Co KG, Austria	Auftrags-Nr.: Our works order No.: No usine:	17500 / 16
Besteller: Purchaser: Archeteur:	VOEST-ALPINE TUBULAR CORPORATION USA-77042 HOUSTON TEXAS INDUSTRIAL PIPING SPEC., TULSA OK 74158-1270, US	Bestellnr.: Your order No.: No de la commande:	MIP00080/VATC PO#410606
Pruefgegenstand: Object of tests: Eprouvette:	**Line Pipe** **LP-USA-02** **LINEPIPE-01.0** **non upset ends (API 5 D + 5 L) - non upset** **UV coating**	Zeichen des Lieferwerks: Marking of producer: Marque du fabricant:	**va**
		Erschmelzungsart: Melting process: Procédé d'élaboration:	**BOF** fully killed, produced to fine grain practice
Werkstoff: Material: Matières:	GRADE B / GRADE X42/ GRADE C		
Anforderungen: Requirements: Exigence:	Gr B acc. ASTM A 106 / A 106 M -ASME SA 106 - 2014 Gr B acc. ASTM A 53 / A 53 M - ASME SA 53 - 2012 Gr B / X42 acc. API SPEC 5 L (PSL1)-45.edition - 2012 NACE MR 0175 / ISO 15156-2009 NACE MR0103-2012 (latest edition) LINEPIPE-01.0		
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE, BOTH ENDS BEVELLED ACC. TO API/ASTM (30°)		
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" 11/14 4.500" x 0.438" B/X42 PSL1 SMLS 2970 PSI length ft heat no A/SA 53 Grade B S A/SA 106 Grade B Sched 120 PO# MIP00080 MADE IN AUSTRIA		
Colour coding:	Fully painted:	Bands: Purple	
Label:	PO No.: MIP00080, DAT QUAY Port of Houston, TX		
Remarks:	*) Grade C without marking on tubes SI units have been converted to US customary units		

Kindberg, 18.11.2014

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

voestalpine
ONE STEP AHEAD.

No. 105797

Miscellanius Pipe MK 4-83

1 of 5

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:
	16	4.500 In x 0.438 In 19,01 lbs/ft	1-53	511	21 367.703ft	184 889.00kg		

Volume of delivery

Heat	Lot			Remark
1014364396	193480	--	01	
1014364397	193481	--	01	
1014364398	193482	--	01	
1014364399	193483	--	01	

Test results

1 Dimensionskontrolle/ Dimensional Inspection: bestanden/passed

2 Ringfaltversuch/Flattening test: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: 2970 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, 18.11.2014

voestalpine Tubulars GmbH & Co KG
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No. 105797

Miscellanius Pipe MK 4-83 2 of 5

voestalpine Tubulars GmbH & Co KG

Tensile testing

Lot No	Test Type	Heat treatment	Temp	Specimen			Yield Strength	Tensile Strength	Elong.	Reduct. in area	Rt/Rm
			[°C]	No.	Type	Dimension [mm]	[PSI]	[PSI]	[%]	[%]	
							Requ. from 42 061	60 190	26.50		
							Requ. to				
193480 --	01	Standard	as rolled	20	1	Strip	25.32 x 11.30 Rt0.50	48 442	72 808	35.30	0.67
193481 --	01	Standard	as rolled	20	1	Strip	25.35 x 11.39 Rt0.50	48 297	72 228	36.00	0.67
193482 --	01	Standard	as rolled	20	1	Strip	25.40 x 11.38 Rt0.50	52 213	74 984	35.50	0.70
193483 --	01	Standard	as rolled	20	1	Strip	25.39 x 11.20 Rt0.50	48 587	73 679	34.30	0.66

yield strength:
Gr B: 35500 PSI
X42: 42100 PSI
Gr C: 40000 PSI
tensile strength:
Gr B: 60200 PSI
X42: 60200 PSI
Gr C: 70000 PSI

Hardness testing

Lot No	Test Type	Heat treatment	Specimen No.	Location	Test Method	Hardness Number from	Hardness Number to	Mean Hardness Number from	Mean Hardness Number to	Variation
						Requ.:			99.50	
193480 --	01	Standard	as rolled	1	Body	HRB	80.90	82.00	81.27	81.80	0.53
193481 --	01	Standard	as rolled	1	Body	HRB	80.50	81.40	80.80	80.97	0.17
193482 --	01	Standard	as rolled	1	Body	HRB	81.50	82.20	81.83	81.93	0.10
193483 --	01	Standard	as rolled	1	Body	HRB	81.60	82.30	81.83	82.10	0.27

Kindberg, 18.11.2014

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

No. 105797

Miscellanious Pipe MK 4-83 3 of 5

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														
1014364396																	
0.1753	0.2596	0.9553	0.0145	0.0071	0.0503	0.0234	0.0237	0.0294	0.0015	0.0062	0.0033	0.0012	0.0002	0.0047	0.0411	0.0023	0.3496
1014364397																	
0.1748	0.2610	0.9646	0.0141	0.0056	0.0374	0.0135	0.0180	0.0312	0.0015	0.0048	0.0032	0.0002	0.0000	0.0049	0.0379	0.0028	0.3467
1014364398																	
0.1782	0.2652	0.9486	0.0151	0.0048	0.0339	0.0142	0.0184	0.0295	0.0016	0.0031	0.0031	0.0007	0.0002	0.0056	0.0380	0.0028	0.3465
1014364399																	
0.1741	0.2647	0.9644	0.0137	0.0072	0.0434	0.0405	0.0194	0.0307	0.0015	0.0095	0.0031	0.0009	0.0002	0.0071	0.0396	0.0026	0.3500

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. 193480 -- 01 1 Standard Heat No. 1014364396																	
0.1742	0.2407	0.9369	0.0145	0.0077	0.0457	0.0300	0.0207	0.0255	0.0020	0.0086	0.0048	0.0016	0.0004	0.0000	0.0382	0.0000	0.3456
Lot No. 193480 -- 01 2 Standard Heat No. 1014364396																	
0.1702	0.2361	0.9281	0.0144	0.0073	0.0458	0.0279	0.0214	0.0251	0.0019	0.0080	0.0046	0.0015	0.0004	0.0000	0.0371	0.0000	0.3399
Lot No. 193481 -- 01 1 Standard Heat No. 1014364397																	
0.1735	0.2452	0.9250	0.0151	0.0068	0.0324	0.0139	0.0173	0.0254	0.0019	0.0048	0.0040	0.0015	0.0004	0.0000	0.0330	0.0000	0.3380
Lot No. 193481 -- 01 2 Standard Heat No. 1014364397																	
0.1675	0.2416	0.9131	0.0150	0.0066	0.0322	0.0143	0.0172	0.0251	0.0018	0.0046	0.0038	0.0015	0.0004	0.0000	0.0314	0.0000	0.3299
Lot No. 193482 -- 01 1 Standard Heat No. 1014364398																	
0.1721	0.2399	0.9063	0.0141	0.0051	0.0303	0.0133	0.0166	0.0242	0.0017	0.0032	0.0042	0.0014	0.0003	0.0000	0.0324	0.0000	0.3327
Lot No. 193482 -- 01 2 Standard Heat No. 1014364398																	
0.1732	0.2360	0.8982	0.0151	0.0061	0.0298	0.0138	0.0167	0.0239	0.0017	0.0033	0.0040	0.0009	0.0004	0.0000	0.0321	0.0000	0.3324

Kindberg, 18.11.2014

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

voestalpine
ONE STEP AHEAD.

No. 105797

Miscellanius Pipe MK 4-83 4 of 5

[| 00608321 | | | 1014364396] | [LN: 17] | ER020791-4 | FSVAT4120 |

voestalpine Tubulars GmbH & Co KG

Chemical test results

Product analysis

Lot No. 193483 -- 01 1 Standard Heat No. 1014364399

0.1759	0.2496	0.9512	0.0143	0.0088	0.0412	0.0406	0.0182	0.0270	0.0019	0.0108	0.0048	0.0015	0.0004	0.0000	0.0371	0.0000	0.3497

Lot No. 193483 -- 01 2 Standard Heat No. 1014364399

0.1763	0.2474	0.9507	0.0142	0.0089	0.0409	0.0401	0.0188	0.0264	0.0019	0.0107	0.0048	0.0018	0.0004	0.0000	0.0374	0.0000	0.3500

Kindberg, 18.11.2014

Page 5 of 5

No. 105797

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

voestalpine
ONE STEP AHEAD.

Miscellanius Pipe MK 4-83 5 of 5

Miscellanious Pipe MK3-71 and MK3-73

18, 19

FSBOL6XH

RECEIVED FEB 15 2017 L. Dawson

HR056624

BOLY PIPE CO., LTD. MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng, Rayong, Thailand/21140
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	SEAMLESS STEEL PIPE (LINE PIPE)
PURCHASER		ORDER NO.	2014001-8
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	2014001-8 / API Cert. NO. 5L-0956
Grade	X42/B PSL1	L/C NO.:	/ DATE 2014-4-15

Size	6"×sch80(0.432")	Length range		DRL		Total Length (FT)	64928.386	Total Bundles	340
Order Quantity (MT)	850	Total Joints	1646	Total Weight (MT)	854.697	Delivery Condition		CHAMFER	
Making Method	Hot Finished, Seamless								

No.	Heat No.	* 1	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000														Batch No.	Mechanical Properties				Impact Test (Temperature 0° C)			Hardness	Quantity		Length	Weight
			* 2	2 C	2 Si	2 Mn	3 P	3 S	2 Cr	2 Ni	2 Cu	3 Mo	3 V	3 Ti	3 Nb	3 Al		* 3	* 4	Y.S.	T.S.	E.L.%	Size (mm)	T(J)	L(J)	HB (Average)	Bundle	Jts	FT	MT
	min																min	Mpa		290	415	29				<225				
	max			28		130	30	30									max													
1	13100083-1		H	16	25	107	12	2	34.4	2.8	5.6	5				20	YSJ21403135			330	505	37				149	31	152	5998.32	78.292
			P	15	23	105	12	2	34.1	2.5	5.3	5				19														
			P	14	24	104	11	1	34.2	2.6	5.4	4				18														
2	13100084-1		H	17	24	106	11	1	34.2	3	2.8	5				20	YSJ21403134			325	515	36				155	33	155	6117.14	79.12
			P	16	24	103	11	1	34.2	2	2.6	4				19														
			P	15	23	104	10	1	34.2	2	2.5	5				18														
3	13100085-1		H	18	27	108	9	1	34.4	3.1	5.5	4				20	YSJ11403137			320	520	35				153	22	110	4340.97	56.318
			P	17	26	106	7	1	34.1	3.1	5.5	3				18														
			P	16	25	107	8	1	34.2	3.1	5.5	2				19														
4	13100086-1		H	16	26	105	8	1	35	3.1	6.4	5				20	YSJ11403136			325	515	35.5				155	35	172	6787.87	88.96
			P	15	24	103	7	1	33	3.1	6.2	4				18														
			P	14	25	104	8	1	34	3.1	6.3	3				19														

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS
Pipe ends Land(1.5±0.8)mm	PASS	Drift Test	/								

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30+5)°	Heat Treatmen	O.D Size	I.D Size	W.T.Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES	G.L.=Gauge Length *1 Process C= Electric Furnace & Continuous Casting *2 Chemical Composition H=Heat(ladle)Analysis *3 Sampling Position P=Pipe Body *4 Size 2= StripTX38mm.
INSPECTORS TO	WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE . MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.HARDNESS FOR NACE MR-0103.
Shi Xiu Feng	Q.A Signature

[| 00608321 | | 14010239-1] | [LN: 18] | ER020791-4 | FSBOL6XH |

1 of 3

[| 00608321 | | 14010239-1] | [LN: 18] | ER020791-4 | FSBOL6XH |

miscellanious Pipe MK3-71 and MK3-73 2 of 3

BOLY PIPE CO., LTD.

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, Thailand/21140
Phone Number:+66-33-010-907,+66-33-010-909

MILL TEST CERTIFICATES

EN10204/3.1

| | | |

Miscellanius Pipe MK3-71 and MK3-73 3 of 3

[| 00608321 | | | 14010239-1] | [LN: 18] | ER020791-4 | FSBOL6XH |

BOLY PIPE CO., LTD.

MILL TEST CERTIFICATES

EN10204/3.1

Address: 7/342 M.6, T.Mapyangpon A.Pluakdaeng,
Rayong, Thailand/21140
Phone Number:+66-33-010-907,+66-33-010-909

CUSTOMER		PRODUCT	SEAMLESS STEEL PIPE (LINE PIPE)		
PURCHASER		ORDER NO.	2014001-8		
Standard	API spec. 5L 2012 ;ASTM A106-GRADE B 2011;ASMESA106-GRADE B 2011; ASTM A53-GRADE B 2012;ASME SA53-GRADE B 2011;ASTM A530-12	S/C.NO:	2014001-8	API Cert. NO.	5L-0956
Grade	X42/B PSL1	L/C NO.:	/	DATE	2014-4-15

Size	6"×sch80(0.432")	Length range	DRL	Total Length (FT)	64928.386	Total Bundles	340	Order Quantity (MT)	850		
Total Joints	1645	Total Weight (MT)	854.697	Delivery Condition		CHAMFER		Making Method		Hot Finished, Seamless	

No.	Heat No.	*	*	Chemical Composition (%) 1=X10,2=X100,3=X1000,4=X10000,5=X100000													Batch No.	Mechanical Properties			Impact Test (Temperature 0° C)			Hardness	Quantity		Length	Weight
				2	2	2	3	3	2	2	2	3	3	3	3	3		*	*									
		1	2	C	Si	Mn	P	S	Cr	Ni	Cu	Mo	V	Ti	Nb	Al		3	4	Y.S.	T.S.	E.L.%	Size (mm)	T(J)	L(J)	HB (Average)	Bundle	Jts	FT	MT
	min																	min	Mpa	290	415	29				<225				
	max			28		130	30	30										max												
9	14010236-1		H	15	28	100	11	6	35	2	5	8	18	2	4		YSJ11403129			320	505	40				149	32	156	6157.08	81.87
			P	14	25	98	9	5	35	2	3	7	17	2	2															
			P	13	27	99	8	5	34	1	4	8	16	2	3															
10	14010238-1		H	16	25	102	11	5	36	2	4	12	19	2	4		YSJ11403128			340	515	35				151	31	148	5840.01	77.048
			P	15	23	101	8	4	35	2	3	11	17	2	3															
			P	14	24	99	10	5	34	1	3	10	18	2	3															
11	14010238-1		H	16	25	102	11	5	36	2	4	12	19	2	4		YSJ21403139			350	520	37				155	2	6	205.79	2.736
			P	15	23	101	9	5	34	2	2	10	17	2	2															
			P	14	24	100	10	4	35	2	3	11	18	2	3															
12	14010239-1		H	16	26	99	12	5	33	2	4	10	18	3	4		YSJ21403127			360	520	33				158	32	158	6235.06	82.218
			P	14	24	98	10	4	31	2	2	9	16	3	2															
			P	15	25	97	11	3	32	2	3	8	17	2	3															

E.T.	/	E.M.I	PASS	U.T	/	M.P.I	PASS	Coating	PASS	Visual	PASS	Pipe ends Land(1.6±0.8)mm	PASS	Drift Test	/

Expansion	Residual Magnetism Measurement	Flattening	Bending	Hydrostatic Test (20.5MPa/6s)	Chamfer Inspection (30+5)°	Heat Treatmen	O.D Size	I.D Size	W.T Measure
/	PASS	/	/	PASS	PASS	/	PASS	PASS	PASS

NOTES: G.L=Gauge Length *1 Process C= Electric Furnace & Continuous Casting *2 Chemical Composition H=Heat(ladle)Analysis *3 Sampling Position P=Pipe Body *4 Size 2= StripTX38mm

INSPECTORS TO: Shil xiu Fang

WE HEREBY CERTIFY THAT THE MATERIAL HEREIN DESCRIBED HAS BEEN MANUFACTURED SAMPLED, TESTED AND INSPECTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE ABOVE SPECIFICATIONS AND PURCHASE ORDER.WE HEREBY CERTIFY THAT THE MATERIAL ARE MERCURY FREE / NO WELD REPAIR FINE GRAIN PRACTICE . MEETS HARDNESS PER ANSI/NACE MR0175/ISO 15156:2009.HARDNESS FOR NACE MR-0103.

Q.A Signature: He Tian Hang

[| 00608321 | | | 870603] | [LN: 16] | ER020791-1 | FSHB20STD |

16

alchemia

ALCHEMIA S.A.
Oddział Walcownia Rur Batory
w Chorzowie
ul. Dyrekcyjna 6
41-506Chorzów
POLAND
(A01)(A04)

(A03)

ŚWIADECTWO ODBIORU No 4044/EXP/R/15

CERTYFICAT DE RECEPTION INSPECTION CERTIFICATE
ABNAHMEPRÜFZEUGNIS СЕРТИФИКАТ

(A02) Acc. to EN 10204:2006 type 3.1
/nr normy/

FSHB20STD HRD61899

(A06) **Zamawiający** STEEL & COMMODITIES MC 98000 MONACO
Acheteur-Customer-Besteller-Заказчик

(A06) **Adres wysyłkowy**
Adresse-Address-Versandadreesse-Адрес получателя

(A07) Nr zamówienia klienta Numéro de la commande du client Purchaser's order No Kundenbestellnummer No заказа	(A08,09) Nr potwierdzenia No de la commande Manuf. Order No Werksauftragsnummer Приказ №
PL/ABR/15/00711 2381	4239244/15

Wyszczególnienie zamówienia:
Specyfication de la commande-Order Specification-Spizifikation der Bestellung-Спецификация заказа

Wyrób i wymagania dodatkowe (stan obr. termicz.,mech. itp.) Produit et prescriptions supplémentaires (traitement thermique et l'usinage) Product and any supplementary requirements (Heat and mechanical treatment etc.) Erzeugnis und Zusätzliche Anforderungen (therm und mechan. Bearbeitung usw.) Продукта и дополнительные требования (состояние терм. и механобраб. и пр.)	Wymiar wyrobu Dimensions du produit Product dimensions Masse des Erzeugnisses Размер продукта	Oznaczenie stali Désignation del'acier Steel designation Stahlbezeichnung Марка стали	Wytop Coulée Heat Abstich Плавка	Sztuk Pièces Pieces Stück Штук	mb ft (c. mtr.) c. mtr. l. M. пог. м	kg lb (kg) кг
(B01,B03) Seamless steel pipes acc. to ASTM A106/ A106M/14/A53/A53M/12/ ASME SA106/ SA53/SEC.II.Part.A/13. Outside diameter tolerances +/- 1 %. Tolerances of wall thickness +22,5/-12,5% Outside surface double lacquered. Bevelled ends. Pipes hot finished > 850 °C and cooled in still air. Melting proces Electric furnace-Fully killed.No Mercury, Mercury compounds or Mercury bearing instruments and or equipment have been used in any manner which might cause contamination in manufacture, assembly or test of material. No weld repair. Fine grain practice. *Country of melt and manufacture: Poland.*	(B09) 20" x 0,375" (508 x 9,53 mm) 37 - 45 ft (11,28 - 13,72 m)	(B02) B/C	(B07) 870603	(B08) 2	(B15) 75,20 (22,91)	(B13) 6234 (2828)

RECEIVED
JAN 17 2017
L. Dawson

Kontrolę techniczną powyższego zamówienia przeprowadził Oddział Technicznej Kontroli. Wyniki badań podano niżej.
Le controle technique de la été exécute par le Service de Controle. Les resultats des essais sont indiqués ci-après.
The technical investigation of this order has been executed by the Works Control. Results of tests are as follows.
Die technische Prüfung obiger Bestellung wurde von der Fabrikationskontrolle durchgeführt. Die Ergebnisse der Proben sind nachstehend angeführt.
Технический контроль вышеупомянутого заказа произвел Отдел Технического Контроля. Результат испытания представлен ниже.

1. SKŁAD CHEMICZNY - COMPOSITIO CHIMIQUE – CHEMICAL COMPOSITION – CHEMISCHE ZUSAMMENSETZUNG
(C71-C92) ХИМИЧЕСКИЙ СОСТАВ

Wytop Coulée Heat Abstich Плавка	C	Mn	Si	P	S	Cr	Ni	Cu
(B07) 870603 control anal. control anal.	0,14 0,14 0,14	1,12 1,12 1,13	0,20 0,20 0,21	0,007 0,007 0,006	0,004 0,003 0,003	0,07 0,07 0,07	0,07 0,07 0,07	0,13 0,13 0,13
	Mo	V	Ceq					
	0,04 0,04 0,04	0,04 0,04 0,04	0,37 0,37 0,37					

Miscellanius Pipe MK 2-36

[| 00608321 | | | 870603] | [LN: 16] | ER020791-1 | FSHB20STD |

2. BADANIA MECHANICZNE – ESSAIS MECANIQUES – MECHANICAL TESTS – MECHANISCHE UNTERSUCHUNGEN МЕХАНИЧЕСКИЕ ИСПЫТАНИЯ

Nr wytopu lub próby No de la coulée ou De l'eprouvette Heat No Or. Tests No Abstich Oder Probe No No плавки или пробы	Yield Re PSI MPa min 275	Tensile Rm PSI MPa min 485	A 2" % min 30,0	Z %	Badanie udarności Impact Impact test Kerbschlagprobe Испытание на удар (C40,C41,C02) Wartość pojedyncza Valeurs individuelles Individual values Einzelwerte Единственный результат	Średnia Moyenne Mean Mittel Средний	Twardość Dureté Hardness Härte Твердость (C30)	^0C MPa min
(B07,C02,C00)	(C11)	(C12)	(C13)	(C50-69)	(C42)	(C43)	(C31)	(C50-C69)
Test size: 1½" 870603/19597 L	51488 (355)	71068 (490)	41,9				Hardness quarantee - acc.to NACE MR 0175/ISO 15156-2/03 AN.A.P.A.2.1.2 and NACE MR 0103/05 P.2.1 MAX 22HRC/237HB	

3. INNE BADANIA – AUTRES ESSAIS – OTHER TESTS – ANDERE UNTERSUCHUNGEN – ДРУГИЕ ИСПЫТАНИЯ (D51-D99)

(Z04)

BADANIA TECHNOLOGICZNE – ESSAIS TECHNOLOGIQUES – TECHNOLOGICAL TESTS – TECHNOLOGISCHE PRÜFUNGEN ТЕХНОЛОГИЯ ИССЛЕДОВАНИЯ

Flattening test - positive results

Each pipes has been hydrostatically tested by pressure 870 PSI - positive results time 5 s

4. BADANIA NIENISZCZĄCE - Essais Non Destuctifs – Non Destructive Tests – Zerstörungsfreie Prüfungen - Неразрушающий Контроль (D02-D50)

Numery rur - Le nombre de tubes - Numbers of tubes - Nummern von Röhren - Номера трубок

5. UWAGI DODATKOWE – Additional Remarks – Autresobservations – Andere Bemerungen- Дополнительные примечания (Z05-Z99)

Manufacturer has Quality Management System accordance with Directive 97/23/EC (PED) – Annex I – par. 4.3 –TÜV Nord, Certificate No 07-203-9120 WZ-0888/13 and Certificate No 07-202-9120 WZ-0888/13 and ISO 9001/TUV Certificate No 04100 950250.

(Z01)Powierzchnię i wymiary zbadano w 100% - Surface et dimensions ont été controlés at 100% - Surface and dimensions tested at 100%
Oberfläche und Abmessungen geprüft zu 100% - Наружный осмотр и проверка измерений произведены в 100% - **positive results**

(Z01)Niniejszym potwierdzam, że wyżej wymieniony material został zbadany i spełnia warunki potwierdzenia zamówienia - Par la presente je confirme que le materiel susmentionne a ete examine et il remplit les conditions de la confirmation de commande.- We hereby certify, that the material described above has been tested and complies with the terms of the order.- Es wird bestaetigt, dass das oben genannte Material geprueft wurde und den Bedingungen der Bestellung entspricht.- Подтверждаем, что вышеуказанный материал был протестирован и соответствует условиям подтверждения договора.

(D01)Cechowanie – Marquage – Marking –Kennzeichnung – Обозначен
Acc.to A106/B/C/A53/B/ SA106/B/C/SA53/B.

B

(D51-D99)Na podstawie wyżej przeprowadzonych prób material zwolniono – Sur la base des essais si-dessus le material est dliv-According to the carried out tests the material released – Untersuchungen wurde das Material freigegeben – На основании вушеименованных Испытаний признан годным.

Kontrola Jakości Contrôle de Fabrication Control of Manufacture Fabrikationskontrolle Технический контроль (Z03)	Dyrekcja Direction Management Direktion Дирекция (Z05)	(Z02)
SPECJALISTA DS. ZARZĄDU KONTROLI JAKOŚCI Halina Kehmer	KIEROWNIK Działu Kontroli Jakości i Nadzoru Technologicznego Grzegorz Datta	dn. 20.08. 2015 r.

4044/EXP/R/15

Miscellanius Pipe MK 2-36

2 of 2

voestalpine Tubulars GmbH & Co KG

Alpinestrasse 17
8652 Kindberg-Aumuehl
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F. +43/050304/63-532
www.voestalpine.com/tubulars

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

14, 15

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FSVAT2.5STD

MILL TEST CERTIFICATE 3.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1

(gem. EN 10204)

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

No. 122503 Rev.: 0

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-02-PSL2** **LINEPIPE-01.0** **non upset ends (API 5 D + 5 L) - non upset** **UV coating**
Werkstoff: Material: Matières:	GRADE B / GRADE BN /GRADE X42N / GRADE C
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 BN/X42N acc. to API 5 L, 45.edt.-2012 (PSL2) NACE MR 0175 / ISO 15156-2015 NACE MR 0103-2015 LINEPIPE-01.0; LP-USA-02-PSL2
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE, both ends bevelled acc. to API/ASTM (30°)
Wärmebehandlung: Heat treatment: Traitment de chaleur:	NORMALIZED ROLLED
Coupl.die stamped: Coupl.paint stencilling: Coupl.Colour coding:	Fully painted: Bands:
Tube die stamped: Tube paint stencilling:	va SPEC 5L-0033 "API" 07.2016 2.875" x 0.203" BN X42N PSL2 SMLS 2970 PSI Length FT Heat No. Lot No. A/SA 53 Grade B S A/SA 106 Grade B Sched.40 PO# HR068855 MADE IN AUSTRIA
Tube Colour coding:	Fully painted: Bands: purple
Label:	PO No.: HR068855, DAT Port of Houston TX
Remarks:	*) Grade C without marking on tubes *) SI units have been converted to US customary units *) (Nb+V) <= 0,06%

Auftrags-Nr.: Our works order No.: No usine:	21600 / 5
Bestellnr.: Your order No.: No de la commande:	HR068855/VATC PO# 605620
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, 12.08.2016

No. 122503

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
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
représentant autorisé du controle

voestalpine
ONE STEP AHEAD.

Miscellanious Pipe MK 2-41 and MK 2-44

1 of 8

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:
	5	2,875 in x 0,203 in 5,80 lbs/ft	1-4	117	4661,096 ft	12456,50 kg	

Volume of delivery

Heat	Lot	Remark
1016382797	208020 -- 01	

Kindberg, 12.08.2016

No. 122503

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Miscellaneous Pipe MK 2-41 and MK 2-44

voestalpine Tubulars GmbH & Co KG

Additional tests and inspections performed on pipe

1 Dimensionskontrolle/ Dimensional Inspection: bestanden/passed

2 Ringfaltversuch/Flattening test:bestanden/passed

3 Streuflusspruefung gem. ASTM E 570 / Flux Leakage testing acc. ASTM E 570: bestanden/passed

4 Ultraschallpruefung gem. Norm (Wanddicke - 100 % Umfang)/Ultrasonic inspection acc. to standard (wallthickness - 100 % circumference): bestanden/passed

5 Visuelle Inspektion/ Visual Inspection: bestanden/passed

6 Wasserinnendruckversuch/Hydrostatic test: bestanden/passed, Mindestpruefdruck/min test pressure: 2970 PSI, min.Haltezeit/min duration: 5 sec

7 Streuflusspruefung/Diverted flux acc. API 5 L (old version - SR 4) OD + ID, longitudinal 12.5 %: 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, 12.08.2016

No. 122503

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Miscellanius Pipe MK2-41 and MK2-44

voestalpine Tubulars GmbH & Co KG

Tensile testing

Lot No	Test Type	Heat treatment	Loc.	Temp	Specimen				Yield Strength	Tensile Strength	Elong. gage length	Reduct. in area	Rt/Rm
				[°F]	No.	Type	Dimension[inch]		[PSI]	[PSI]	[%] [inch]	[%]	
								Requ. from	42061	60190	21.50		
								Requ. to	71793	94999			0.93
208020 -- 01	Standard	normalized rolled	Rear	68	1	Strip-long	0.74 x 0.22	Rt0.50	54679	73679	33.00 2		0.74
								yield strength:	Requ. from - to				
								GR B/ BN / X42N:	42100 PSI - 71800 PSI				
								Gr C:	40000 PSI				
								tensile strength:	Requ. from - to				
								GR B/ BN / X42N:	60200 PSI - 95000 PSI				
								Gr C:	70000 PSI				

Kindberg, 12.08.2016

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Miscellanious Pipe MK2-41 and MK 2-44

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voestalpine Tubulars GmbH & Co KG

Hardness testing

Lot No	Test Type	Heat treatment	Specimen Loc.	No.	Location	Test Method	Hardness Number from	to	Mean Hardness Number from	to	Variation
						Requ.:				99.50	
208020	– 01	Standard	normalized rolled	Rear	1	Body HRB	80.70	82.00	81.13	81.60	0.47

Kindberg, 12.08.2016

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Miscellanius Pipe MK 2-41 and MK 2-44

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Impact testing

Requirement:	Length [inch] 2.165	Wide [inch] .394	Height [inch] .13	Specimen Orientation long.	Type CH-V	Temp. [°F] - 20	[	Single ft-lbs	] [	Average ft-lbs -1	Factor]

Lot No	Test Type	Heat Treatment	Loc.	No.			Single1	Single2	Single3	Average	Unit
208020 -- 01	Standard	normalized rolled	Rear	1	long.	Imp. Values:	33	32	31	32	ft-lbs
Werte informativ!						Including Factor:					
						Shear-Area [%]:					
						Lateral Expansion (un-/broken):					
						Lateral Expansion: [inch]				H: .13	[inch]

Kindberg, 12.08.2016

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Miscellanius Pipe MK2-41 and MK2-44

voestalpine Tubulars GmbH & Co KG

Chemical testing

Heat analysis

	C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
min. Requ.	0.0000	0.1000	0.2900															
max. Requ.	0.2300	0.4000	1.0600	0.0250	0.0150	0.3000	0.3000	0.4000		0.0400	0.1500	0.0600		0.0010		0.0500		0.4000
1016382797	0.1751	0.2493	0.9599	0.0121	0.0056	0.0468	0.0203	0.0197	0.0265	0.0019	0.0040	0.0016	0.0009	0.0003	0.0072	0.0393	0.0023	0.3482

Kindberg, 12.08.2016

No. 122503

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Miscellanius Pipe MK2-41 and MK2-44

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voestalpine Tubulars GmbH & Co KG

Chemical testing

Product analysis

C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
Lot No. 208020 -- 01 1 Standard Heat No. 1016382797																	
0.1790	0.2372	0.9429	0.0103	0.0054	0.0328	0.0167	0.0218	0.0279	0.0022	0.0036	0.0038	0.0020	0.0003	0.0050	0.0385	0.0000	0.3468
Lot No. 208020 -- 01 2 Standard Heat No. 1016382797																	
0.1797	0.2526	0.9582	0.0095	0.0055	0.0324	0.0160	0.0211	0.0294	0.0023	0.0033	0.0043	0.0019	0.0004	0.0037	0.0385	0.0000	0.3499

Kindberg, 12.08.2016

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Miscellanius Pipe MK 2-41 and MK 2-44

8 of 8

[| 16C77718 | | | 1013444472] | [LN: 1] | T0378778-1 | FSVAT2XXH |

voestalpine Tubulars GmbH & Co KG

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8652 Kindberg-Aumuehl
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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

INSPECTION - CERTIFICATE 3.1 Rev.1

(according to EN 10204)

ABNAHMEPRUEFZEUGNIS 3.1 Rev.1

No. 86939

(gem. EN 10204)

CERTIFICAT DE CONTROLE DES PRODUITS PAR L'USINE 3.1

(selon EN 10204)

Hersteller: Manufacturer: Producteur:	voestalpine Tubulars GmbH & Co KG, Austria
Besteller: Purchaser: Archeteur:	VOEST-ALPINE TUBULAR CORPORATION USA-77042 HOUSTON TEXAS INDUSTRIAL PIPING SPEC. INC., TULSA OK 74158-1270
Pruefgegenstand: Object of tests: Eprouvette:	SEAMLESS STEEL TUBES, LINE PIPE
Werkstoff: Material: Matières:	GRADE B / GRADE X42 / GRADE C
Anforderungen: Requirements: Exigence:	Gr B acc. ASTM A 106 / A 106 M - ASME SA 106-2011 Gr B acc. ASTM A 53 / A 53 M - ASME SA 53-2012 Gr B acc. API SPEC 5 L (PSL1)-2007 X42 acc. API SPEC 5 L (PSL1)-2007 NACE MR 0175 / ISO 15156-2009 NACE MR0103-2010 (latest edition) LINEPIPE-01.0
Ausführung: Condition: Cond. de livraison:	NU, PLAIN END, PE, BOTH ENDS BEVELLED ACC. TO API/ASTM (30°)
Wärmebehandlung: Heat treatment: Traitment de chaleur:	AS ROLLED
Coupl.die stamped:	
Coupl.paint stencilling:	
Colour coding:	Fully painted: Bands:
Tube die stamped:	
Tube paint stencilling:	heat no va SPEC 5L-0033 "API" 02/13 API 5L B/API 5L X42 PSL1 A/SA 53 GRADE B/() S A/SA 106 GRADE B 2.375" x 0.436" SMLS 2970 PSI length ft heat no PO# MIP00004 MADE IN AUSTRIA/().
Colour coding:	Fully painted: Bands: Purple
Label:	PO No.: MIP00004 DAT Port of Houston TX
Remarks:	*) Grade C without marking on tubes

Auftrags-Nr.: 12408 / 2
Our works order No.:
No usine:

Bestellnr.: MIP00004/VATC
Your order No.: PO#211633

No de la commande:

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

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

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Kindberg, 12.12.2013

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

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ONE STEP AHEAD.

No. 86939

Miscellanious Pipe MK 2-43

1 of 4

[| 16C77718 | | | 1013444472] | [LN: 1] | T0378778-1 | FSVAT2XXH |

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	2,375 in x 0,436 in; 9,02 lbs/ft	1-18	375	16 099.178ft	65 642.20kg		

Volume of delivery

Heat	Lot		Remark
1013444472	170071	AD 01	
1013445000	170072	AD 01	

Test results

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

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

3 Wasserinnendruckversuch/Hydrostatic test:2970 PSI (duration min. 5 sec.)o.B./satisfactory

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

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

Test remarks

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

Kindberg, 12.12.2013

Page 2 of 4

No. 86939

voestalpine Tubulars GmbH & Co KG
Qualitätsstelle / Quality Department
SCHNEIDHOFER
Abnahmebeauftragter
authorized inspection representative
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Miscellanius Pipe MK 2-43

2 of 4

[| 16C77718 | | | 1013444472] | [LN: 1] | T0378778-1 | FSVAT2XXH |

voestalpine Tubulars GmbH & Co KG

Tensile testing

Lot No		Test Type	Heat treatment	Temp [°C]	No.	Type	Specimen Dimension [mm]			Yield Strength [PSI]	Tensile Strength [PSI]	Elong. [%]	Reduct. in area [%]	Rt/Rm
										Requ. from	42 061	60 190	25.00	
										Requ. to				
170071	AD 01	Standard	as rolled	20	1	Strip	19.00	x	11.29	Rt0.50	54 969	75 564	36.60	0.73
170072	AD 01	Standard	as rolled	20	1	Strip	18.95	x	11.10	Rt0.50	53 954	73 389	35.90	0.74

yield strength:
Gr B: 35500 PSI
X42: 42100 PSI
Gr C: 40000 PSI
tensile strength:
Gr B: 60200 PSI
X42: 60200 PSI
Gr C: 70000 PSI

Hardness testing

Lot No		Test Type	Heat treatment	Specimen No.	Location	Test Method	Hardness Number from	to	Mean Hardness Number from	to	Variation
						Requ.:				99.50	
170071	AD01	Standard	naturhart	1	Body	HRB	80.90	82.60	81.60	82.20	0.60
170072	AD01	Standard	naturhart	1	Body	HRB	80.80	82.90	81.03	81.97	0.93

Kindberg, 12.12.2013

Page 3 of 4

No. 86939

voestalpine Tubulars GmbH & Co KG
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Miscellanius Pipe MK 2-43

3 of 4

[| 16C77718 | | | 1013444472] | [LN: 1] | T0378778-1 | FSVAT2XXH |

voestalpine Tubulars GmbH & Co KG

Chemical test results

Heat analysis

	C	Si	Mn	P	S	Cr	Ni	Cu	Al	Ti	Mo	V	Sn	B	N2	Nb	Ca	CEQ
max	0.2300		1.0600	0.0300	0.0300	0.4000	0.4000	0.4000			0.1500	0.0800						0.4000
min		0.1000	0.2900															
1013444472	0.1681	0.2558	0.9744	0.0094	0.0045	0.0314	0.0194	0.0288	0.0311	0.0019	0.0034	0.0018	0.0025	0.0000	0.0043	0.0371	0.0020	0.3410
1013445000	0.1646	0.2251	0.9469	0.0127	0.0049	0.0333	0.0252	0.0338	0.0226	0.0015	0.0071	0.0014	0.0031	0.0001	0.0047	0.0339	0.0016	0.3347

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. 170071 AD 01 1 Standard Heat No. 1013444472	0.1651	0.2236	0.9219	0.0081	0.0041	0.0262	0.0198	0.0302	0.0278	0.0019	0.0036	0.0029	0.0024	0.0004	0.0000	0.0330	0.0000	0.3286
Lot No. 170071 AD 01 2 Standard Heat No. 1013444472	0.1655	0.2132	0.9003	0.0053	0.0012	0.0250	0.0193	0.0265	0.0262	0.0017	0.0030	0.0024	0.0019	0.0003	0.0000	0.0316	0.0000	0.3247
Lot No. 170072 AD 01 1 Standard Heat No. 1013445000	0.1617	0.1938	0.9131	0.0100	0.0044	0.0296	0.0261	0.0337	0.0195	0.0016	0.0067	0.0027	0.0040	0.0004	0.0000	0.0323	0.0000	0.3257
Lot No. 170072 AD 01 2 Standard Heat No. 1013445000	0.1637	0.1976	0.9285	0.0092	0.0034	0.0284	0.0265	0.0346	0.0200	0.0016	0.0070	0.0031	0.0038	0.0004	0.0000	0.0329	0.0000	0.3302

Kindberg, 12.12.2013

No. 86939

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

voestalpine
ONE STEP AHEAD.

Miscellanius Pipe MK 2-43

4 of 4

PRECISION SCREEN MANUFACTURING

CERTIFICATE OF CONFORMANCE

February 15, 2017

Precision Screen Manufacturing
PO Box 1234
Oologah, OK 74053

BOARDMAN Purchase Order # 00608413
PSM Sales Order # 016220
Product: 2-1/4" X 3/16" BB 19W4 MILL FINISH SMOOTH GRATING

This document certifies that the MILL FINISH SMOOTH GRATING products listed below were manufactured from CARBON STEEL ASTM A 1011, and meet or exceed the performance standards of ANSI/NAAMM-MBG531-09.

Alejandra Sanchez-PSM QC

Miscellaneous Mesh Screen MK 3-60, MK 3-61, MK 3-62, MK 3-63 and MK 3-75

PRECISION SCREEN MANUFACTURING

Phone: (866)596-7537• Fax: (866)896-7537
SAN ANTONIO, TX/TULSA, OK
www.psm-mfg.com

MATERIAL TEST REPORT

February 15, 2017

BOARDMAN, INC.

PO # 00608413
Heat # V11218
3 MESH X .080" 304SS

RECEIVED
FEB 23 2017
L. Dawson

CHEMICAL COMPOSITION

C	Mn	Si	P	S	Cr	Mo	V
.024	1.5		.036	.006	18.16		
Ti	**Cu**	**Al**	**Ca**	**B**	**W**	**Ni**	**Pb**
						8.04	
Sn	**Nb**	**N**	**Mg**	**As**	**Zn**	**Co**	**Ta**
		.054					

MECHANICAL PROPERTIES

Tensile-(psi)	Yield	Elongation-%	Reduction of Area %
12400			

Material is free from mercury contamination

Surface Condition Good

I hereby certify that this data is correct as contained in the records of this company.

Alejandra Sanchez - PSM QC

Miscellanius Mesh Screen MK 3-60, MK 3-61 and MK 3-62

PRECISION SCREEN MANUFACTURING

Phone: (866)596-7537• Fax: (866)896-7537
SAN ANTONIO, TX/TULSA, OK
www.psm-mfg.com

MATERIAL TEST REPORT

February 15, 2017

BOARDMAN, INC.

PO # 00608413
Heat # J71998
20 MESH X .016" 304SS

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FEB 2 3 2017
L. Dawson

CHEMICAL COMPOSITION

C	Mn	Si	P	S	Cr	Mo	V
0.055	1.53	0.42	0.017	0.010	18.12		
Ti	**Cu**	**Al**	**Ca**	**B**	**W**	**Ni**	**Pb**
						8.09	
Sn	**Nb**	**N**	**Mg**	**As**	**Zn**	**Co**	**Ta**

Material is free from mercury contamination

Surface Condition Good

I hereby certify that this data is correct as contained in the records of this company.

Alejandra Sanchez - PSM QC

Miscellanius mesh screen MK 3-63

PRECISION SCREEN MANUFACTURING

Phone: (866)596-7537• Fax: (866)896-7537
SAN ANTONIO, TX/TULSA, OK
www.psm-mfg.com

MATERIAL TEST REPORT

February 15, 2017

BOARDMAN, INC.

PO # 00608413
Heat # SL-C26887
20 MESH X .016" 316SS

CHEMICAL COMPOSITION

C	Mn	Si	P	S	Cr	Mo	V
0.027	1.11	0.40	0.014	0.010	16.24	2.14	
Ti	**Cu**	**Al**	**Ca**	**B**	**W**	**Ni**	**Pb**
						10.16	
Sn	**Nb**	**N**	**Mg**	**As**	**Zn**	**Co**	**Ta**
		0.034					

MECHANICAL PROPERTIES

Tensile-(N/mm2)	Yield-(KG/MM2)	Elongation-%	Reduction of Area %
69		39	

This material meets the chemistry specifications for: ASTM A580/A580M-06

Material is free from mercury contamination

Surface Condition Good

I hereby certify that this data is correct as contained in the records of this company.

Alejandra Sanchez - PSM QC

Miscellanius mesh screen MK3-75

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

9

USA FASTENER GROUP, INC.
USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A193	14	Threaded Rod	3080627	90096-2

Heat Number	Grade	Size	TPI	Length	Finish
3105305	B7	1.5/8	8	12FT	Plain

C	Si	S	P	Mn	Mo	Cr	Ni	Al	V	Fe	Ti	Cu
0.39	0.23	0.005	0.018	0.87	0.18	0.98	0	0	0	0	0	0

Yield		Scale	Tensile		Scale
114000	0	psi	131000	0	psi

Elong %		R.A %		Hardness		Scale
20	0	60	0	28	0	HRC

Charpy Set 1			Scale	Temp	Macro Etch			Wedge Tensile	Proof Load
0	0	0			R	C	S		
Charpy Set 2					Pass	Pass	Pass		
0	0	0							

Quenched			Tempered		Stress Relieved	
@	0 °	In	@	1166 ° F	@	0 °

Remarks:

Memo:
1-5/8-8 X 12 AT STUD A193-B7 CAD

RECEIVED
APR 20 2017
L. Dawson

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Stud MK 1-16

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

Material Test Report

9

USA FASTENER GROUP INC.
USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	96149-4

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	1.5/8	8	Plain	JU1293-02		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.230	0.012	0.012	0.700	0.000	0.110	0.040	0.090

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
29	0	HRC	92	0	HRB

First Charpy Set			Charpy Scale	Charpy Temp	Macro Etch			Proofload
0	0	0			S	C	R	311,500 lbf
Second Charpy Set					2	2	2	
0	0	0						

Quenching	Tempering
80min @ 850 ° C in	120min @ 520 ° C

APPROVED
APR 20 2017
L. Dawson

Remarks:

Memos:
1-5/8-8 HVY HEX NUT A194-2H S.KOREA ONLY CAD

USA FASTENER GROUP - CONFIDENTIAL

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 1-17

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

10

Material Test Report

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	12	Heavy Hex Nuts	3080627	113994-00

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	3/8	16	Plain	W25875		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.400	0.230	0.007	0.004	0.770	0.000	0.000	0.000	

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
27	28	HRC	0	0	

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R

Proofload
13,900 lbs

Quenching	Tempering
@ 0 ° in	1 hr @ 1000 ° F

Remarks
Heat treated @ 1620 F @ 1 hr
Oil quenched

RECEIVED
APR 17 2017
L Tawson

Memos:
3/8-16 HVY HEX NUT A194-2H DOMESTIC PLAIN

COUNTRY OF ORIGIN: CANADA

USA FASTENER GROUP

Quality Assurance
Laura Taylor

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Miscellanius Nut MK 2-39

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

7

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
USS	15	FLAT WASHER	3080627	101538-2

Heat Number	Grade	Size	TPI	Length	Finish
288522	8	3/4			

C	Si	S	P	Mn	Mo	Cr	Ni	Al	V	Fe	Ti	Cu
0.33	0	0.004	0.008	0.85	0	0	0	0	0	0	0	

Yield		Scale	Tensile		Scale
0	0		0	0	

Elong %		R.A %	
0	0	0	0

Hardness		Scale
38	45	HRC

Charpy Set 1			Scale	Temp	Macro Etch			Wedge Tensile	Proof Load
0	0	0			R	C	S		
Charpy Set 2									
0	0	0							

Quenched	Tempered	Stress Relieved
@ 0 ° in	@ 0 °	@ 0 °

Remarks:

APR 17 2017
L. Grayson

Memo:
3/4 USS FLAT WASHER GR.8 PLAIN

COUNTRY OF ORIGIN: USA

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Washer MK 2-46

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

Material Test Report

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	16	Heavy Hex Nuts	3080627	114079-A

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	3/4	10	Plain	692415		2H,DAL,TSI

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.450	0.170	0.014	0.018	0.660	0.000	0.000	0.000	0.000

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	29	0	HRC

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
1	1	1

Proofload
58450 lbf

Quenching	Tempering
@ 0 ° in	@ 1030 ° F

RECEIVED
APR 17 2017
L. Dawson

Remarks

Memos:
3/4-10 HVY HEX NUT A194-2H S.KOREA ONLY PLAIN

COUNTRY OF ORIGIN: S.KOREA

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 2-47

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

12

Material Test Report

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	16	Heavy Hex Nuts	3080627	114079-A

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	3/4	10	Plain	692415		2H,DAL,TSI

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.450	0.170	0.014	0.018	0.660	0.000	0.000	0.000	0.000

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	29	0	HRC

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
1	1	1

Proofload
58450 lbf

Quenching	Tempering
@ 0 ° in	@ 1030 ° F

Remarks

RECEIVED
APR 17 2017
L. Dawson

Memos:
3/4-10 HVY HEX NUT A194-2H S.KOREA ONLY PLAIN

COUNTRY OF ORIGIN: KOREA

USA FASTENER GROUP

Quality Assurance
Laura Taylor

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Miscellanius Nut MK3-55

11

SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

CERTIFICATE
OF
CONFORMANCE

TO: **Boardman, Inc.**
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-20-17
Customer Part #: ✓
Description 3/4-10 X 2-1/4 A307 HEX HD M/B PLAIN
Quantity Shipped: 16
LOT#: 00605379
SBS Order #: 5735156
Customer P.O.#: 00608689

RECEIVED
APR 20 2017
L. Dawson

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

Miscellaneous Bolt MK 3-54

SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

CERTIFICATE
OF
CONFORMANCE

TO: **Boardman, Inc.**
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-13-17
Customer Part #:
Description 5/8-11 X 3 A307A HEX HD M/B PLN
Quantity Shipped: 24
LOT#: 753441
SBS Order #: 5735156
Customer P.O.#: 00608689

RECEIVED
APR 17 2017
L. DAWSON

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

Miscellaneous Bolt MK 3-67

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

14

Material Test Report

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	102295-8

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	5/8	11	Plain	JU4397-01		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.180	0.019	0.016	0.680	0.000	0.130	0.050	0.120

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	92	0	HRB

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
2	2	2

Proofload
39550 lbf

Quenching	Tempering
60min @ 850 ° C in	120 min @ 520 ° C

Remarks
MEETS ASTM A194-2H AND ASME SA194-2H (REV 15)

RECEIVED
APR 17 2017
L. Dawson

Memos:
5/8-11 HVY HEX NUT A194-2H S.KOREA

COUNTRY OF ORIGIN: KOREA

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 3-68

SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

15

CERTIFICATE OF CONFORMANCE

TO: Boardman, Inc.
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-13-17
Customer Part #:
Description 5/8-11 X 1-3/4 A307 ALL THREAD STUD PLAIN
Quantity Shipped: 8
LOT#: 753443
SBS Order #: 5735156
Customer P.O.#: 00608689

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

Miscellanius Stud MK 3-79

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

2

Material Test Report

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	99725-23

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	1	8	Plain	JU1777-04		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.190	0.012	0.011	0.680		0.110	0.040	0.080

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
29	0	HRC	93	0	HRB

First Charpy Set		
Second Charpy Set		

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
2	2	2

Proofload
106000 lbf

Quenching	Tempering
70 MIN @ 850 ° C in	120 MIN@ 520 ° C

Remarks
MEETS ASTM A194-2H AND ASME SA194-2H (REV 15)

RECEIVED
APR 17 2017
L. Dawson

Memos:
1-8 HVY HEX NUT A194-2H S.KOREA ONLY PLAIN

COUNTRY OF ORIGIN: S.KOREA

USA FASTENER GROUP INC

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellaneous Nut MK 4-85

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

16

USA FASTENER GROUP INC
USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A320	2015	Threaded Rod	3080627	104150

Heat Number	Grade	Size	TPI	Length	Finish
A163519	L7/B7	1.1/8	8	12FT	Plain

C	Si	S	P	Mn	Mo	Cr	Ni	Al	V	Fe	Ti	Cu
0.4	0.26	0.015	0.009	0.86	0.21	1.03	0.11	0.035	0.005	0	0.001	0.22

Yield		Scale	Tensile		Scale
121	0	ksi	135	0	ksi

Elong %		R.A %		Hardness		Scale
21	0	64	0	29	0	HRC

Charpy Set 1			Scale	Temp	Macro Etch			Wedge Tensile	Proof Load
38	34	43	Ft Lbs	-150 °F	R	C	S		
Charpy Set 2					1	2	1		
0	0	0							

Quenched			Tempered		Stress Relieved	
@	0 °	In	@	1332 ° F	@	0 °

Remarks:
Sn=.011; N=.0080; B=.0004; Ca=.0006; As=.004; Sb=.003
Conforms to ASTM A193 B7 Rev. 2016; ASME SA-193/SA-193M B7 Rev.2013

Memo:
1-1/8-8 X 8-3/4 AT STUD A193-B7 CAD
MFG FROM ABOVE

RECEIVED
APR 20 2017
Dawson

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellaneous Stud MK5-92

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

Material Test Report

17

USA FASTENER GROUP INC.

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	96149-1

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	1.1/8	8	Plain	JU1777-04		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.190	0.012	0.011	0.680	0.000	0.110	0.040	0.080

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	93	0	HRB

First Charpy Set			Charpy Scale	Charpy Temp	Macro Etch			Proofload
0	0	0			S	C	R	138,200 lbf
Second Charpy Set					2	2	2	
0	0	0						

Quenching
70min @ 850 ° C in

Tempering
120min @ 520 ° C

RECEIVED
APR 20 2017
L Dawson

Remarks:
MEETS ASTM A194-2H AND ASME SA194-2H (REV 15)

Memos:
1-1/8-8 HVY HEX NUT A194-2H S.KOREA ONLY CAD

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 593

SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

3

CERTIFICATE OF CONFORMANCE

TO: Boardman, Inc.
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-13-17
Customer Part #:
Description 5/8-11 X 2 A307A HEX HD M/B PLN
Quantity Shipped: 8
LOT#: 753433
SBS Order #: 5735156
Customer P.O.#: 00608689

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

Miscellaneous Bolt MK 5-104

SBS INDUSTRIES, INC.

1843 N. 106TH E. Ave., Tulsa OK 74116-1596 918-836-7756
4238 Royal Ave., Oklahoma City OK 73108-2072 405-949-2658

CERTIFICATE
OF
CONFORMANCE

TO: **Boardman, Inc.**
1135 S. McKinley
Oklahoma City, OK 73108

Date of Shipment: 4-20-17
Customer Part #:
Description 5/8 REG LOCKWASHER PLAIN
Quantity Shipped: 8
LOT#: 751907
SBS Order #: 5735156
Customer P.O.#: 00608689

The above described material was produced in accordance with the applicable standards and/or applicable specifications as designated on the purchase order and/or by the drawing that is current for these parts on which the inquiry and/or order was placed.

Berry Heinlein
Approved Signature
BERRY HEINLEIN

Miscellanius Washer MK 5-105

Material Test Report

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513

5

USA FASTENER GROUP, INC.
USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
		USS Flat Washer	3080627	104731-7

Heat Number	Grade	Size	TPI	Length	Finish
299155		5/8			Plain

C	Si	S	P	Mn	Mo	Cr	Ni	Al	V	Fe	Ti	Cu
0.34	0	0	0.007	0.83	0	0	0	0	0	0	0	0

Yield		Scale	Tensile		Scale
0	0		0	0	

Elong %		R.A %	
0	0	0	0

Hardness		Scale
38	45	HRC

Charpy Set 1			Scale	Temp	Macro Etch			Wedge Tensile	Proof Load
0	0	0			R	C	S		
Charpy Set 2									
0	0	0							

Quenched	Tempered	Stress Relieved
@ 0 ° in	@ 0 °	@ 0 °

Remarks:

Memo:
5/8 USS FLAT WASHER GR.8 PLAIN

COUNTRY OF ORIGIN: USA

USA FASTENER GROUP
Received
APR 12 2017
L. Dawson

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Washer MK 5-106

Customer
SBS Industries, Inc
1843 North 106th East Ave
Tulsa , OK 74116
Fax
918-834-8513 4

Material Test Report

USA Fastener Group, Inc.
1300 Gazin St., Houston, Texas 77020
P: (866)546-5872 | F: (713)641-4655
sales@usafgrp.com

Specification	Year	Description	PO Number	Lot Number
A194	14	Heavy Hex Nuts	3080627	102295-8

Grade	Size	TPI	Finish	Heat Number	Heat Code	Markings
2H	5/8	11	Plain	JU4397-01		

C	Si	S	P	Mn	Mo	Cr	Ni	Cu
0.440	0.180	0.019	0.016	0.680	0.000	0.130	0.050	0.120

Hardness		Scale	Tempered Hardness		Tempered Hardness Scale
30	0	HRC	92	0	HRB

First Charpy Set		
0	0	0
Second Charpy Set		
0	0	0

Charpy Scale	Charpy Temp

Macro Etch		
S	C	R
2	2	2

Proofload
39550 lbf

Quenching	Tempering
60min @ 850 ° C in	120 min @ 520 ° C

Remarks
MEETS ASTM A194-2H AND ASME SA194-2H (REV.15)

RECEIVED
APR 17 2017
L. Dawson

Memos:
5/8-11 HVY HEX NUT A194-2H S.KOREA ONLY PLAIN

COUNTRY OF ORIGIN: S.KOREA

USA FASTENER GROUP

The above described product was manufactured, sampled, tested and inspected in accordance with the required specification, including any supplementary requirements or other requirements designated in the purchase order or contract and were found to meet those requirements.

Quality Assurance
Laura Taylor

Miscellanius Nut MK 5-107

Since 1910
BOARDMAN
1135 South McKinley Ave * Oklahoma City, Oklahoma 73108
(405) 634-5434 * Fax (405) 632-6948
STEEL & ALLOY PLATE FABRICATION * PRESSURE VESSELS AND FCCU COMPONENTS

CUSTOMER:	UOP RUSSELL LLC
P.O. NO.:	4500754152
PROJECT:	J447XX
VESSEL:	78" I.D. x 24'-4" TAN/TAN – MOL SIEVE DEHYDRATOR
ITEM NO:	V-442 & 443
JOB NO.:	70699
DATE:	01/05/17
ENGINEER:	R. WOLF
DIR/FILE:	E:\DWG\JOBS\70600-70699\70699\70699.CW7 Rev.: 0

DESIGN DATA

DESIGN PRESSURE: Int.: 1,095 psi @ 600 deg. F. Ext.: n/a

CORROSION ALLOW: 0.0625"

X-RAY: **RT-1**

Cat. A, Long. Seams	FULL per UW-11(a) TYPE 1
Cat. B, Girth Seams	FULL per UW-11(a) TYPE 1
Head to Shell Seams	FULL per UW-11(a) TYPE 1
Heads, Cat. A Seams	Seamless or FULL X-ray

WIND: ASCE 7-10
Speed = 120 mph
Exposure = C
Risk Category = III

SEISMIC: ASCE 7-10
Soil Profile = D
Spectral Response Ss = 100%
Spectral Response S_1 = 40%
Importance Factor = 1.25

PWHT: Required per Code

MAWP: 1,095 psi @ 600 deg. F. - Limited by Design

MDMT (design): (-)20 deg. F. @ 1,095 psi, Impacts required on heads, shells, and repad per UG-84. SA350-LF2 nozzles tested per UCS-66(g). SA105 nozzles exempt per UCS-66(b)(3). SA106-B piping exempt per Fig. UCS-66, Curve B.

MAP, N&C: 1,095 psi @ 60 deg. F. - Limited by Design

HYDROTEST: Shop, (Utilizing MAWP) = 1,424 psi. Horizontal position.
Field, (Utilizing MAWP) = 1,424 psi. Vertical position.
(See Hydrostatic Test report)

Design is based on the 2015 ASME Code, Section VIII, Division 1, No Addenda.

Nozzles 2" and under are exempt from reinforcement calculations per paragraph UG-36(c)(3)(a).

Nozzles without reinforcing elements are exempt from weld strength calculations per paragraph UW-15(b)(2).

CERTIFIED Randy Wolf DATE: 01/11/2017

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24. Lifting Lugs (Vertical Lift Loaded)

Deficiencies Summary

No deficiencies found.

Pressure Summary

Component Summary						
Identifier	**P Design (psi)**	**T Design (°F)**	**MDMT (°F)**	**MDMT Exemption**		**Impact Tested**
Top Head	1 095	600	-24.4	Note 1		Yes
Straight Flange on Top Head	1 095	600	-24.4	Note 2		Yes
Shell Course #3	1 095	600	-24.4	Note 2		Yes
Shell Course #2	1 095	600	-24.4	Note 2		Yes
Shell Course #1	1 095	600	-24.4	Note 2		Yes
Straight Flange on Bottom Head	1 095	600	-24.4	Note 2		Yes
Bottom Head	1 095	600	-24.4	Note 3		Yes
Outlet (B)	1 095	600	-32.7	Nozzle	Note 4	No
				Pad	Note 5	Yes
Fill / Manway (C)	1 095	600	-55	Note 6		No
Dump (D)	1 095	600	-55	Note 7		No
TI (E1)	1 095	600	-155	Note 8		No
TI (E2)	1 095	600	-155	Note 8		No

Chamber Summary	
Design MDMT	-20 °F
Rated MDMT	-24.4 °F @ 1 095 psi
MAWP hot & corroded	1 095 psi
(1) This pressure chamber is not designed for external pressure.	

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

Notes for MDMT Rating		
Note #	**Exemption**	**Details**
1.	Straight Flange governs MDMT	
2.	Material is impact tested per UG-84 to -20°F.	UCS-66(i) reduction of 4.4°F applied (ratio = 0.9562).
3.	Straight Flange governs MDMT	
4.	Nozzle impact test exemption temperature from Fig UCS-66 Curve B = -13°F Fig UCS-66.1 MDMT reduction = 31.2°F, (coincident ratio = 0.6881)	UCS-66 governing thickness = 0.4375 in.
5.	Pad is impact tested per UG-84 to -20°F.	UCS-66(i) reduction of 12.7°F applied (ratio = 0.8733).
6.	Flange rating governs: Flange rated MDMT = -76°F Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	UCS-66(i) reduction of 26°F applied (ratio = 0.7399).

	Flange is impact tested per material specification to -50°F.	
7.	Nozzle is impact tested per material specification to -50°F with an additional 5°F reduction per UCS-66(g)	UCS-66 governing thickness = 2.375 in.
8.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.1157).	

Settings Summary

COMPRESS 2017 Build 7700	
ASME Section VIII Division 1, 2015 Edition	
Units	U.S. Customary
Datum Line Location	0.00" from bottom seam
Vessel Design Mode	Design Mode
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	1.2000
Skirt/legs stress increase	1.0
Minimum nozzle projection	2"
Juncture calculations for d > 30 only	Yes
Preheat P-No 1 Materials > 1.2500" and <= 1.5000" thick	Yes
UG-37(a) shell tr calculation considers longitudinal stress	No
Cylindrical shells made from pipe are entered as minimum thickness	No
Nozzles made from pipe are entered as minimum thickness	No
ASME B16.9 fittings are entered as minimum thickness	No
Butt welds	Tapered per Figure UCS-66.3 (a)
Disallow Appendix 1-5, 1-8 calculations under 15 psi	No
Hydro/Pneumatic Test	
Shop Hydrotest Pressure	1.3 times vessel MAWP
Test liquid specific gravity	1.0000
Field Hydrotest Pressure	1.3 times vessel MAWP
Wind load present @ field	33% of design
Maximum stress during test	90% of yield
Required Marking - UG-116	
UG-116(e) Radiography	RT1
UG-116(f) Postweld heat treatment	HT
Code Cases\Interpretations	
Use Code Case 2547	No
Use Code Case 2695	No
Apply interpretation VIII-1-83-66	Yes

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:	No
Note: UG-22(b),(c) and (f) loads only considered when supports are present.	

License Information	
Company Name	Boardman
License	Commercial
License Key ID	20125
Support Expires	January 25, 2018

Hydrostatic Test

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

Gauge pressure at 60°F = 1.3*MAWP*LSR
= 1.3*1 095*1
= 1 423.5 psi

Horizontal shop hydrostatic test				
Identifier	**Local test pressure (psi)**	**Test liquid static head (psi)**	**UG-99(b) stress ratio**	**UG-99(b) pressure factor**
Top Head	1 426.798	3.298	1.0309	1.30
Straight Flange on Top Head	1 426.798	3.298	1.0309	1.30
Shell Course #3	1 426.798	3.298	1.0309	1.30
Shell Course #2	1 426.798	3.298	1.0309	1.30
Shell Course #1	1 426.798	3.298	1.0309	1.30
Straight Flange on Bottom Head	1 426.798	3.298	1.0309	1.30
Bottom Head	1 426.798	3.298	1.0309	1.30
Dump (D)	1 423.897	0.397	1.087	1.30
Fill / Manway (C)	1 425.716	2.216	1.087	1.30
Outlet (B) (1)	1 425.528	2.028	1	1.30
TI (E1)	1 425.41	1.91	1.087	1.30
TI (E2)	1 425.41	1.91	1.087	1.30
(1) Outlet (B) limits the UG-99(b) stress ratio. (2) The zero degree angular position is assumed to be up, and the test liquid height is assumed to the top-most flange.				

The test temperature of 60 °F is warmer than the minimum recommended temperature of 5.6 °F so the brittle fracture provision of UG-99(h) has been met.

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

Gauge pressure at 60°F = 1.3*MAWP*LSR
= 1.3*1 095*1
= 1 423.5 psi

Vertical field hydrostatic test				
Identifier	**Local test pressure (psi)**	**Test liquid static head (psi)**	**UG-99(b) stress ratio**	**UG-99(b) pressure factor**
Top Head	1 424.8	1.3	1.0309	1.30
Straight Flange on Top Head	1 424.8	1.3	1.0309	1.30
Shell Course #3	1 428.265	4.765	1.0309	1.30
Shell Course #2	1 431.73	8.23	1.0309	1.30
Shell Course #1	1 435.196	11.696	1.0309	1.30
Straight Flange on Bottom Head	1 435.268	11.768	1.0309	1.30
Bottom Head	1 435.972	12.472	1.0309	1.30
Dump (D)	1 434.437	10.937	1.087	1.30
Fill / Manway (C)	1 423.941	0.441	1.087	1.30
Outlet (B) (1)	1 436.712	13.212	1	1.30
TI (E1)	1 433.734	10.234	1.087	1.30
TI (E2)	1 430.089	6.589	1.087	1.30
(1) Outlet (B) limits the UG-99(b) stress ratio.				

The test temperature of 60 °F is warmer than the minimum recommended temperature of 5.6 °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**
Top Head	SA-516 70	78 ID	21.7752	2.2752*	2.2752	0.0625	1.00	Internal
Straight Flange on Top Head	SA-516 70	78 ID	2	2.375	2.3447	0.0625	1.00	Internal
Shell Course #3	SA-516 70	78 ID	96	2.375	2.3447	0.0625	1.00	Internal
Shell Course #2	SA-516 70	78 ID	96	2.375	2.3447	0.0625	1.00	Internal
Shell Course #1	SA-516 70	78 ID	96	2.375	2.3447	0.0625	1.00	Internal
Straight Flange on Bottom Head	SA-516 70	78 ID	2	2.375	2.3447	0.0625	1.00	Internal
Bottom Head	SA-516 70	78 ID	21.7752	2.2752*	2.2752	0.0625	1.00	Internal
Skirt Course	SA-516 70	82.75 OD	61.4797	0.375	0.1691	0	0.55	Seismic
*Head minimum thickness after forming								

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

Weight Summary

Weight (lb) Contributed by Vessel Elements										
Component	Metal New*	Metal Corroded	Insulation	Insulation Supports	Lining	Piping + Liquid	Operating Liquid		Test Liquid	
							New	Corroded	New	Corroded
Top Head	4 840.2	4 716.9	254.2	0	0	0	0	0	2 642	2 658.3
Shell Course #3	16 292.7	15 876.2	757	0	0	0	0	0	16 558.6	16 611.7
Shell Course #2	16 291	15 874.7	757	0	0	0	0	0	16 558.7	16 611.9
Shell Course #1	15 884.5	15 478.9	757	0	0	0	0	0	16 598.2	16 651.9
Bottom Head	5 151	5 019.2	254.2	0	0	0	0	0	2 608.2	2 624.5
Skirt Course	1 654.1	1 654.1	0	0	0	0	0	0	0	0
Base Ring	512	512	0	0	0	0	0	0	0	0
TOTAL:	**60 625.7**	**59 132**	**2 779.5**	**0**	**0**	**0**	**0**	**0**	**54 965.8**	**55 158.2**
*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						
Top Head	0	0	2 252.2	2 232.9	0	1 550.8	0	0	0	0
Shell Course #3	0	0	0	0	8 328	160	0	0	696.7	0
Shell Course #2	0	0	2	1.7	12 212.8	160	0	0	0	0
Shell Course #1	0	0	2 259	2 240.3	11 347.5	1 810.8	0	0	0	1 115
Bottom Head	0	0	250.1	243.4	0	220	0	0	0	0
Skirt Course	0	0	0	0	0	0	0	0	73.9	0
TOTAL:	**0**	**0**	**4 763.2**	**4 718.2**	**31 888.4**	**3 901.6**	**0**	**0**	**770.6**	**1 115***

Vessel Totals		
	New	Corroded
Operating Weight (lb)	105 844	104 305
Empty Weight (lb)	105 844	104 305
Test Weight (lb)	160 810	159 464
Capacity** (US gal)	6 578	6 601
**The vessel capacity does not include volume of nozzle, piping or other attachments.		

Vessel Lift Condition	
Vessel Lift Weight, New (lb)	73 956
Center of Gravity from Datum (in)	138.8077

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)		
B	8.625	0.5	0.3934	Yes	Yes	2.2752*	2.055		3.5	2	0.0625	105.7
C	26.25	4.125	0.6218	Yes	Yes	2.2752*	2.055		N/A	N/A	0.0625	110.4
D	27.75	4.875	0.6218	Yes	Yes	2.375	2.3446		N/A	N/A	0.0625	103.0
E1	1.75	0.35	0.125	Yes	Yes	2.375	N/A		N/A	N/A	0.0625	Exempt
E2	1.75	0.35	0.125	Yes	Yes	2.375	N/A		N/A	N/A	0.0625	Exempt
*Head minimum thickness after forming												

Definitions	
t_n	Nozzle thickness
Req t_n	Nozzle thickness required per UG-45/UG-16 Increased for pipe to account for 12.5% pipe thickness tolerance
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**
B	Outlet	NPS 8 Sch 80 (XS)	Nozzle	SA-106 B Smls pipe	No	No	No	NPS 8 Class 600 WN A350 LF2	No
			Pad	SA-516 70	Yes	Yes	No		
C	Fill / Manway	26.25 OD x 4.125	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 18 Class 600 V2 (or equiv.) A350 LF2 Cl.1	NPS 18 Class 600 A350 LF2 Cl.1
D	Dump	27.75 OD x 4.875	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 18 Class 600 V3 (or equiv.) A350 LF2 Cl.1	NPS 18 Class 600 A350 LF2 Cl.1
E1	TI	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
E2	TI	NPS 0.75 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No

Top Head

ASME Section VIII Division 1, 2015 Edition				
Component		Ellipsoidal Head		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Attached To		Shell Course #3		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		1.23	34	1
Dimensions				
Inner Diameter		78"		
Head Ratio		2		
Minimum Thickness		2.2752"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Length L_{sf}		2"		
Nominal Thickness t_{sf}		2.375"		
Weight and Capacity				
		Weight (lb)[1]		**Capacity (US gal)[1]**
New		4 840.21		310.28
Corroded		4 716.9		312.14
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	254.17
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Category A joints		Seamless No RT		
Head to shell seam		Full UW-11(a) Type 1		

[1] includes straight flange

Results Summary	
Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2752"
Straight Flange governs MDMT	-24.4°F

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

Design thickness for internal pressure, (Corroded at 600 °F) Appendix 1-4(c)

t = P*D*K / (2*S*E - 0.2*P) + Corrosion
= 1 095*78.125*0.997872 / (2*19 400*1 - 0.2*1 095) + 0.0625
= 2.2751"

% Extreme fiber elongation - UCS-79(d)

EFE = $(75*t / R_f)*(1 - R_f / R_o)$
= (75*2.375 / 14.4475)*(1 - 14.4475 / ¤)
= 12.3291%

Straight Flange on Top Head

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		1.3	36	1
Dimensions				
Inner Diameter		78"		
Length		2"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		339.43		41.37
Corroded		330.76		41.5
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	0
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Seamless No RT		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.3447"

Design thickness due to combined loadings + corrosion	0.9723"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9094	0.9083
						Seismic	0.9098	0.9079
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.9079	0.9068
						Seismic	0.9084	0.9064
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0011	0.0028
						Seismic	0.0004	0.0035
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.0011	0.0028
						Seismic	0.0005	0.0035
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0008	0.0021
						Seismic	0.0003	0.0025
Empty, New	0	20 000	17 289	70	0	Wind	0.0008	0.0021
						Seismic	0.0003	0.0026
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	19 400	12 641	600	0.0625	Weight	0.0029	0.0029

Shell Course #3

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		4.76	132	1
Dimensions				
Inner Diameter		78"		
Length		96"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		16 292.67		1 985.81
Corroded		15 876.25		1 992.18
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	757.04
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Full UW-11(a) Type 1		
Top Circumferential seam		Full UW-11(a) Type 1		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"

Design thickness due to internal pressure (t)	2.3447"
Design thickness due to combined loadings + corrosion	0.9766"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9086	0.9035
						Seismic	0.9141	0.898
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.9071	0.902
						Seismic	0.9127	0.8963
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0024	0.0101
						Seismic	0.004	0.0186
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.0025	0.0102
						Seismic	0.004	0.0188
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0017	0.0074
						Seismic	0.0039	0.0136
Empty, New	0	20 000	17 289	70	0	Wind	0.0018	0.0075
						Seismic	0.0039	0.0138
Hot Shut Down, Corroded, Weight &	0	19 400	12 641	600	0.0625	Weight	0.0094	0.0094

Eccentric Moments Only								

Shell Course #2

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		8.23	228	1
Dimensions				
Inner Diameter		78"		
Length		96"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		16 291.05		1 985.81
Corroded		15 874.67		1 992.18
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	757.04
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Full UW-11(a) Type 1		
Top Circumferential seam		Full UW-11(a) Type 1		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"

Design thickness due to internal pressure (t)	2.3447"
Design thickness due to combined loadings + corrosion	0.9874"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9089	0.8987
						Seismic	0.9249	0.8827
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.9073	0.8971
						Seismic	0.9237	0.8807
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0019	0.0175
						Seismic	0.0148	0.0421
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.0021	0.0177
						Seismic	0.015	0.0427
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0014	0.0128
						Seismic	0.0143	0.0308
Empty, New	0	20 000	17 289	70	0	Wind	0.0015	0.013
						Seismic	0.0146	0.0314
Hot Shut Down, Corroded, Weight &	0	19 400	12 641	600	0.0625	Weight	0.0146	0.0146

Eccentric Moments Only								

Shell Course #1

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		11.7	324	1
Dimensions				
Inner Diameter		78"		
Length		96"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		15 884.54		1 985.81
Corroded		15 478.87		1 992.18
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	757.04
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Longitudinal seam		Full UW-11(a) Type 1		
Top Circumferential seam		Full UW-11(a) Type 1		
Bottom Circumferential seam		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"

Design thickness due to internal pressure (t)	2.3447"
Design thickness due to combined loadings + corrosion	1.0006"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9076	0.8868
						Seismic	0.9381	0.8563
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.906	0.8851
						Seismic	0.9371	0.854
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0038	0.0357
						Seismic	0.028	0.0825
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.004	0.036
						Seismic	0.0285	0.0835
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0028	0.0261
						Seismic	0.0272	0.0604
Empty, New	0	20 000	17 289	70	0	Wind	0.003	0.0264
						Seismic	0.0276	0.0613
Hot Shut Down, Corroded, Weight &	0	19 400	12 641	600	0.0625	Weight	0.0278	0.0315

Eccentric Moments Only								

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 Course #1		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		12.47	345.5	1
Dimensions				
Inner Diameter		78"		
Head Ratio		2		
Minimum Thickness		2.2752"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Length L_{sf}		2"		
Nominal Thickness t_{sf}		2.375"		
Weight and Capacity				
		Weight (lb)[1]		**Capacity (US gal)[1]**
New		5 151.05		310.28
Corroded		5 019.2		312.14
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	12.5	254.17
		Spacing(in)	**Individual Weight (lb)**	**Total Weight (lb)**
Insulation Supports		0	0	0
Radiography				
Category A joints		Seamless No RT		
Head to shell seam		Full UW-11(a) Type 1		

[1] includes straight flange

Results Summary	
Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.2752"
Straight Flange governs MDMT	-24.4°F

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

Design thickness for internal pressure, (Corroded at 600 °F) Appendix 1-4(c)

t = P*D*K / (2*S*E - 0.2*P) + Corrosion
= 1 095*78.125*0.997872 / (2*19 400*1 - 0.2*1 095) + 0.0625
= 2.2751"

% Extreme fiber elongation - UCS-79(d)

EFE = $(75*t / R_f)*(1 - R_f / R_o)$
= (75*2.375 / 14.4475)*(1 - 14.4475 / ¤)
= 12.3291%

Straight Flange on Bottom Head

ASME Section VIII Division 1, 2015 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 37)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
Yes (-20°F)	Yes	No	Yes	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		1 095	600	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Test horizontal		3.3	91.375	1
Test vertical		11.77	326	1
Dimensions				
Inner Diameter		78"		
Length		2"		
Nominal Thickness		2.375"		
Corrosion	**Inner**	0.0625"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		339.43		41.37
Corroded		330.76		41.5
Insulation				
		Thickness (in)	**Density (lb/ft^3)**	**Weight (lb)**
Insulation		4	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		Full UW-11(a) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0.0625" = 0.125"
Design thickness due to internal pressure (t)	2.3447"

Design thickness due to combined loadings + corrosion	1.0016"
Rated MDMT	-24.4 °F

UCS-66 Material Toughness Requirements	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*39.0625 / (20 000*1 - 0.6*1 095) =	2.2113"
Stress ratio = t_r*E* / (t_n - c) = 2.2113*1 / (2.375 - 0.0625) =	0.9562
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	4.4°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 4.4 , -155] =	-24.4°F
Design MDMT of -20°F is acceptable.	

Design thickness, (at 600 °F) UG-27(c)(1)

t = P*R / (S*E - 0.6000*P) + Corrosion
= 1 095*39.0625 / (19 400*1.00 - 0.6000*1 095) + 0.0625
= 2.3447"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*2.375 / 40.1875)*(1 - 40.1875 / ¤)
= 2.9549%

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	1 095	19 400	12 641	600	0.0625	Wind	0.9083	0.8861
						Seismic	0.9391	0.8553
Operating, Hot & New	1 095	19 400	12 690	600	0	Wind	0.9067	0.8844
						Seismic	0.9381	0.8529
Hot Shut Down, Corroded	0	19 400	12 641	600	0.0625	Wind	0.0028	0.0369
						Seismic	0.029	0.0842
Hot Shut Down, New	0	19 400	12 690	600	0	Wind	0.003	0.0372
						Seismic	0.0295	0.0852
Empty, Corroded	0	20 000	17 282	70	0.0625	Wind	0.0021	0.027
						Seismic	0.0281	0.0616
Empty, New	0	20 000	17 289	70	0	Wind	0.0022	0.0273
						Seismic	0.0286	0.0625
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	19 400	12 641	600	0.0625	Weight	0.0268	0.0327

Wind Code

Building Code: ASCE 7-10		
Elevation of base above grade		1.00 ft
Increase effective outer diameter by		1.50 ft
Wind Force Coefficient, Cf		0.7000
Risk Category (Table 1.5-1)		III
Basic Wind Speed, V		120.00 mph
Exposure Category		C
Wind Directionality Factor, Kd		0.9500
Top Deflection Limit		6.00 in. per 100 ft.
Topographic Factor, Kzt		1.0000
Enforce min. loading of 16 psf		Yes
Hazardous, toxic, or explosive contents		No
Vessel Characteristics		
Height, h		31.4813 ft
Minimum Diameter, b	Operating, Corroded	7.5625 ft
	Empty, Corroded	7.5625 ft
	Hydrotest, New, Field	7.5625 ft
Fundamental Frequency, n_1	Operating, Corroded	8.5274 Hz
	Empty, Corroded	8.9819 Hz
	Hydrotest, New, Field	7.2181 Hz
Damping coefficient, e	Operating, Corroded	0.0201
	Empty, Corroded	0.0210
	Hydrotest, New, Field	0.0260

Table Lookup Values

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

Wind Deflection Reports:

Operating, Corroded
Empty, Corroded

Hydrotest, New, field

Wind Pressure Calculations

Wind Deflection Report: Operating, Corroded								
Component	**Elevation of Bottom above Base (in)**	**Effective OD (ft)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Platform Wind Shear at Bottom (lb_f)**	**Total Wind Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**	**Deflection at Top (in)**
Top Head	354	9.05	26.5	*	883	1 092	2 431	0.0124
Shell Course #3	258	9.06	26.5	22.81	883	2 020	14 817	0.0115
Shell Course #2	162	9.06	26.5	22.81	883	2 888	34 500	0.0079
Shell Course #1	66	9.06	26.5	22.81	883	3 696	70 600	0.0043
Bottom Head (top)	61.4797	9.05	26.5	*	1 634	4 485	78 357	0.0011
Skirt Course	0	8.40	26.5	3.97	1 634	4 965	102 564	0.001
*Moment of Inertia I varies over the length of the component								

Wind Deflection Report: Empty, Corroded								
Component	**Elevation of Bottom above Base (in)**	**Effective OD (ft)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Platform Wind Shear at Bottom (lb_f)**	**Total Wind Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**	**Deflection at Top (in)**
Top Head	354	9.05	29.4	*	883	1 092	2 431	0.0112
Shell Course #3	258	9.06	29.4	22.81	883	2 020	14 817	0.0104
Shell Course #2	162	9.06	29.4	22.81	883	2 888	34 500	0.0071
Shell Course #1	66	9.06	29.4	22.81	883	3 696	70 600	0.0039
Bottom Head (top)	61.4797	9.05	29.4	*	1 634	4 485	78 357	0.001
Skirt Course	0	8.40	29.4	3.97	1 634	4 965	102 564	0.0009
*Moment of Inertia I varies over the length of the component								

Wind Deflection Report: Field Hydrotest, New								
Component	**Elevation of Bottom above Base (in)**	**Effective OD (ft)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Platform Wind Shear at Bottom (lb_f)**	**Total Wind Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**	**Deflection at Top (in)**
Top Head	354	9.05	29.5	*	292	438	871	0.0074
Shell Course #3	258	9.06	29.5	23.37	292	1 134	7 124	0.0068
Shell Course #2	162	9.06	29.5	23.37	292	1 830	18 986	0.0047
Shell Course #1	66	9.06	29.5	23.37	292	2 526	46 252	0.0026
Bottom Head (top)	61.4797	9.05	29.5	*	539	2 806	53 309	0.0007
Skirt Course	0	8.40	29.5	3.97	539	3 219	68 745	0.0006
*Moment of Inertia I varies over the length of the component								

Wind Pressure (WP) Calculations

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

$Kz = 2.0100 * (Z/\underline{Zg})^{2/\underline{d}}$
$= 2.0100 * (Z/900.00)^{0.2105}$
$qz = 0.00256 * Kz * Kzt * Kd * \underline{V}^2$
$= 0.00256 * Kz * 1.0000 * 0.9500 * 120.0000^2$
$= 35.0208 * Kz$
$WP = 0.6 * \max[qz * \underline{G} * \underline{Cf}, 16 \text{ lb/ft}^2]$
$= 0.6 * \max[qz * \underline{G} * 0.7000, 16 \text{ lb/ft}^2]$

Design Wind Pressures							
Height Z (')	Kz	qz (psf)	WP (psf)				
			Operating	Empty	Hydrotest New	Hydrotest Corroded	Vacuum
15.0	0.8489	29.73	11.15	11.15	9.60	N.A.	N.A.
20.0	0.9019	31.58	11.85	11.85	9.60	N.A.	N.A.
25.0	0.9453	33.10	12.42	12.42	9.60	N.A.	N.A.
30.0	0.9823	34.40	12.90	12.90	9.60	N.A.	N.A.
40.0	1.0436	36.55	13.71	13.71	9.60	N.A.	N.A.
Design Wind Force determined from: F = Pressure * Af , where Af is the projected area.							

Gust Factor Calculations

Operating, Corroded
Empty, Corroded
Hydrotest, New, field

Gust Factor Calculations: Operating, Corroded

Vessel is considered a rigid structure as $n_1 = 8.5274$ Hz ≥ 1 Hz.

$\bar{z} = \max[0.6000 * \underline{h} , \underline{z_{min}}]$
$= \max[0.6000 * 31.4813 , 15.0000]$
$= 18.8888$
$I_{\bar{z}} = \underline{c} * (33 / \bar{z})^{1/6}$
$= 0.2000 * (33 / 18.8888)^{1/6}$
$= 0.2195$
$L_{\bar{z}} = \underline{l} * (\bar{z} / 33)^{\underline{ep}}$
$= 500.0000 * (18.8888 / 33)^{0.2000}$
$= 447.2063$
$Q = Sqr(1 / (1 + 0.6300 * ((\underline{b} + \underline{h}) / L_{\bar{z}})^{0.6300}))$
$= Sqr(1 / (1 + 0.6300 * ((7.5625 + 31.4813) / 447.2063)^{0.6300}))$
$= 0.9384$
$G = 0.925 * (1 + 1.7 * \underline{g_Q} * I_{\bar{z}} * Q) / (1 + 1.7 * \underline{g_v} * I_{\bar{z}})$
$= 0.925 * (1 + 1.7 * 3.4000 * 0.2195 * 0.9384) / (1 + 1.7 * 3.4000 * 0.2195)$
$= 0.8931$

Gust Factor Calculations: Empty, Corroded

Vessel is considered a rigid structure as n_1 = 8.9819 Hz ≥ 1 Hz.

$\bar{z}$ = max[0.6000 * $\underline{h}$, $z_{\underline{min}}$]
= max[0.6000 * 31.4813 , 15.0000]
= 18.8888

$I_{\bar{z}}$ = $\underline{c}$ * (33 / $\bar{z}$)$^{1/6}$
= 0.2000 * (33 / 18.8888)$^{1/6}$
= 0.2195

$L_{\bar{z}}$ = $\underline{l}$ * ($\bar{z}$ / 33)$^{\underline{ep}}$
= 500.0000 * (18.8888 / 33)$^{0.2000}$
= 447.2063

Q = Sqr(1 / (1 + 0.6300 * (($\underline{b}$ + $\underline{h}$) / $L_{\bar{z}}$)$^{0.6300}$))
= Sqr(1 / (1 + 0.6300 * ((7.5625 + 31.4813) / 447.2063)$^{0.6300}$))
= 0.9384

G = 0.925 * (1 + 1.7 * $g_{\underline{Q}}$ * $I_{\bar{z}}$ * Q) / (1 + 1.7 * $g_{\underline{v}}$ * $I_{\bar{z}}$)
= 0.925 * (1 + 1.7 * 3.4000* 0.2195 * 0.9384) / (1 + 1.7 * 3.4000 * 0.2195)
= 0.8931

Gust Factor Calculations: Hydrotest, New, field

Vessel is considered a rigid structure as n_1 = 7.2181 Hz ≥ 1 Hz.

$\bar{z}$ = max[0.6000 * $\underline{h}$, $z_{\underline{min}}$]
= max[0.6000 * 31.4813 , 15.0000]
= 18.8888

$I_{\bar{z}}$ = $\underline{c}$ * (33 / $\bar{z}$)$^{1/6}$
= 0.2000 * (33 / 18.8888)$^{1/6}$
= 0.2195

$L_{\bar{z}}$ = $\underline{l}$ * ($\bar{z}$ / 33)$^{\underline{ep}}$
= 500.0000 * (18.8888 / 33)$^{0.2000}$
= 447.2063

Q = Sqr(1 / (1 + 0.6300 * (($\underline{b}$ + $\underline{h}$) / $L_{\bar{z}}$)$^{0.6300}$))
= Sqr(1 / (1 + 0.6300 * ((7.5625 + 31.4813) / 447.2063)$^{0.6300}$))
= 0.9384

G = 0.925 * (1 + 1.7 * $g_{\underline{Q}}$ * $I_{\bar{z}}$ * Q) / (1 + 1.7 * $g_{\underline{v}}$ * $I_{\bar{z}}$)
= 0.925 * (1 + 1.7 * 3.4000* 0.2195 * 0.9384) / (1 + 1.7 * 3.4000 * 0.2195)
= 0.8931

Table Lookup Values	
d = 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 = 3.4000	[26.9.4 page 254]
g_v = 3.4000	[26.9.4 page 254]

Seismic Code

Building Code: ASCE 7-10 ground supported		
Site Class		D
Importance Factor, I_e		1.2500
Spectral Response Acceleration at short period (% g), S_s		100.00%
Spectral Response Acceleration at period of 1 sec (% g), S_1		40.00%
Response Modification Coeficient from Table 15.4-2, R		3.0000
Acceleration-based Site Coefficient, F_a		1.1000
Velocity-based Site Coefficient, F_v		1.6000
Long-period Transition Period, T_L		12.0000
Redundancy factor, u		1.0000
Risk Category (Table 1.5-1)		III
User Defined Vertical Accelerations Considered		No
Hazardous, toxic, or explosive contents		No
Vessel Characteristics		
Height		31.4813 ft
Weight	Operating, Corroded	104 305 lb
	Empty, Corroded	104 305 lb
Period of Vibration Calculation		
Fundamental Period, T	Operating, Corroded	0.117 sec (f = 8.5 Hz)
	Empty, Corroded	0.111 sec (f = 9.0 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.	$D + P + P_s + 0.7E$	$= (1.0 + 0.14S_{DS})D + P + P_s + 0.7uQ_E$	
8.	$0.6D + P + P_s + 0.7E$	$= (0.6 - 0.14S_{DS})D + P + P_s + 0.7uQ_E$	
Parameter description			
D	= Dead load		
P	= Internal or external pressure load		
P_s	= Static head load		
E	= Seismic load	$= E_h$ +/- E_v	$= uQ_E$ +/- $0.2S_{DS}D$

Seismic Shear Reports:

Operating, Corroded
Empty, Corroded

Base Shear Calculations

Seismic Shear Report: Operating, Corroded					
Component	**Elevation of Bottom above Base (in)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Seismic Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**
Top Head	354	26.5	*	3 594	4 910
Shell Course #3	258	26.5	22.8114	11 614	64 068
Shell Course #2	162	26.5	22.8114	18 016	184 544
Shell Course #1	66	26.5	22.8114	21 837	354 980
Bottom Head (top)	61.4797	26.5	*	21 906	369 191
Skirt Course	0	26.5	3.97	22 310	483 035
*Moment of Inertia I varies over the length of the component					

Seismic Shear Report: Empty, Corroded					
Component	**Elevation of Bottom above Base (in)**	**Elastic Modulus E (10^6 psi)**	**Inertia I (ft^4)**	**Seismic Shear at Bottom (lb_f)**	**Bending Moment at Bottom (lb_f-ft)**
Top Head	354	29.4	*	3 594	4 910
Shell Course #3	258	29.4	22.8114	11 614	64 068
Shell Course #2	162	29.4	22.8114	18 016	184 544
Shell Course #1	66	29.4	22.8114	21 837	354 980
Bottom Head (top)	61.4797	29.4	*	21 906	369 191
Skirt Course	0	29.4	3.97	22 310	483 035
*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}

$S_{MS} = \underline{F_a} * \underline{S_s} = 1.1000 * 100.00 / 100 = 1.1000$

The maximum considered earthquake spectral response acceleration at 1 s period, S_{M1}

$S_{M1} = \underline{F_v} * \underline{S_1} = 1.6000 * 40.00 / 100 = 0.6400$

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 $\underline{S_{Ds}} = 0.7333$ is D.
From Table 11.6-2, the Seismic Design Category based on $\underline{S_{D1}} = 0.4267$ is D.

This vessel is assigned to Seismic Design Category D.

12.4.2.3: Seismic Load Combinations: Vertical Term

Factor is applied to dead load.

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

Base Shear Calculations

Operating, Corroded
Empty, Corroded

Base Shear Calculations: Operating, Corroded

Paragraph 15.4.4: Period Determination

Fundamental Period is taken from the Rayleigh method listed previously in this report.
T = 0.1173 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 = 0.1173) <= (T_L = 12.0000)

$C_s = \underline{S_{DS}} / (\underline{R} / \underline{I_e}) = 0.7333 / (3.0000 / 1.2500) = 0.3056$

$C_s\text{Min} = \max[\ 0.044 * \underline{S_{DS}} * \underline{I_e}\ ,\ 0.03\ ] = \max[\ 0.044 * 0.7333 * 1.2500\ ,\ 0.03\ ] = 0.0403$

$C_s\text{Max} = \underline{S_{D1}} / (T * (\underline{R} / \underline{I_e})) = 0.4267 / (0.1173 * (3.0000 / 1.2500)) = 1.5160$

$C_s = 0.3056$

12.8.1: Calculation of Base Shear

$V = C_s * \underline{W}$
$= 0.3056 * 104\ 305.3672$
$= 31\ 871.08$ lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E_h

$Q_E = V$

$E_h = 0.7 * u * Q_E$ (Only 70% of seismic load considered as per Section 2.4.1)
$= 0.7000 * 1.0000 * 31\ 871.08$
$= 22\ 309.76$ 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 = 0.1113 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 = 0.1113) <= (T_L = 12.0000)

$C_s = \underline{S_{DS}} / (\underline{R} / \underline{I_e}) = 0.7333 / (3.0000 / 1.2500) = 0.3056$

$C_s\text{Min} = \max[\ 0.044 * \underline{S_{DS}} * \underline{I_e}\ ,\ 0.03\ ] = \max[\ 0.044 * 0.7333 * 1.2500\ ,\ 0.03\ ] = 0.0403$

$C_s\text{Max} = \underline{S_{D1}} / (T * (\underline{R} / \underline{I_e})) = 0.4267 / (0.1113 * (3.0000 / 1.2500)) = 1.5968$

$C_s = 0.3056$

12.8.1: Calculation of Base Shear

$V = C_s * \underline{W}$
$= 0.3056 * 104\ 305.3672$
$= 31\ 871.08$ lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E_h

$Q_E = V$

$E_h = 0.7 * u * Q_E$ (Only 70% of seismic load considered as per Section 2.4.1)
$= 0.7000 * 1.0000 * 31\ 871.08$
$= 22\ 309.76$ lb

Skirt Course

ASME Section VIII Division 1, 2015 Edition		
Component		Support Skirt
Material		SA-516 70 (II-D p. 18, ln. 37)
Skirt is Attached To		Bottom Head
Skirt Attachment Offset		4.5203" down from the top seam
Design Temperature		
Internal		600°F
Dimensions		
Inner Diameter	**Top**	82"
	Botttom	82"
Length (includes base ring thickness)		61.4797"
Nominal Thickness		0.375"
Corrosion	**Inner**	0"
	Outer	0"
Weight		
New		1 654.15 lb
Corroded		1 654.15 lb
Joint Efficiency		
Top		0.55
Bottom		0.8

Skirt design thickness, largest of the following + corrosion = 0.1691 in

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

The skirt thickness of 0.375 in is adequate.

Results Summary							
Loading	**Condition**	**Tensile or Compressive Side**	**Governing Skirt Location**	**Temperature (°F)**	**Allowable Stress (psi)**	**Calculated Stress/E (psi)**	**Required thickness (in)**
Wind	operating, corroded	Tensile	top	600	9 176.73	-159.68	0.0065
		Compressive	bottom			1 683.15	0.0688
	operating, new	Tensile	top	600	9 176.73	-168.7	0.0069
		Compressive	bottom			1 699.49	0.0694
	empty, corroded	Tensile	top	60	12 747.46	-159.68	0.0047
		Compressive	bottom			1 683.15	0.0495
	empty, new	Tensile	top	60	12 747.46	-168.7	0.005
		Compressive	bottom			1 699.49	0.05
		Tensile	top			-659.55	0.0194

	test, new	Compressive	bottom	60	12 747.46	2 062.55	0.0607
Seismic	operating, corroded	Tensile	top	600	19 400	3 077.5	0.0595
		Compressive	bottom		9 176.73	4 077.23	0.1666
	operating, new	Tensile	top	600	19 400	3 122.59	0.0604
		Compressive	bottom		9 176.73	4 137.52	0.1691
	empty, corroded	Tensile	top	60	20 000	3 077.5	0.0577
		Compressive	bottom		12 747.46	4 077.23	0.1199
	empty, new	Tensile	top	60	20 000	3 122.59	0.0585
		Compressive	bottom		12 747.46	4 137.52	0.1217

Loading due to seismic, operating & new

Tensile side

Required thickness, tensile stress at base:

$$t = -(0.6 - 0.14*S_{DS})*W / (s*D*S_t*E) + 48*M / (s*D^2*S_t*E)$$
$$= -(0.6 - 0.14*0.7333)*105\,117.3 / (s*82.375*19\,400*0.8) + 48*490\,164.3 / (s*82.375^2*19\,400*0.8)$$
$$= 0.0581 \text{ in}$$

Required thickness, tensile stress at the top:

$$t = -(0.6 - 0.14*S_{DS})*W_t / (s*D_t*S_t*E) + 48*M_t / (s*D_t^2*S_t*E)$$
$$= -(0.6 - 0.14*0.7333)*103\,463.16 / (s*82.375*19\,400*0.55) + 48*374\,333.1 / (s*82.375^2*19\,400*0.55)$$
$$= 0.0604 \text{ in}$$

Compressive side

Required thickness, compressive stress at base:

$$t = (1 + 0.14*S_{DS})*W / (s*D*S_c*E_c) + 48*M / (s*D^2*S_c*E_c)$$
$$= (1 + 0.14*0.7333)*105\,117.3 / (s*82.375*9\,177*1) + 48*490\,164.3 / (s*82.375^2*9\,177*1)$$
$$= 0.1691 \text{ in}$$

Required thickness, compressive stress at the top:

$$t = (1 + 0.14*S_{DS})*W_t / (s*D_t*S_c*E_c) + 48*M_t / (s*D_t^2*S_c*E_c)$$
$$= (1 + 0.14*0.7333)*103\,463.16 / (s*82.375*9\,177*1) + 48*374\,333.1 / (s*82.375^2*9\,177*1)$$
$$= 0.1399 \text{ in}$$

Base Ring

Inputs	
Base configuration	single base plate without gussets
Base plate material	SA516-70
Base plate allowable stress, S_p	20 000 psi
Foundation compressive strength	1 658 psi
Concrete ultimate 28-day strength	3 000 psi
Bolt circle, BC	87.25"
Base plate inner diameter, D_i	79.75"
Base plate outer diameter, D_o	90.75"
Base plate thickness, t_b	1.25"
Anchor Bolts	
Material	C.S.
Allowable stress, S_b	20 000 psi
Bolt size and type	1.25" series 8 threaded
Number of bolts, N	12
Corrosion allowance (applied to root radius)	0"
Anchor bolt clearance	0.375"
Bolt root area (corroded), A_b	0.93 in^2
Diameter of anchor bolt holes, d_b	1.625"
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	4 964.7	102 564.2	104 305.4	0	0.5221	113.59
Wind	operating, new	4 964.7	102 644.7	105 844	0	0.5246	114.68
Wind	empty, corroded	4 964.7	102 564.2	104 305.4	0	0.5221	113.59
Wind	empty, new	4 964.7	102 644.7	105 844	0	0.5246	114.68
Wind	test, new	3 219.3	68 744.5	160 830.8	0	0.5774	138.92
Seismic	operating, corroded	22 309.8	483 034.8	104 305.4	0.8911	1.0876	492.83
Seismic	operating, new	22 638.9	490 164.3	105 844	0.9043	1.0956	500.1
Seismic	empty, corroded	22 309.8	483 034.8	104 305.4	0.8911	1.0876	492.83
Seismic	empty, new	22 638.9	490 164.3	105 844	0.9043	1.0956	500.1

Anchor bolt load (governing)

$P = -(0.6 - 0.14*S_{DS})*W / N + 48 * M / (N*BC)$
$= -(0.6 - 0.14*0.7333)*105\ 844 / 12 + 48 * 490\ 164.3 / (12*87.25)$
$= 18\ 085.07\ lb_f$

Required area per bolt = $P / S_b = \underline{0.9043}\ in^2$

The area provided ($0.929\ in^2$) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, governing)

Base plate width, t_c:	5.5 in
Average base plate diameter, d:	85.25 in
Base plate elastic modulus, E_s:	29.0E+06 psi
Base plate yield stress, S_y:	38 000 psi

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

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

$t_s = (N*A_b) / (s*d)$
$= (12*0.929) / (s*85.25)$
$= 0.0416$ in

From table 12.4 for k = 0.262547:

$K_1 = 2.5237, K_2 = 1.4056$
$L_1 = 20.246, L_2 = 48.6872, L_3 = 17.7525$

Total tensile force on bolting

$T = (12*M - (0.6 - 0.14*S_{DS})*W *(L_1 + L_3)) / (L_2 + L_3)$
$= (12*490\ 164.3 - (0.6 - 0.14*0.7333)*105\ 844 *(20.246 + 17.7525)) / (48.6872 + 17.7525)$
$= 58\ 425.04\ lb_f$

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

$f_s = T / (t_s * (d / 2) * K_1)$
$= 58\ 425.04 / (0.0416 * (85.25 / 2) * 2.5237)$
$= 13\ 048$ psi

Total compressive load on foundation

$C_c = T + (1 + 0.14*S_{DS})*W + \text{Bolt Preload}$
$= 58\ 425.04 + (1 + 0.14*0.7333)*105\ 844 + 0$
$= 175\ 135.68\ lb_f$

Foundation bearing stress

$f_c = C_c / (((t_c - t_s) + n*t_s)*(d / 2)*K_2)$
$= 175\ 135.68 / (((5.5 - 0.0416) + 9.2889*0.0416)*(85.25 / 2)*1.4056)$
$= \underline{500}$ psi

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

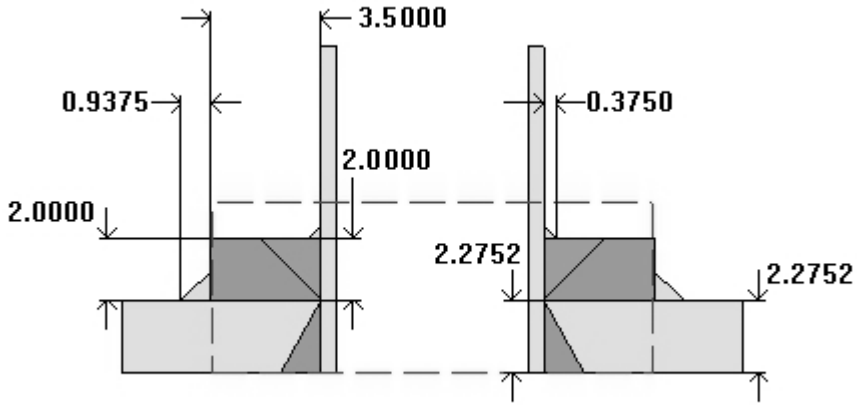
$k = 1 / (1 + f_s / (n*f_c))$
$= 1 / (1 + 13\ 048 / (9.2889*500))$
$= 0.262547$

Base plate required thickness (governing)

$t_r = (3*f_c*L^2 / S_p)^{0.5}$
$= (3*500*4^2 / 20\ 000)^{0.5}$
$= \underline{1.0956}$ in

The base plate thickness is satisfactory.

Outlet (B)

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	-42"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Description	NPS 8 Sch 80 (XS)
Access opening	No
Material specification	SA-106 B Smls pipe (II-D p. 14, ln. 15)
Inside diameter, new	7.625"
Pipe nominal wall thickness	0.5"
Pipe minimum wall thickness[1]	0.4375"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	12.844"
Projection available outside vessel to flange face, Lf	18.344"
Local vessel minimum thickness	2.2752"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Reinforcing Pad	

Material specification	SA-516 70 (II-D p. 18, ln. 37) (normalized)
Diameter, D_p	15.625"
Thickness, t_e	2"
Is split	No
Welds	
Inner fillet, Leg_{41}	0.375"
Outer fillet, Leg_{42}	0.9375"
Nozzle to vessel groove weld	2.2752"
Pad groove weld	2"

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

ASME B16.5-2013 Flange	
Description	NPS 8 Class 600 WN A350 LF2
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	No
Rated MDMT	-55°F
Liquid static head	0 psi
MAWP rating	1 135 psi @ 600°F
MAP rating	1 480 psi @ 60°F
Hydrotest rating	2 225 psi @ 60°F
PWHT performed	Yes
Impact Tested	No
Circumferential joint radiography	None UW-11(c) Type 1
Bore diameter, B (specified by purchaser)	7.625"
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 26°F applied (ratio = 0.7399). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle	
Governing thickness, t_g =	0.4375"
Exemption temperature from Fig UCS-66 Curve B =	-13°F
t_r = 1 095*3.875 / (17 100*1 - 0.6*1 095) =	0.2581"
Stress ratio = t_r*E^* / (t_n - c) = 0.2581*1 / (0.4375 - 0.0625) =	0.6881
Reduction in MDMT, T_R from Fig UCS-66.1 =	31.2°F
MDMT = max[MDMT - T_R, -55] = max[-13 - 31.2 , -55] =	-44.2°F

Material is exempt from impact testing at the Design MDMT of -20°F.

UCS-66 Material Toughness Requirements Pad	
Material impact test temperature per UG-84 =	-20°F
t_r = 1 095*0.8986*78.125 / (2*20 000*1 - 0.2*1 095) =	1.9324"
Stress ratio = t_r*E* / (t_n - c) = 1.9324*1 / (2.2752 - 0.0625) =	0.8733
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	12.7°F
MDMT = max[T_{impact} - T_R, -155] = max[-20 - 12.7 , -155] =	-32.7°F
Design MDMT of -20°F is acceptable.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1 095 psi @ 600 °F The opening is adequately reinforced							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
15.6486	16.5361	1.6838	0.9784	--	13.75	0.1239	0.3443	0.4375

UG-41 Weld Failure Path Analysis Summary (lb$_f$)						
All failure paths are stronger than the applicable weld loads						
Weld load W	Weld load W_{1-1}	Path 1-1 strength	Weld load W_{2-2}	Path 2-2 strength	Weld load W_{3-3}	Path 3-3 strength
274 211.23	288 134.62	286 081.22	54 490.52	861 926.49	321 240.52	649 093.36

UW-16 Weld Sizing Summary			
Weld description	Required weld size (in)	Actual weld size (in)	Status
Nozzle to pad fillet (Leg_{41})	0.25	0.2625	weld size is adequate
Pad to shell fillet (Leg_{42})	0.375	0.6562	weld size is adequate

Fill / Manway (C)

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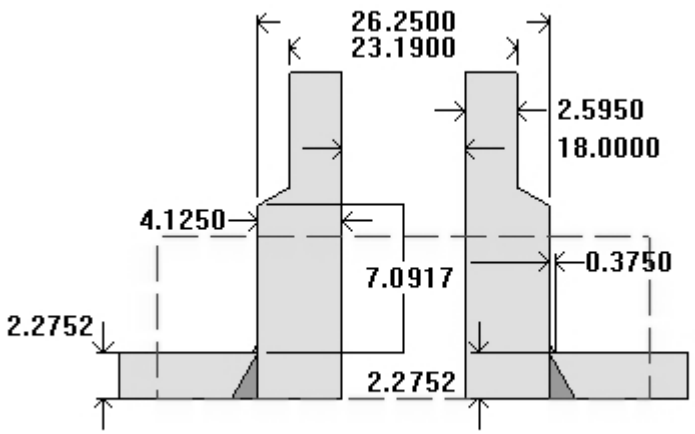
Note: Per UW-16(b) minimum inside corner radius r_1 = min [1 / 4*t , 0.125 in] = 0.125 in

Location and Orientation	
Located on	Top Head
Orientation	0°
End of nozzle to datum line	324"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	18"
Wall thickness, t_n	4.125"
Minimum wall thickness	2.4075"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	9.855"
Heavy barrel length, L_{hb}	7.0917"
Projection available outside vessel to flange face, Lf	13.355"
Local vessel minimum thickness	2.2752"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	

Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	2.2752"

ASME B16.5-2013 Flange	
Description	NPS 18 Class 600 FVC V2 (or equiv.) A350 LF2 Cl.1 (Nut Stop)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	Yes
Rated MDMT	-55°F
Liquid static head	0 psi
MAWP rating	1 135 psi @ 600°F
MAP rating	1 480 psi @ 60°F
Hydrotest rating	2 225 psi @ 60°F
PWHT performed	Yes
Impact Tested	No
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 26°F applied (ratio = 0.7399). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
Impact test temperature per material specification =	-50°F
t_r = 1 095*0.8986*78.125 / (2*20 000*1 - 0.2*1 095) =	1.9324"
Stress ratio = $t_r*E^* / (t_n - c)$ = 1.9324*1 / (2.2752 - 0.0625) =	0.8733
UCS-66(i) reduction in MDMT, T_R from Fig UCS-66.1 =	12.7°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, max[T_{impact} - T_R, -155]] = min[-50 - 5, max[-50 - 12.7 , -155]] =	-62.7°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1 095*9.0625 / (20 000*1 - 0.6*1 095) =	0.513"
Stress ratio = $t_r*E^* / (t_n - c)$ = 0.513*1 / (2.4075 - 0.0625) =	0.2188
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1 095 psi @ 600 °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}
36.9476	40.7942	3.8992	36.7616	--	--	0.1334	0.6218	2.4075

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

Dump (D)

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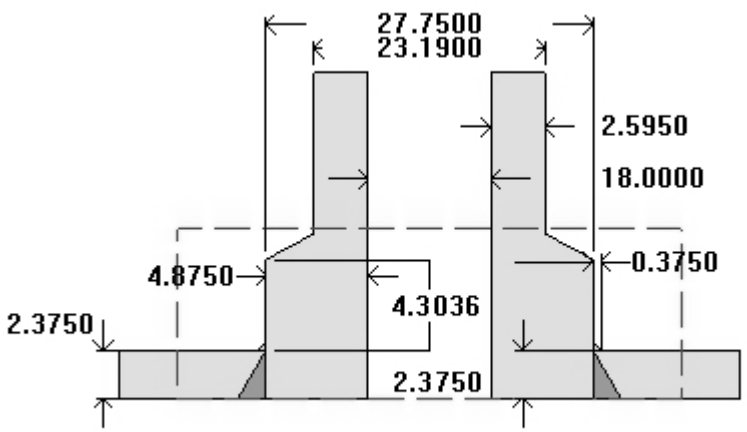
	
Note: Per UW-16(b) minimum inside corner radius r_1 = min [1 / 4*t , 0.125 in] = 0.125 in	
Location and Orientation	
Located on	Shell Course #1
Orientation	0°
Nozzle center line offset to datum line	30"
End of nozzle to shell center	52.375"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-350 LF2 Cl 1 (II-D p. 18, ln. 28)
Inside diameter, new	18"
Wall thickness, t_n	4.875"
Minimum wall thickness	2.4075"
Corrosion allowance	0.0625"
Projection available outside vessel, Lpr	7.5"
Heavy barrel length, L_{hb}	4.3036"
Projection available outside vessel to flange face, Lf	11"
Local vessel minimum thickness	2.375"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

Nozzle to vessel groove weld	2.375"

ASME B16.5-2013 Flange	
Description	NPS 18 Class 600 FVC V3 (or equiv.) A350 LF2 Cl.1 (Nut Stop)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31)
Blind included	Yes
Rated MDMT	-55°F
Liquid static head	0 psi
MAWP rating	1 135 psi @ 600°F
MAP rating	1 480 psi @ 60°F
Hydrotest rating	2 225 psi @ 60°F
PWHT performed	Yes
Impact Tested	No
Notes	
Flange is impact tested per material specification to -50°F. UCS-66(i) reduction of 26°F applied (ratio = 0.7399). Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
Impact test temperature per material specification =	-50°F
Additional reduction per UCS-66(g) =	5°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Nozzle	
Impact test temperature per material specification =	-50°F
t_r = 1 095*9.0625 / (20 000*1 - 0.6*1 095) =	0.513"
Stress ratio = t_r*E^* / (t_n - c) = 0.513*1 / (2.4075 - 0.0625) =	0.2188
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
MDMT = min[T_{impact} - $T_{UCS-66(g)}$, -155] = min[-50 - 5 , -155] =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

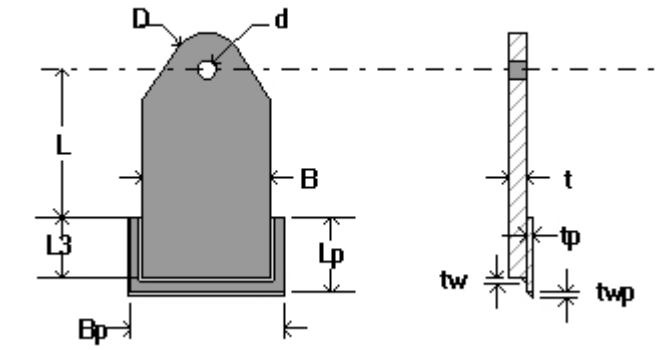
Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 1 095 psi @ 600 °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}**
42.4943	43.7701	0.5359	43.1008	--	--	0.1334	0.6218	2.4075

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

Lifting Lugs (From Horiz. - Empty)

Geometry Inputs	
	
Attached To	Shell Course #3
Material	SA516-70
Distance of Lift Point From Datum	311.5"
Angular Position	0° and 180°
Length, L	23.5"
Width, B	21"
Thickness, t	1.5"
Hole Diameter, d	3"
Pin Diameter, Dp	2.75"
Diameter at Pin, D	12"
Load Angle from Vertical, i	0°
Has Brace Plate	No
Welds	
Size, t_w	0.5"
Reinforcement Pad	
Width, B_p	25"
Length, L_p	12.5"
Thickness, t_p	0.5"
Weld Size, t_{wp}	0.375"
Weld Length, L_3	10.5"

Intermediate Values	
Load Factor	1.5000
Vessel Weight (new, incl. Load Factor), W	110 933.5 lb
Lug Weight (new), W_{lug}	696.7 lb (Qty=2)
Distance from Center of Gravity to Top Lug, l_1	172.6923"

Distance from Center of Gravity to Tail Lug, l_2	196.5577"
Distance from Vessel Center Line to Tail Lug, l_3	50.375"
Allowable Stress, Tensile, v_t	19 980 psi
Allowable Stress, Shear, v_s	13 320 psi
Allowable Stress, Bearing, v_p	29 970 psi
Allowable Stress, Bending, v_b	22 201 psi
Allowable Stress, Weld Shear, $w_{allowable}$	13 320 psi
Allowable Stress set to 1/3 Sy per ASME B30.20	No

Summary Values	
Required Lift Pin Diameter, d_{reqd}	1.6282"
Required Lug Thickness, t_{reqd}	0.673"
Lug Stress Ratio, v_{ratio}	0.29
Weld Shear Stress Ratio, w_{ratio}	0.85
Lug Design	Acceptable
Local Stresses WRC 107	Acceptable
Maximum Out of Plane Lift Angle - Weak Axis Bending	7.64°

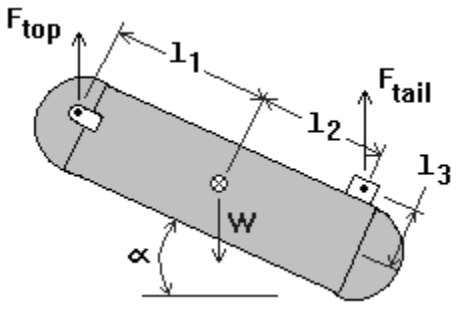
COMPRESS recommends a spreader beam be used to prevent weak axis bending of the top lugs.
No consideration is given for any bracing plate from the lug to the vessel.

Lift Forces

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

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

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



α [°]	F_{top}[lbf]	F_{tail}[lbf]
0	29 526	51 882
15	30 441	50 052
30	31 420	48 094
45	32 640	45 654
60	34 484	41 966

75	38 278	34 378
90	55 467	0
16[1]	30 502	49 929
14[2]	30 379	50 175
15[3]	30 441	50 052
[1]Lift angle at maximum lug stress.		
[2]Lift angle at maximum weld stress.		
[3]Lift angle at maximum pad weld stress.		
Shell angle at lift lug	0.00°	

Lug Pin Diameter - Shear stress

$d_{reqd} = (2*F_v / (s*v_s))^{0.5}$

$= (2*55\,467 / (s*13\,320))^{0.5} = \underline{1.6282"}$

$d_{reqd} / D_p = 1.6282 / 2.75 = 0.59$ Acceptable

$v = F_v / A$

$= F_v / (2*(0.25*s*D_p^2))$

$= 55\,467 / (2*(0.25*s*2.75^2)) = 4\,669$ psi

$v / v_s = 4\,669 / 13\,320 = 0.35$ Acceptable

Lug Thickness - Tensile stress

$t_{reqd} = F_v / ((D - d)*v_t)$

$= 55\,467 / ((12 - 3)*19\,980) = 0.3085"$

$t_{reqd} / t = 0.3085 / 1.5 = 0.21$ Acceptable

$v = F_v / A$

$= F_v / ((D - d)*t)$

$= 55\,467 / ((12 - 3)*1.5) = 4\,109$ psi

$v / v_t = 4\,109 / 19\,980 = 0.21$ Acceptable

Lug Thickness - Bearing stress

$t_{reqd} = F_v / (D_p*v_p)$

$= 55\,467 / (2.75*29\,970) = \underline{0.673"}$

$t_{reqd} / t = 0.673 / 1.5 = 0.45$ Acceptable

$v = F_v / A_{bearing}$

$= F_v / (D_p*(t))$

$= 55\,467 / (2.75*(1.5)) = 13\,446$ psi

$v / v_p = 13\,446 / 29\,970 = 0.45$ Acceptable

Lug Thickness - Shear stress

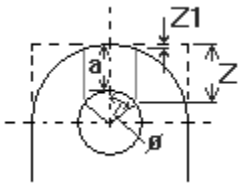
t_{reqd} = $[F_v / v_s] / (2*L_{shear})$
= (55 467 / 13 320) / (2*4.9045) = 0.4245"

t_{reqd} / t = 0.4245 / 1.5 = 0.28 Acceptable

w = F_v / A_{shear}
= $F_v / (2*t*L_{shear})$
= 55 467 / (2*1.5*4.9045) = 3 770 psi

w / v_s = 3 770 / 13 320 = 0.28 Acceptable

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



i = $55*D_p / d$
= 55*2.75 / 3
= 50.4167°

Z = $0.5*(D - d) + 0.5*D_p*(1 - \cos(i))$
= $0.5*(12 - 3) + 0.5*2.75*(1 - \cos(50.4167))$
= 4.9989"

Z1 = $0.5*D - \sqrt{0.25*D*D - (0.5*D_p*\sin(i))^2}$
= $0.5*12 - \sqrt{0.25*12*12 - (0.5*2.75*\sin(50.4167))^2}$
= 0.0943"

L_{shear} = Z - Z1
= 4.9045"

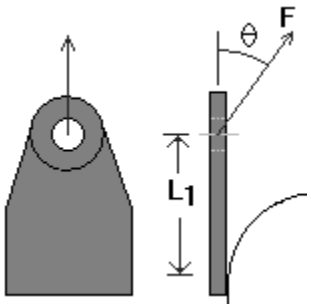
Lug Plate Stress

Lug stress, tensile + bending, during rotational lift:

v_{ratio} = $[F_{ten} / (A_{ten}*v_t)] + [M_{bend} / (Z_{bend}*v_b)] \le 1$
= $[(F_{top}(d)*\sin(d)) / (t*B*v_t)] + [(6*F_{top}(d)*L*\cos(d)) / (t*B^2 * v_b)] \le 1$
= $30\,502*\sin(16.0) / (1.5*21*19\,980) + 6*(30\,502)*23.5*\cos(16.0) / (1.5*21^2*22\,201)$
= 0.29 Acceptable

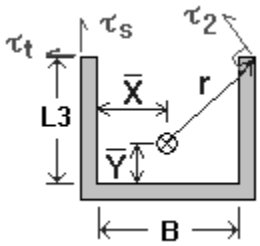
Weak Axis Bending Stress

Maximum lift cable angle from vertical t = 7.64°



v_b = M / Z = $(F*\sin(t)* L_1) / Z$
F*cos(t) = 0.5*W => F = 0.5*W / cos(t)
t = $\arctan((2*v_b*Z) / (W* L_1))$
t = $\arctan((2*22\,201*(21*1.5^2/6)) / (110\,933*23.5))$ = 7.64°

Weld Stress



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

Direct shear:

Maximum weld shear stress occurs at lift angle 14.00°; lift force = 30 379 lb_f

$A_{weld} = 0.707*t_w*(2*L_3 + B)$
$= 0.707*0.5*(2*10.5 + 21) = 14.847\ in^2$

$w_t = F_{lug}*\cos(d) / A_{weld}$
$= 30\ 379*\cos(14.0) / 14.847 = 1\ 985\ psi$

$w_s = F_{lug}*\sin(d) / A_{weld}$
$= 30\ 379*\sin(14.0) / 14.847 = 495\ psi$

Torsional shear:

Weld centroid:

$Y_{bar} = L_3^2 / (2*L_3 + B)$
$= 10.5^2 / (2*10.5 + 21) = 2.625"$

Second polar moment of area:

$J = 0.707*t_w*((8*L_3^3 + 6*L_3*B^2 + B^3) / 12 - L_3^4 / (2*L_3 + B))$
$= 0.707*0.5*((8*10.5^3 + 6*10.5*21^2 + 21^3) / 12 - 10.5^4 / (2*10.5 + 21)) = 1261.76\ in^4$

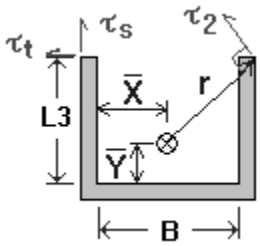
Radial distance from centroid to weld:

$r = sqr((X_{bar})^2 + (L_3 - Y_{bar})^2)$
$= sqr((0.5*21)^2 + (10.5 - 2.625)^2) = 13.125"$

$t_r = \arctan((L_3 - Y_{bar}) / (X_{bar}))$
$= \arctan(7.875 / 10.5) = 36.87°$

$w_2 = M * r / J$
$= [F(d)*\cos(d)*(L + L_3 - Y_{bar})] * r / J$
$= (30\ 379*\cos(14.0)*31.375)*13.125 / 1261.7630$
$= 9\ 620\ psi$

$w_{ratio} = sqr((w_t + w_2*\sin(t_r))^2 + (w_s + w_2*\cos(t_r))^2) / w_{allowable} \le 1$
$= sqr ((1\ 985 + 9\ 620*\sin(36.87))^2 + (495 + 9\ 620*\cos(36.87))^2) / 13\ 320$
$= \underline{0.85}$ Acceptable



Pad Weld Stress

Direct shear:

Maximum weld shear stress occurs at lift angle 15.00°; lift force = 30 441 lb_f

$A_{weld} = 0.707*t_{wp}*(2*L_p + B_p)$
$= 0.707*0.375*(2*12.5 + 25) = 13.2563\ in^2$

$w_t = F_{lug}*\cos(d) / A_{weld}$
$= 30\,441*\cos(15.0) / 13.2563 = 2\,218$ psi

$w_s = F_{lug}*\sin(d) / A_{weld}$
$= 30\,441*\sin(15.0) / 13.2563 = 594$ psi

Torsional shear:

Weld centroid:

$Y_{barp} = L_p^2 / (2*L_p + B_p)$
$= 12.5^2 / (2*12.5 + 25) = 3.125"$

Second polar moment of area:

$J_p = 0.707*t_{wp}*((8*L_p^3 + 6*L_p*B_p^2 + B_p^3) / 12 - L_p^4 / (2*L_p + B_p))$
$= 0.707*0.375*\ ((8*12.5^3 + 6*12.5*25^2 + 25^3) / 12 - 12.5^4 / (2*12.5 + 25)) = 1596.62\ in^4$

Radial distance from centroid to weld:

$r_p = sqr((X_{barp})^2 + (L_p - Y_{barp})^2)$
$= sqr((0.5*25)^2 + (12.5 - 3.125)^2) = 15.625"$

$t_r = \arctan((L_p - Y_{barp}) / (X_{barp}))$
$= \arctan(9.375 / 12.5) = 36.87°$

$w_2 = M * r_p / J_p$
$= [F(d)*\cos(d)*(L + L_p - Y_{barp})] * r_p / J_p$
$= (30\,441*\cos(15.0)*32.875)*15.625 / 1596.6187$
$= 9\,460$ psi

$w_{ratio} = sqr((w_t + w_2*\sin(t_r))^2 + (w_s + w_2*\cos(t_r))^2) / w_{allowable} \le 1$
$= sqr\ ((2\,218 + 9\,460*\sin(36.87))^2 + (594 + 9\,460*\cos(36.87))^2) / 13\,320$
$= 0.85$ Acceptable

WRC 107 Analysis

Maximum stress ratio occurs at lift angle = 90.00° with lift force = 55 467 lb_f

Geometry	
Height (radial)	1.5"
Width (circumferential)	21"
Length	10.5"
Fillet Weld Size:	0.5"
Located On	Shell Course #3 (10.5" from top end)
Location Angle	0.00° and 180.00°
Reinforcement Pad	
Thickness	0.5"
Width	25"
Length	12.5"
Weld Size	0.375"

Applied Loads	
Radial load, P_r	0 lb_f
Circumferential moment, M_c	0 lb_f-in
Circumferential shear, V_c	0 lb_f
Longitudinal moment, M_L	69 333.4 lb_f-in
Longitudinal shear, V_L	55 466.73 lb_f
Torsion moment, M_t	0 lb_f-in
Internal pressure, P	0 psi
Mean shell radius, R_m	40.1875"
Design factor	3

Maximum stresses due to the applied loads at the lug edge

$j = R_m / T = 40.1875 / 2.875 = 13.9783$

$C_1 = 11$, $C_2 = 5.75$ in

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

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

Maximum combined stress (P_L+P_b+Q) = 1 678 psi
Allowable combined stress (P_L+P_b+Q) = $\pm 3*S = \pm 60\,000$ psi

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

Maximum local primary membrane stress (P_L) = -111 psi
Allowable local primary membrane stress (P_L) = $\pm 1.5*S = \pm 30\,000$ psi

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

Stresses at the lug edge per WRC Bulletin 107										
Figure	**value**	**e**	**A_u**	**A_l**	**B_u**	**B_l**	**C_u**	**C_l**	**D_u**	**D_l**
3C*	2.0219	0.1925	0	0	0	0	0	0	0	0
4C*	2.2633	0.2389	0	0	0	0	0	0	0	0
1C	0.0839	0.2437	0	0	0	0	0	0	0	0
2C-1	0.054	0.2437	0	0	0	0	0	0	0	0
3A*	0.531	0.2205	0	0	0	0	0	0	0	0
1A	0.0869	0.2636	0	0	0	0	0	0	0	0
3B*	1.4742	0.1776	-111	-111	111	111	0	0	0	0
1B-1	0.0436	0.1913	-285	285	285	-285	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-396	174	396	-174	0	0	0	0
Primary membrane circumferential stress*			-111	-111	111	111	0	0	0	0
3C*	1.7801	0.2389	0	0	0	0	0	0	0	0
4C*	2.375	0.1925	0	0	0	0	0	0	0	0
1C-1	0.0986	0.2099	0	0	0	0	0	0	0	0
2C	0.0659	0.2099	0	0	0	0	0	0	0	0
4A*	0.8817	0.2205	0	0	0	0	0	0	0	0
2A	0.0505	0.2177	0	0	0	0	0	0	0	0
4B*	0.4439	0.1776	-29	-29	29	29	0	0	0	0
2B-1	0.0714	0.185	-483	483	483	-483	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-512	454	512	-454	0	0	0	0
Primary membrane longitudinal stress*			-29	-29	29	29	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-839	-839	839	839
Total Shear stress			0	0	0	0	-839	-839	839	839
Combined stress (P_L+P_b+Q)			-512	454	512	-454	1 678	1 678	1 678	1 678
* denotes primary stress.										

Maximum stresses due to the applied loads at the pad edge

$j = R_m / T = 40.1875 / 2.375 = 16.9211$

$C_1 = 12.875$, $C_2 = 6.625$ in

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

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

Maximum combined stress (P_L+P_b+Q) = 1 762 psi
Allowable combined stress (P_L+P_b+Q) = ±3*S = ±60 000 psi

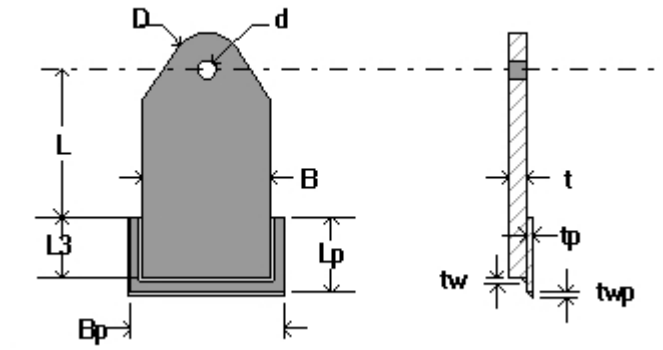
The maximum combined stress (P_L+P_b+Q) is within allowable limits.

Maximum local primary membrane stress (P_L) = -151 psi
Allowable local primary membrane stress (P_L) = ±1.5*S = ±30 000 psi

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

Stresses at the pad edge per WRC Bulletin 107										
Figure	**value**	**e**	**A_u**	**A_l**	**B_u**	**B_l**	**C_u**	**C_l**	**D_u**	**D_l**
3C*	2.0638	0.2233	0	0	0	0	0	0	0	0
4C*	2.4619	0.279	0	0	0	0	0	0	0	0
1C	0.0666	0.2847	0	0	0	0	0	0	0	0
2C-1	0.0377	0.2847	0	0	0	0	0	0	0	0
3A*	0.7166	0.2567	0	0	0	0	0	0	0	0
1A	0.0803	0.3068	0	0	0	0	0	0	0	0
3B*	1.9105	0.2057	-151	-151	151	151	0	0	0	0
1B-1	0.0364	0.2217	-301	301	301	-301	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-452	150	452	-150	0	0	0	0
Primary membrane circumferential stress*			-151	-151	151	151	0	0	0	0
3C*	1.7476	0.279	0	0	0	0	0	0	0	0
4C*	2.6721	0.2233	0	0	0	0	0	0	0	0
1C-1	0.0767	0.2443	0	0	0	0	0	0	0	0
2C	0.0469	0.2443	0	0	0	0	0	0	0	0
4A*	1.281	0.2567	0	0	0	0	0	0	0	0
2A	0.0448	0.2518	0	0	0	0	0	0	0	0
4B*	0.6325	0.2057	-43	-43	43	43	0	0	0	0
2B-1	0.0605	0.2141	-519	519	519	-519	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-562	476	562	-476	0	0	0	0
Primary membrane longitudinal stress*			-43	-43	43	43	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-881	-881	881	881
Total Shear stress			0	0	0	0	-881	-881	881	881
Combined stress (P_L+P_b+Q)			-562	476	562	-476	1 762	1 762	1 762	1 762
* denotes primary stress.										

Lifting Lugs (Vertical Lift Loaded)

Geometry Inputs	
	
Attached To	Shell Course #3
Material	SA516-70
Distance of Lift Point From Datum	311.5"
Angular Position	0° and 180°
Length, L	23.5"
Width, B	21"
Thickness, t	1.5"
Hole Diameter, d	3"
Pin Diameter, Dp	2.75"
Diameter at Pin, D	12"
Load Angle from Vertical, i	0°
Has Brace Plate	No
Welds	
Size, t_w	0.5"
Reinforcement Pad	
Width, B_p	25"
Length, L_p	12.5"
Thickness, t_p	0.5"
Weld Size, t_{wp}	0.375"
Weld Length, L_3	10.5"

Intermediate Values	
Load Factor	1.5000
Vessel Weight (new, incl. Load Factor), W	158 655.1 lb
Lug Weight (new), W_{lug}	696.7 lb (Qty=2)
Allowable Stress, Tensile, v_t	19 980 psi

Allowable Stress, Shear, v_s	13 320 psi
Allowable Stress, Bearing, v_p	29 970 psi
Allowable Stress, Bending, v_b	22 201 psi
Allowable Stress, Weld Shear, $w_{allowable}$	13 320 psi
Allowable Stress set to 1/3 Sy per ASME B30.20	No

Summary Values	
Required Lift Pin Diameter, d_{reqd}	1.9472"
Required Lug Thickness, t_{reqd}	0.9625"
Lug Stress Ratio, v_{ratio}	0.13
Weld Shear Stress Ratio, w_{ratio}	0.4
Lug Design	Acceptable
Local Stresses WRC 107	Acceptable
Maximum Out of Plane Lift Angle - Weak Axis Bending	5.36°

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

Lift Forces

F_r = force on vessel at lug

$F_r = [W / \cos(i_1)]*(1 - x_1 / (x_1 + x_2))$

$= (158\,655.1) / \cos(0)*(1 - 41.375/ (41.375 + 41.375))$

$= 79\,328\ lb_f$

where 'x_1' is the distance between this lug and the center of gravity

'x_2' is the distance between the second lift lug and the center of gravity

Lug Pin Diameter - Shear stress

$d_{reqd} = (2*F_v / (s*v_s))^{0.5}$

$= (2*79\,328 / (s*13\,320))^{0.5} = 1.9472"$

$d_{reqd} / D_p = 1.9472 / 2.75 = 0.71$ Acceptable

$v = F_v / A$

$= F_v / (2*(0.25*s*D_p^2))$

$= 79\,328 / (2*(0.25*s*2.75^2)) = 6\,678$ psi

$v / v_s = 6\,678 / 13\,320 = 0.5$ Acceptable

Lug Thickness - Tensile stress

$t_{reqd} = F_v / ((D - d)*v_t)$

$= 79\,328 / ((12 - 3)*19\,980) = 0.4411"$

$t_{reqd} / t = 0.4411 / 1.5 = 0.29$ Acceptable

$v = F_v / A$
$= F_v / ((D - d)*t)$
$= 79\,328 / ((12 - 3)*1.5) = 5\,876$ psi

$v / v_t = 5\,876 / 19\,980 = 0.29$ Acceptable

Lug Thickness - Bearing stress

$t_{reqd} = F_v / (D_p*v_p)$
$= 79\,328 / (2.75*29\,970) = \underline{0.9625"}$

$t_{reqd} / t = 0.9625 / 1.5 = 0.64$ Acceptable

$v = F_v / A_{bearing}$
$= F_v / (D_p*(t))$
$= 79\,328 / (2.75*(1.5)) = 19\,231$ psi

$v / v_p = 19\,231 / 29\,970 = 0.64$ Acceptable

Lug Thickness - Shear stress

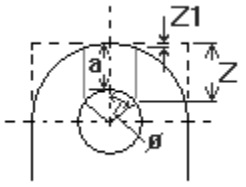
$t_{reqd} = [F_v / v_s] / (2*L_{shear})$
$= (79\,328 / 13\,320) / (2*4.9045) = \underline{0.6071"}$

$t_{reqd} / t = 0.6071 / 1.5 = 0.40$ Acceptable

$w = F_v / A_{shear}$
$= F_v / (2*t*L_{shear})$
$= 79\,328 / (2*1.5*4.9045) = 5\,391$ psi

$w / v_s = 5\,391 / 13\,320 = 0.4$ Acceptable

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



$i = 55*D_p / d$
$= 55*2.75 / 3$
$= 50.4167°$

$Z = 0.5*(D - d) + 0.5*D_p*(1 - \cos(i))$
$= 0.5*(12 - 3) + 0.5*2.75*(1 - \cos(50.4167))$
$= 4.9989"$

$Z1 = 0.5*D - \text{sqr}(0.25*D*D - (0.5*D_p*\sin(i))^2)$
$= 0.5*12 - \text{sqr}(0.25*12*12 - (0.5*2.75*\sin(50.4167))^2)$
$= 0.0943"$

$L_{shear} = Z - Z1$
$= 4.9045"$

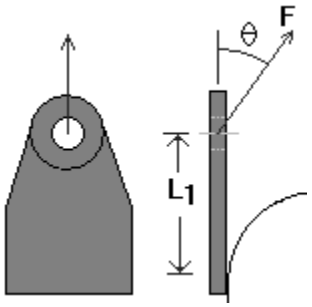
Lug Plate Stress

Lug stress, tensile + bending, during rotational lift:

$v_{ratio} = [F_{ten} / (A_{ten}*v_t)] + [M_{bend} / (Z_{bend}*v_b)] \le 1$
$= [(F_{top}(d)*\sin(d)) / (t*B*v_t)] + [(6*F_{top}(d)*L*\cos(d)) / (t*B^2 * v_b)] \le 1$
$= 79\,328*\sin(90.0) / (1.5*21*19\,980) + 6*(79\,328)*23.5*\cos(90.0) / (1.5*21^2*22\,201)$
$= \underline{0.13}$ Acceptable

Weak Axis Bending Stress

Maximum lift cable angle from vertical $t = 5.36°$



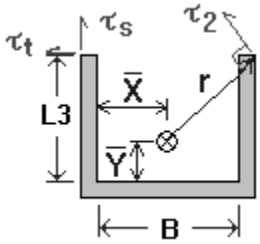
v_b $= M / Z$ $= (F*\sin(t)* L_1) / Z$

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

$t = \arctan((2*v_b*Z) / (W* L_1))$

$t = \arctan((2*22\,201*(21*1.5^2/6)) / (158\,655*23.5)) = 5.36°$

Weld Stress



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

Direct shear:

Maximum weld shear stress occurs at lift angle 90.00°; lift force = 79 328 lb_f

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

$= 0.707*0.5*(2*10.5 + 21) = 14.847\ in^2$

$w_t = F_{lug}*\cos(d) / A_{weld}$

$= 79\,328*\cos(90.0) / 14.847 = 0\ psi$

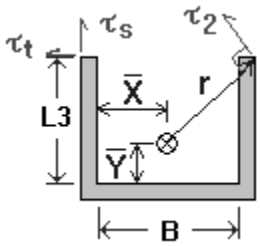
$w_s = F_{lug}*\sin(d) / A_{weld}$

$= 79\,328*\sin(90.0) / 14.847 = 5\,343\ psi$

$w = sqr(w_t^2 + w_s^2)$

$= sqr(0^2 + 5\,343^2) = 5\,343\ psi$

$w / w_{allowable} = 5\,343 / 13\,320 = \underline{0.40} \leq 1$ Acceptable



Pad Weld Stress

Direct shear:

Maximum weld shear stress occurs at lift angle 90.00°; lift force = 79 328 lb_f

$A_{weld} = 0.707*t_{wp}*(2*L_p + B_p)$

$= 0.707*0.375*(2*12.5 + 25) = 13.2563\ in^2$

$w_t = F_{lug}*\cos(d) / A_{weld}$

$= 79\ 328*\cos(90.0) / 13.2563 = 0$ psi

$w_s = F_{lug}*\sin(d) / A_{weld}$

$= 79\ 328*\sin(90.0) / 13.2563 = 5\ 984$ psi

$w = sqr(w_t^2 + w_s^2)$

$= sqr(0^2 + 5\ 984^2) = 5\ 984$ psi

$w / w_{allowable} = 5\ 984 / 13\ 320 = 0.45 \leq 1$ Acceptable

WRC 107 Analysis

Geometry	
Height (radial)	1.5"
Width (circumferential)	21"
Length	10.5"
Fillet Weld Size:	0.5"
Located On	Shell Course #3 (10.5" from top end)
Location Angle	0.00° and 180.00°
Reinforcement Pad	
Thickness	0.5"
Width	25"
Length	12.5"
Weld Size	0.375"

Applied Loads	
Radial load, P_r	0 lb_f
Circumferential moment, M_c	0 lb_f-in

Circumferential shear, V_c	0 lb_f
Longitudinal moment, M_L	99 159.4 lb_f-in
Longitudinal shear, V_L	79 327.54 lb_f
Torsion moment, M_t	0 lb_f-in
Internal pressure, P	0 psi
Mean shell radius, R_m	40.1875"
Design factor	3

Maximum stresses due to the applied loads at the lug edge

$j = R_m / T = 40.1875 / 2.875 = 13.9783$

$C_1 = 11$, $C_2 = 5.75$ in

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

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

Maximum combined stress (P_L+P_b+Q) = 2 400 psi
Allowable combined stress (P_L+P_b+Q) = $\pm 3*S = \pm 60\ 000$ psi

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

Maximum local primary membrane stress (P_L) = -159 psi
Allowable local primary membrane stress (P_L) = $\pm 1.5*S = \pm 30\ 000$ psi

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

Stresses at the lug edge per WRC Bulletin 107										
Figure	**value**	**e**	**A_u**	**A_l**	**B_u**	**B_l**	**C_u**	**C_l**	**D_u**	**D_l**
3C*	2.0219	0.1925	0	0	0	0	0	0	0	0
4C*	2.2633	0.2389	0	0	0	0	0	0	0	0
1C	0.0839	0.2437	0	0	0	0	0	0	0	0
2C-1	0.054	0.2437	0	0	0	0	0	0	0	0
3A*	0.531	0.2205	0	0	0	0	0	0	0	0
1A	0.0869	0.2636	0	0	0	0	0	0	0	0
3B*	1.4742	0.1776	-159	-159	159	159	0	0	0	0
1B-1	0.0436	0.1913	-408	408	408	-408	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-567	249	567	-249	0	0	0	0
Primary membrane circumferential stress*			-159	-159	159	159	0	0	0	0
3C*	1.7801	0.2389	0	0	0	0	0	0	0	0
4C*	2.375	0.1925	0	0	0	0	0	0	0	0
1C-1	0.0986	0.2099	0	0	0	0	0	0	0	0
2C	0.0659	0.2099	0	0	0	0	0	0	0	0
4A*	0.8817	0.2205	0	0	0	0	0	0	0	0

2A	0.0505	0.2177	0	0	0	0	0	0	0	0
4B*	0.4439	0.1776	-41	-41	41	41	0	0	0	0
2B-1	0.0714	0.185	-691	691	691	-691	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-732	650	732	-650	0	0	0	0
Primary membrane longitudinal stress*			-41	-41	41	41	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-1 200	-1 200	1 200	1 200
Total Shear stress			0	0	0	0	-1 200	-1 200	1 200	1 200
Combined stress (P_L+P_b+Q)			-732	650	732	-650	2 400	2 400	2 400	2 400
* denotes primary stress.										

Maximum stresses due to the applied loads at the pad edge

j = R_m / T = 40.1875 / 2.375 = 16.9211

C_1 = 12.875, C_2 = 6.625 in

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

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

Maximum combined stress (P_L+P_b+Q) = 2 520 psi
Allowable combined stress (P_L+P_b+Q) = ±3*S = ±60 000 psi

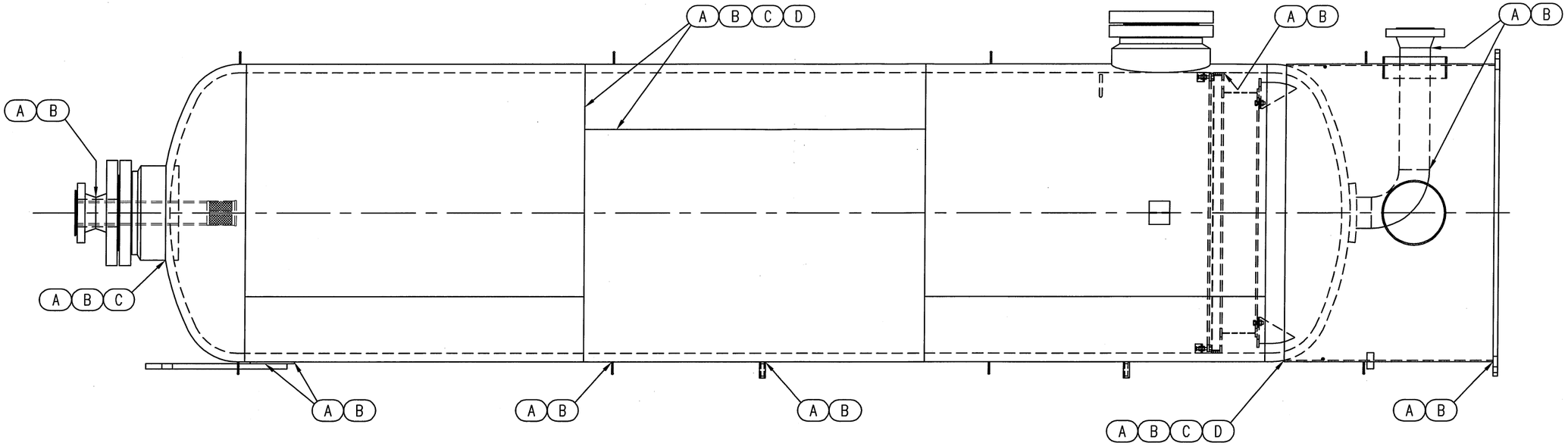
The maximum combined stress (P_L+P_b+Q) is within allowable limits.

Maximum local primary membrane stress (P_L) = -216 psi
Allowable local primary membrane stress (P_L) = ±1.5*S = ±30 000 psi

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

Stresses at the pad edge per WRC Bulletin 107										
Figure	**value**	**e**	**A_u**	**A_l**	**B_u**	**B_l**	**C_u**	**C_l**	**D_u**	**D_l**
3C*	2.0638	0.2233	0	0	0	0	0	0	0	0
4C*	2.4619	0.279	0	0	0	0	0	0	0	0
1C	0.0666	0.2847	0	0	0	0	0	0	0	0
2C-1	0.0377	0.2847	0	0	0	0	0	0	0	0
3A*	0.7166	0.2567	0	0	0	0	0	0	0	0
1A	0.0803	0.3068	0	0	0	0	0	0	0	0
3B*	1.9105	0.2057	-216	-216	216	216	0	0	0	0
1B-1	0.0364	0.2217	-431	431	431	-431	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total circumferential stress			-647	215	647	-215	0	0	0	0
Primary membrane circumferential stress*			-216	-216	216	216	0	0	0	0
3C*	1.7476	0.279	0	0	0	0	0	0	0	0

4C*	2.6721	0.2233	0	0	0	0	0	0	0	0
1C-1	0.0767	0.2443	0	0	0	0	0	0	0	0
2C	0.0469	0.2443	0	0	0	0	0	0	0	0
4A*	1.281	0.2567	0	0	0	0	0	0	0	0
2A	0.0448	0.2518	0	0	0	0	0	0	0	0
4B*	0.6325	0.2057	-61	-61	61	61	0	0	0	0
2B-1	0.0605	0.2141	-742	742	742	-742	0	0	0	0
Pressure stress*			0	0	0	0	0	0	0	0
Total longitudinal stress			-803	681	803	-681	0	0	0	0
Primary membrane longitudinal stress*			-61	-61	61	61	0	0	0	0
Shear from M_t			0	0	0	0	0	0	0	0
Circ shear from V_c			0	0	0	0	0	0	0	0
Long shear from V_L			0	0	0	0	-1 260	-1 260	1 260	1 260
Total Shear stress			0	0	0	0	-1 260	-1 260	1 260	1 260
Combined stress (P_L+P_b+Q)			-803	681	803	-681	2 520	2 520	2 520	2 520
* denotes primary stress.										



PROCEDURE NOTES:

P1-M-26:

* BASE METAL OR WELD METAL BACKING SHALL BE USED WITH THIS PROCEDURE. THIS PROCEDURE SHALL NOT BE USED FOR OPEN GROOVE WELDS.

* PROCEDURE SHALL ONLY BE USED FOR ATTACHMENT WELDS, REPAIRS WELDS, PIPE WELDS AND BACK-UP PASSES FOR SUB-ARC WELDING. THIS PROCEDURE SHALL NOT BE USE TO WELD OUT NOZZLES TO SHELL, LONG SEAMS OR ROUND SEAMS.

P1-GMFC-3:

* GMAW-S SHALL ONLY BE USED ON OPEN ROOT GROOVE WELDS NOT ACCESSIBLE FROM BOTH SIDES WITH A DOWNHILL WELD PROGRESSION. NO WELD SHALL BE MADE ENTIRELY WITH GMAW-S

P1-A-1A DC/AC:

* THIS PROCEDURE CAN BE USED FOR SINGLE OR TANDEM WIRE APPLICATIONS.
* WELDS USING THIS PROCEDURE SHALL BE BACK GOUGED TO CLEAN METAL AND BACK WELDED.

P1-A-1A AC/AC:

* WELDS USING THIS PROCEDURE SHALL BE BACK GOUGED TO CLEAN METAL AND BACK WELDED.

(A) P1-M-26 - W/ E7018-1 (SMAW)
(B) P1-GMFC-3 - W/ ER70S-6 & E71T-12MJ (GMAW/FCAW)
(C) P1-A-1A-DC/AC (W-CVN) - W/ LA-71 / 880M FLUX (SAW)
(D) P1-A-1A-AC/AC (W-CVN) - W/ LA-71 / 880M FLUX (SAW)

AS BUILT

ACAD FILE NAME 70699-WP DATE PLOTTED 01/05/17

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	REVISIONS	DATE	BY		REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/06/17	R W		

ORDER NO. 70699 | ITEM NO. V-442, V-443 | PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

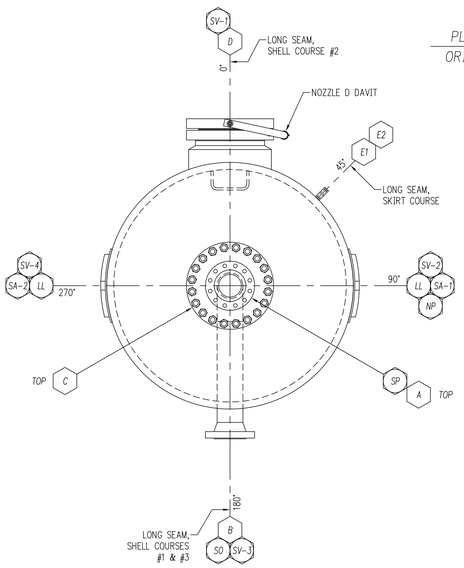
DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC - TULSA, OKLAHOMA
WELD MAP

CUSTOMER UOP RUSSELL LLC | P.O. NO. 4500754152

DRAWN BY R. Wolf | SCALE NONE | DATE 01/05/17

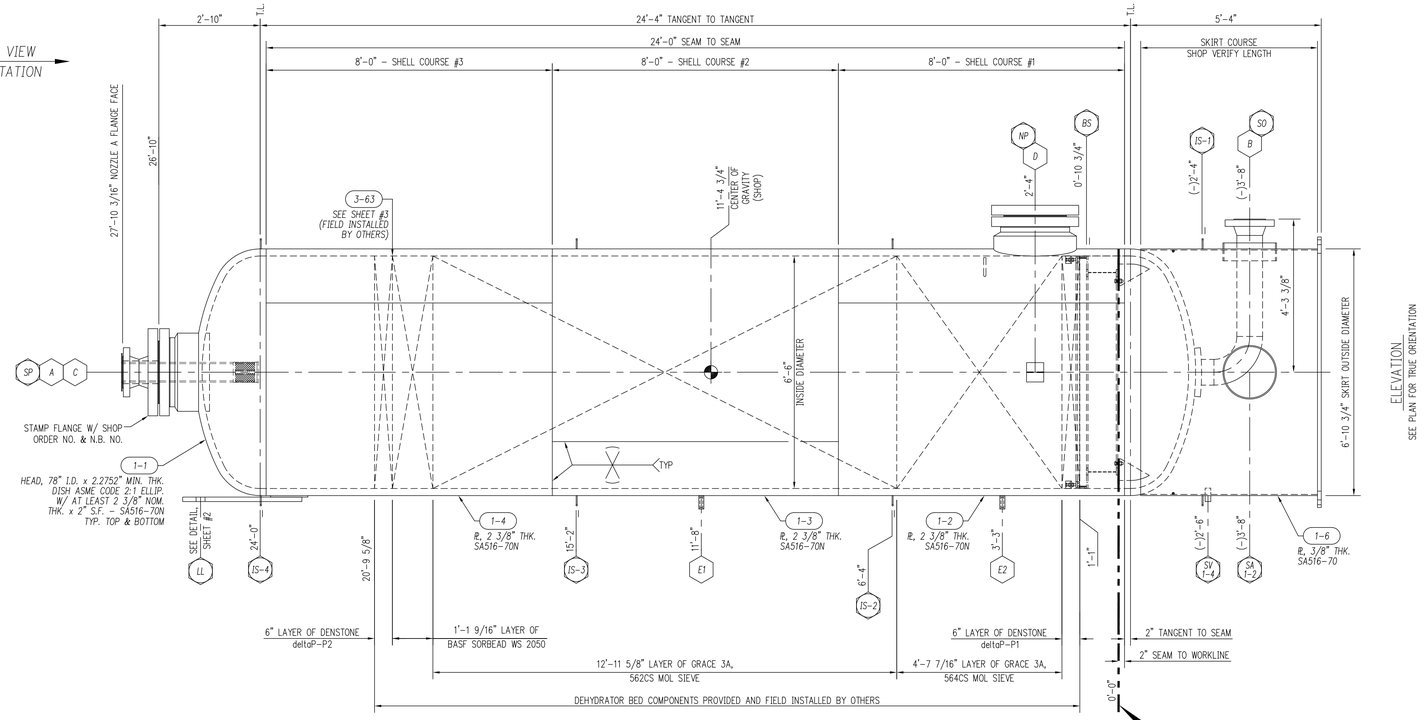
CHECKED BY

APPROVED BY J S | DRAWING NO. B- 21564 SHT 1 OF 1 | REV. 0



PLAN
V-442

PLAN VIEW ORIENTATION



ELEVATION
SEE PLAN FOR TRUE ORIENTATION

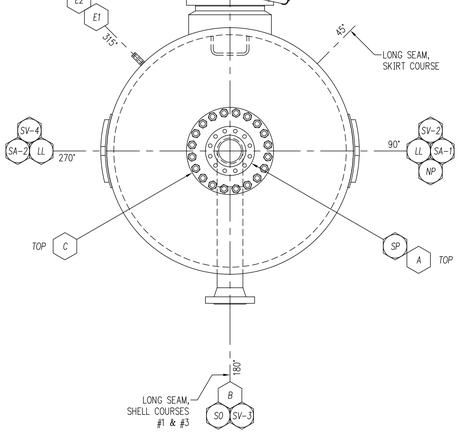
WORKLINE

CENTER PUNCH INSIDE AND OUTSIDE FOR PERMANENT REFERENCE... ALL ELEV. DIMENSIONS ARE TO THIS LINE.

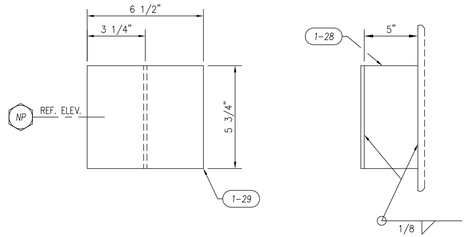
BILL OF MATERIAL						
	ITEM	QTY	LEGEND	ITEM	QTY	LEGEND
	SV	4	SKIRT VENT	LL	2	LIFTING LUG
	SO	1	SKIRT OPENING	IS	4	INSULATION SUPPORT
	SA	2	SKIRT ACCESS	SP	1	STINGER PIPE/DIVERTER PLATE
	NP	1	NAMEPLATE W/ BRACKET	BS	1	BED SUPPORT

REV	ITEM	QTY	DESCRIPTION	MAT'L
	NO.	FOR 2		SPEC.
			HEAD, SHELL, AND REPAD MATERIAL TO BE IMPACT TESTED TO (-)20° F. PER UG-84	
	1-1	4	HEAD, 78" I.D. x 2.2752" MIN. THK. DISH ASME CODE 2:1 ELLIP. W/ AT LEAST 2 3/8" NOM. THK. x 2" S.F.	SA516-70N
	1-2	2	ROLLED CYLINDER, 2 3/8" x 78" I.D. x 96" LONG	SA516-70N
	1-3	2	ROLLED CYLINDER, 2 3/8" x 78" I.D. x 96" LONG	SA516-70N
	1-4	2	ROLLED CYLINDER, 2 3/8" x 78" I.D. x 96" LONG	SA516-70N
	1-5		INTENTIONALLY LEFT BLANK	
	1-6	2	SKIRT PLATE, 3/8" x 62" x 258 13/16" LONG - SHOP TO DETERMINE LENGTH OF SKIRT COURSE	SA516-70
	1-7	4	FLANGE, 8" CL. 600 RF/WN, SCH. 80 BORE	SA350-LF2
	1-8	4	GASKET, 8" CL. 600 FLANGE, SPIRAL WOUND, FOR TESTING	--
	1-9	2	GASKET, 8" CL. 600 FLANGE, FLEXITALLIC STYLE "CG" OR EQUAL, 304 S.S. SPIRAL WOUND, W/ FLEXIBLE GRAPHITE FILLER & C.S. CENTERING RING FOR SERVICE	--
	1-10	2	PIPE, 8" SCH. 80 x 9" LONG (BOE)	SA106-B
	1-11	2	REPAD., MAKE FROM PLATE, 2" x 18" x 18" LONG	SA516-70N
	1-12	2	LR WELD ELBOW, 8" SCH. 80, 90 DEGREE	SA234-WPB
	1-13	2	PIPE, 8" SCH. 80 x 33 7/8" LONG (BBE)	SA106-B
	1-14	2	FLANGE, 18" CL. 600 RF/V2 x 17" LONG	SA350-LF2
	1-15	2	REDUCING FLANGE, 18" x 8" CL. 600 RF/WN, SCH. 80 BORE	SA350-LF2
	1-16	80	STUD, 1 5/8"-8NC x 12" LONG (ZINC OR CADMIUM PLATED)	SA193-B7
	1-17	160	NUT, 1 5/8-8NC, HEAVY HEX (ZINC OR CADMIUM PLATED)	SA194-2H
	1-18	4	GASKET, 18" CL. 600 FLANGE, SPIRAL WOUND, FOR TESTING	--
	1-19	4	GASKET, 18" CL. 600 FLANGE, FLEXITALLIC STYLE "CG" OR EQUAL, 304 S.S. SPIRAL WOUND, W/ FLEXIBLE GRAPHITE FILLER & C.S. CENTERING RING FOR SERVICE	--
	1-20	2	FLANGE, 18" CL. 600 RF/V3 x 16 3/16" LONG - RADIUS BTM. TO FIT 78" I.D.	SA350-LF2
	1-21	2	BLIND FLANGE, 18" CL. 600, RF	SA350-LF2
	1-22	4	SPECIAL FULL COUPLING, 3/4" 6000# NPT x 4 1/2" O.A.L.	SA105
	1-23	4	HEX HEAD PLUG, 3/4" NPT - FOR TESTING/SHIPPING	SA105
	1-24			
	1-25			
	1-26			
	1-27	4	SHIPPING COVER, 8" CL. 600 FLANGE	C.S.
	1-28	2	PLATE, 1/4" x 5" x 5 3/4" LONG	SA516-70
	1-29	2	SHEET, 10 GAUGE x 5 3/4" x 6 1/2" LONG	C.S.
	1-30	2	ASME NAMEPLATE, BOARDMAN STANDARD	S.S.

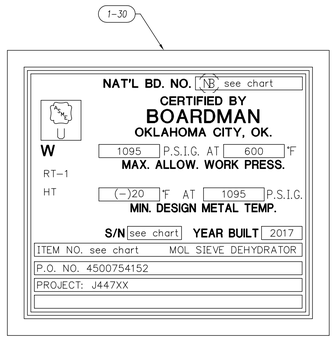
VESSEL PAINT:
UOPR SYSTEM #2 - PRIMER - SHERWIN WILLIAMS ZINC CLAD II, B69V3, B69D11, DATA SHEET 6.02, 2-4 MILS DFT, APPROX. 2,500 SQ.FT. (1,250 PER VESSEL). FINISH - SHERWIN WILLIAMS HI-TEMP ALUMINUM CK100A518 WITH B59V405 CATALYST, 1-2 MILS DFT, APPROX. 700 SQ.FT. (350 PER VESSEL).



PLAN
V-443



NP NAMEPLATE BRACKET DETAIL
SCALE: 1/4" = 1"



SERIAL NO.	N.B. NO.	ITEM NO.
70699-A	3979	V-442
70699-B	3980	V-443

NP NAMEPLATE DETAIL

AS BUILT

1. DESIGN NOTES
DESIGN, FABRICATION AND INSPECTION TO BE IN ACCORDANCE WITH THE ASME CODE, SECTION VIII, DIV. 1, 2015 EDITION, NO ADDENDUM. CODE STAMP IS REQUIRED. NAT'L BOARD REGISTRATION IS REQUIRED.

2. DESIGN DATA
DESIGN PRESS. (INT.) 1,095 PSIG @ 600 °F
DESIGN PRESS. (EXT.) n/a PSIG @ n/a °F
M.A.P. (NAC) 1,095 LIMITED BY DESIGN
M.A.W.P. (CORR.) 1,095 LIMITED BY DESIGN
M.D.M.T. (–)20 °F @ 1,095 PSIG
CHARPY IMPACT TEST REQ'MTS REQUIRED PER UG-84 TO (–)20° F. ON HEADS, SHELLS AND REPAD. SA350-LF2 NOZZLES ARE TESTED PER UCS-66(g). SA105 NOZZLES ARE EXEMPT PER UCS-66(b)(3). SA106-B PIPE EXEMPT PER FIG. UCS-66, CURVE B.
CORROSION ALLOW. HEADS 1/16" SHELL 1/16" NOZZLES 1/16"
RADIOGRAPHY RT-1
SHELL CAT. A (LONG SEAMS) FULL PER UW-11(a) TYPE 1
SHELL CAT. B (CIRC. SEAMS) FULL PER UW-11(a) TYPE 1
HEAD TO SHELL SEAMS FULL PER UW-11(a) TYPE 1
HEAD CAT. A SEAMLESS, OR FULL X-RAY
SHOP HYDRO-TEST @ 1,424 PSIG NEW & COLD (HORIZ. POS.).
WATER USED FOR TESTING MUST BE POTABLE AND AT LEAST 60° F. CHLORIDE CONTENT SHALL NOT EXCEED 50 ppm.
FIELD HYDRO-TEST @ 1,424 PSIG VERTICAL POSITION
P.W.H.T. REQ'D PER CODE. HOLD FOR MINIMUM 1.35 MINUTES AT 1150° F. +/– 25° F. CHARTS ARE REQUIRED
INSULATION THICKNESS 4" (BY OTHERS)
FIREPROOFING THICKNESS NONE
AUTHORIZED INSPECTION BY QC/AI/CUSTOMER
FAB. WEIGHT EMPTY 67,201 LBS, FULL H_2O (SHOP) 122,166 LBS

FABRICATION NOTES

3. FLANGES TO BE PER ASME B16.5 UNLESS NOTED OTHERWISE. FLANGE GASKET SURFACE FINISH TO BE BETWEEN 125 & 250 AARH. SPECIAL ATTENTION TO BE APPLIED TO FLANGE FACE PROTECTION. VISUAL INSPECTION PRIOR TO RELEASE FOR SHIPMENT.
4. ALL BOLT HOLES ARE TO STRADDLE THE VESSEL CENTERLINES.
5. ALL SHELL BUTT WELDS AND NOZZLE TO VESSEL WELDS SHALL BE COMPLETE PENETRATION, FULL FUSION.
6. INSIDE EDGE OF NOZZLES TO HAVE 1/8" RADIUS.
7. PRESSURE RETAINING WELD SEAMS UNDER REPADS AND LIFTING LUGS SHALL BE GROUND FLUSH AND 100% RADIOGRAPHED.
8. [REFERENCE (*) ABOVE NOZZLE SCHEDULE] UNLESS NOTED OTHERWISE, NOZZLES MAY BE SQUARE CUT AND MAY PROJECT A MAXIMUM OF 1 1/2" (MEASURED FROM SHORT SIDE OF PIPE), PROVIDED PROJECTION DOES NOT INTERFERE W/ VESSEL INTERNALS. TRIM PROJECTIONS IF REQ'D.
9. PROVIDE 1/4" NPT WEEP HOLE IN REINFORCING PADS OR SEGMENT. TEST REPADS PRIOR TO HYDRO-TEST AT 15 PSIG, USING DRY AIR AND SOAP SUDS. UNLESS NOTED OTHERWISE, PROVIDE A 1/4" NPT VENT HOLE IN REPADS FOR INTERNAL AND EXTERNAL STRUCTURAL ATTACHMENTS TO VESSEL SHELLS AND HEADS. LEAVE WEEP AND VENT HOLES OPEN DURING PWHT (IF REQ'D) AND HYDRO-TEST, FILL WITH RUST INHIBITING GREASE PRIOR TO SHIPMENT.
10. IN ADDITION TO STRENGTH WELDS SHOWN, WHERE POSSIBLE, ALL INTERNAL ATTACHMENTS SHALL BE SEAL WELDED, UNLESS NOTED OTHERWISE.
11. PRIOR TO HYDRO-TEST CLEAN VESSEL OF ALL GREASE, WELD SPATTER, SLAG AND OTHER FOREIGN MATTER.
12. USE TEST GASKETS FOR HYDRO-TEST FOR ALL FLANGES INCLUDING BLIND FLANGES WHERE FURNISHED.
13. AFTER HYDRO-TEST VESSEL SHALL BE THOROUGHLY DRIED AND CLEANED OF ALL LOOSE SCALE, RUST, GREASE, DIRT OR OTHER FOREIGN MATERIAL.
14. TEMP. FOR PAINTING MUST BE ABOVE DEW POINT (MIN. 5° ABOVE DEW POINT).
15. PREPARATION AND PAINT:

UOPR PAINT SYSTEM #2:

	SURFACE PREP	PRIMER	FINISH
INSULATED PORTIONS OF VESSEL	SSPC-SP10 1.5-3 MILS PROFILE	S.W. ZINC CLAD II INORGANIC ZINC 2-4 MILS DFT	NONE
UNINSULATED PORTIONS OF VESSEL, INCL. O.S. & I.S. OF SKIRT, BASE RING, NOZZLES, CLIPS, ETC., PROJECTING BEYOND INSULATION	SSPC-SP10 1.5-3 MILS PROFILE	S.W. ZINC CLAD II INORGANIC ZINC 2-4 MILS DFT	S.W. HI-TEMP ALUMINUM 1-2 MILS DFT

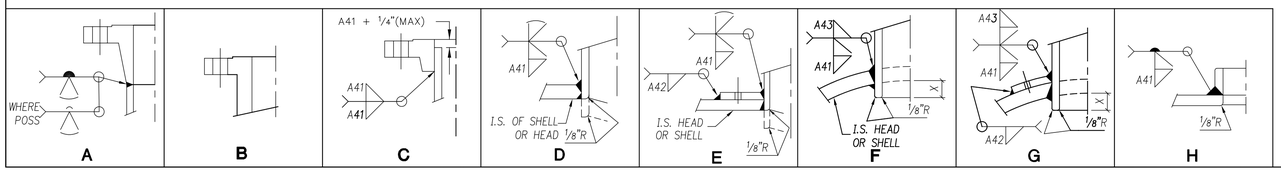
MINIMAL OVERSPRAY IS ACCEPTABLE.

16. PAINT IN 3" HIGH LETTERS AS LOADED (BOTH SIDES OF VESSEL):
P.O. NUMBER: 4500754152
PROJECT: J447XX
ITEM NUMBER: V-442 (OR V-443 – DEPENDING ON VESSEL)
PWHT – DO NOT WELD OR BURN
17. PROTECT ALL FLANGE FACES AND THREADS WITH RUST-INHIBITING GREASE. ALL FLANGES WITHOUT BLINDS TO BE PROTECTED WITH METAL COVERS WITH A MIN. OF FOUR BOLTS. BOLT BLINDS IN PLACE. USE TEST GASKETS AND BOLTING FOR NOZZLES FURNISHED WITH BLINDS.
18. ALL SPARE BOLTING, GASKETS AND OTHER LOOSE ITEMS TO BE CRATED, TAGGED WITH THE NAME OF THE PARTS, VESSEL ITEM NO. & P.O. NO., AND LISTED ON PACKING LIST.

* SEE NOTE #8

MARK	QUAN.	SIZE	RATE	TYPE	SERVICE	NECK	NECK O.D.	PROJECTION FROM C.L.	PROJECTION FROM O.S.	PROJECTION I.S. "X"	FLANGE TYPE	ATTACH. TYPE	f1	f2	WELD SIZES A41	WELD SIZES A42	WELD SIZES A43	REPAD	REMARKS	BILL OF MATERIAL No. FLG	NECK	PAD	COVER	BOLTS	GASKET	X	X
E1-2	TWO	3/4"	6000	CPLG	TI	--	1" I.D.	3'-9 7/8"	4 1/2"	n/a	n/a	H			5/16"	–	–		SET-ON NOZZLE	1-22					1-23		
D	ONE	18"	600	RF/V3	DUMP	--	2'-3 3/4"	4'-4 3/8"	11"	0°	B	D			3/8"	–	–		W/ BLIND, STUDS, NUTS, GASKET & DAVIT	1-20			1-21	1-16/1-17	1-18/1-19		
C	ONE	18"	600	RF/V2	FILL / MANWAY	--	2'-2 1/4"	SEE ELEV.	SEE ELEV.	*	B	D			3/8"	–	–		W/ RDC'G WN, STUDS, NUTS, & GASKET	1-14			1-15	1-16/1-17	1-18/1-19		
B	ONE	8"	600	RF/WN	OUTLET	SCH. 80	8 5/8"	SEE ELEV.	SEE ELEV.	0"	A	E			3/8"	15/16"	–	2" x 3 1/2" WIDE		1-7	1-10	1-11			1-8	1-12	1-13
A	ONE	8"	600	RF/WN	INLET	SCH. 80	8 5/8"	SEE ELEV.	SEE ELEV.	n/a	A	A			–	–	–		W/ STINGER PIPE AND DIVERTER PLATE	1-7					1-8/1-9		

SCHEDULE of OPENINGS



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	REVISIONS	DATE	BY		REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/11/17	R	W	B-21564-WP – WELD MAP
					D-21564-2 – SKIRT, LL, MNWY & MISC DTLS
					D-21564-3 – MISC. INTERNAL DETAILS
					D-21564-4 – VESSEL L & P CLIP DETAILS
					D-21564-5 – VESSEL PIPING & CLIP DETAILS

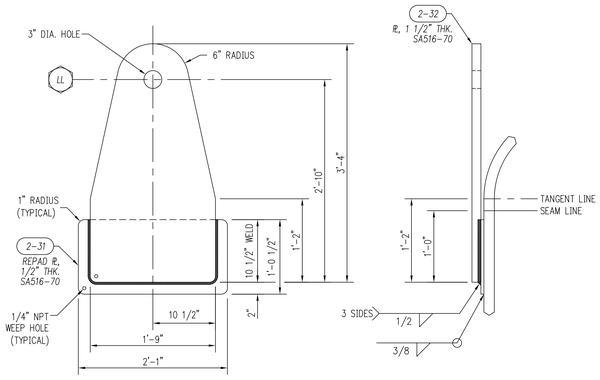
60 mm CRYO PLANT | ACAD FILE NAME 70699 | DATE PLOTTED 01/11/17

ORDER NO. 70699 | ITEM NO. V-442, V-443 | PROJECT: J447XX

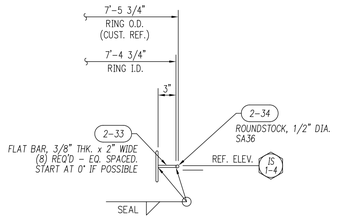
BOARDMAN
OKLAHOMA CITY, OKLAHOMA

DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC – TULSA, OKLAHOMA
PLAN, ELEVATION, AND GENERAL NOTES

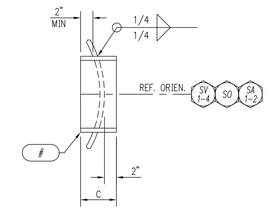
CUSTOMER UOP RUSSELL LLC | P.O. NO. 4500754152
DRAWN BY R. Wolff | SCALE 1/2"=1'-0" | DATE 01/05/17
CHECKED BY WLF | DRAWING NO. D-21564 | SHT 1 OF 5 | REV. 0
APPROVED BY E A



LIFTING LUG DETAIL
(TYPICAL 4)



INSULATION SUPPORT DETAIL
NOTCH AROUND OBSTRUCTIONS AS REQ'D

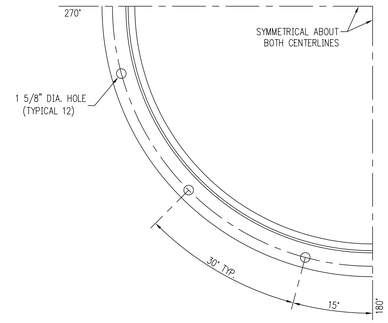


MARK NO.	ITEM NO.	DESCRIPTION	QUANTITY	"C"
SV1-4	2-35	1 1/2" STD. WT PIPE	4	4 1/2"
SO	2-36	20" STD. WT PIPE	1	6"
SA1-2	2-37	18" STD. WT. PIPE	2	6"

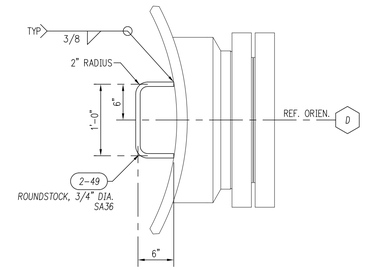
SKIRT VENT/OPENING/ACCESS DETAIL

REV	ITEM NO.	QTY FOR 2	DESCRIPTION	MAT'L SPEC.
	2-31	4	REPAD PLATE, 1/2" x 12 1/2" x 25" LONG	SA516-70
	2-32	4	LIFTING LUG PLATE, 1 1/2" x 21" x 40" LONG	SA516-70
	2-33	64	FLAT BAR, 3/8" x 2" x 3" LONG	SA36
	2-34	8	ROUND BAR, 1/2" DIA. x 280 3/8" LONG - ROLL TO 88 3/4" I.D.	SA36
	2-35	8	PIPE, 1 1/2" SCH. 40 x 4 1/2" LONG	SA106-B
	2-36	2	PIPE, 20" STD. WT. x 6" LONG	SA106-B
	2-37	4	PIPE, 18" STD. WT. x 6" LONG	SA106-B
	2-38	2	PLATE, 1 1/4" x 90 3/4" O.D. x 79 3/4" I.D.	SA516-70
	2-39	42	NUT, 3/8"-16NC HEAVY HEX	C.S.
	2-40	2	PLATE, 1/2" x 3 9/16" x 6 1/2" LONG	SA516-70
	2-41	2	PIPE, 2 1/2" SCH. 40 x 7" LONG	SA106-B
	2-42	2	GREASE FITTING, 1/4" NPT	PLATED C.S.
	2-43	2	DAVIT ARM PIPE, 2" XX-STG x 40 1/16" LONG - SHOP VERIFY LENGTH	SA106-B
	2-44	2	PIPE, 2 1/2" SCH. 40 x 3/4" LONG	SA106-B
	2-45	2	EYEBOLT, 3/4"-10NC x 10" LONG - McMASTER CARR P/N 3016T65 - SHOP TO ADD THREADS AS REQ'D - SEE MANWAY DAVIT DETAIL	GALV. C.S.
	2-46	2	FLAT WASHER, 3/4" NOMINAL	C.S.
	2-47	4	NUT, 3/4"-10NC	C.S.
	2-48	2	ROUND BAR, 3/4" DIA. x 5 7/8" LONG - SHOP VERIFY LENGTH	SA36
	2-49	2	ROUND BAR, 3/4" DIA. x 24" LONG - SHOP VERIFY LENGTH	SA36
	2-50			

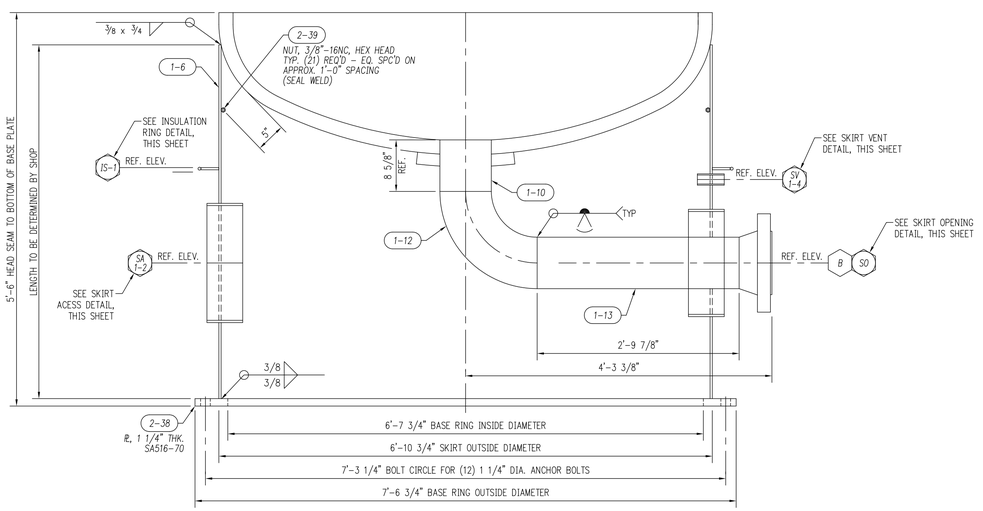
AS BUILT



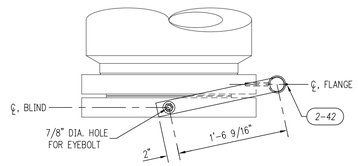
PARTIAL BASE RING DETAIL

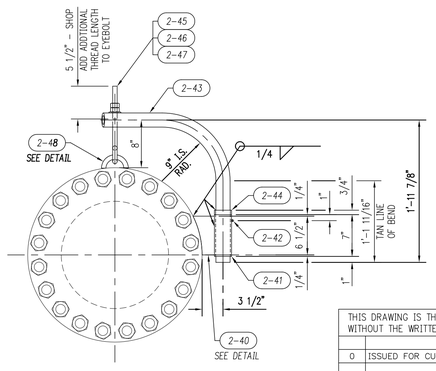


TOP VIEW

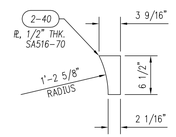


SKIRT DETAIL

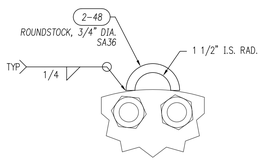




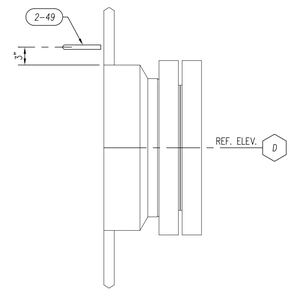
MANWAY DAVIT DETAIL
SEE SHEET ONE FOR TRUE DAVIT LOCATION



ITEM 2-40 DETAIL
(TYPICAL 2)



ITEM 2-48 DETAIL
(TYPICAL 2)
NOT TO SCALE – EYEBOLT NOT SHOWN FOR CLARITY – INSTALL PRIOR TO WELDING



SIDE VIEW

GRAB RUNG DETAIL
(TYPICAL 1 PLACE PER VESSEL)

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	REVISIONS	DATE	BY		REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/11/17	R	W	

60 mm CRYO PLANT — ACAD FILE NAME 70699 — DATE PLOTTED 01/11/17

ORDER NO. 70699 — ITEM NO. V-442, V-443 — PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC – TULSA, OKLAHOMA
SKIRT, LIFTING LUG, MANWAY DAVIT, & MISC. DETAILS

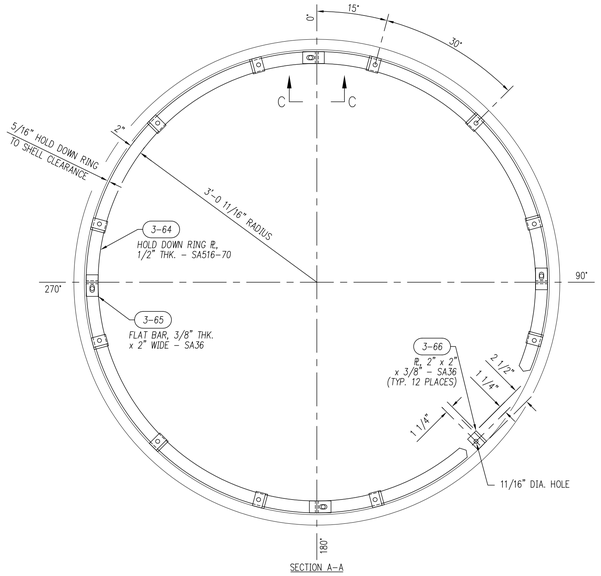
CUSTOMER UOP RUSSELL LLC — P.O. NO. 4500754152

DRAWN BY R. Wolf — SCALE 1"=1'-0" — DATE 01/05/17

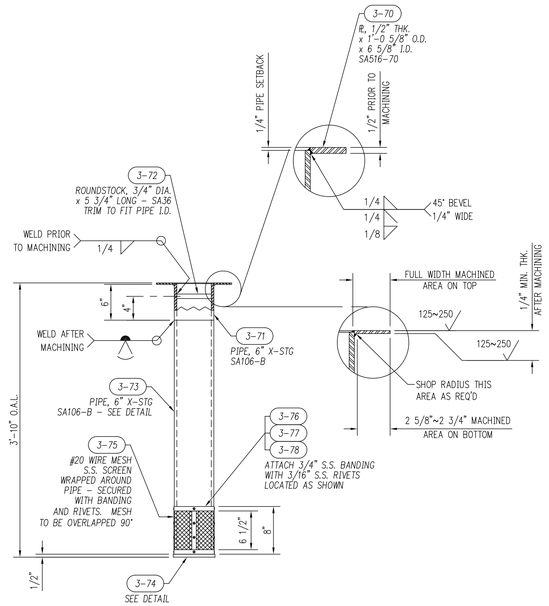
CHECKED BY WLF

APPROVED BY

DRAWING NO. D- 21564 — SHT 2 OF 5 — REV. 0

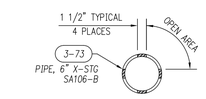


SECTION A–A



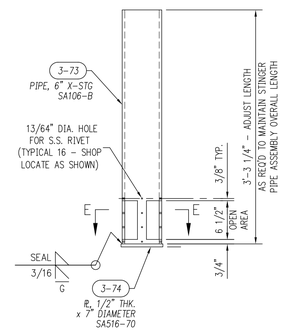
SP A STINGER PIPE/DIVERTER PLATE DETAIL

SHIP LOOSE FOR FIELD INSTALLATION BY OTHERS



SECTION E–E

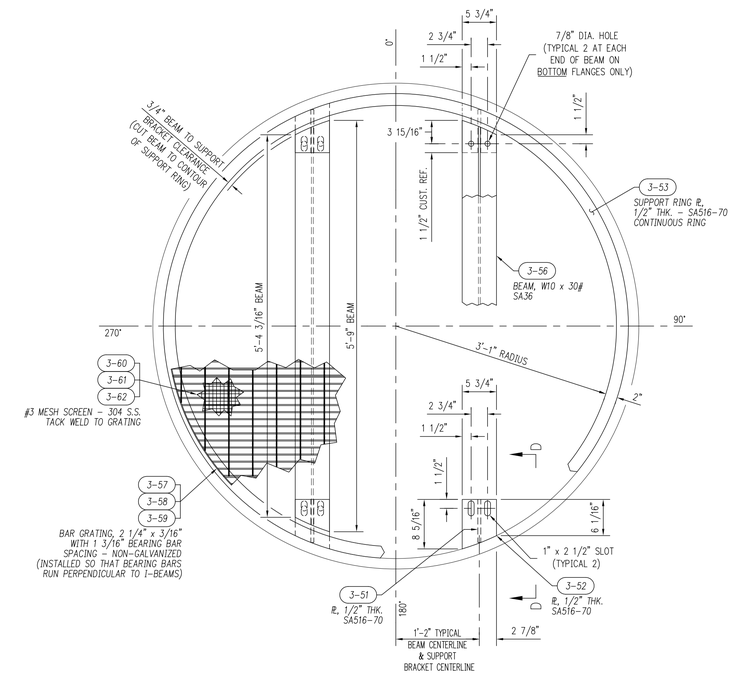
SHOWING PIPE ONLY



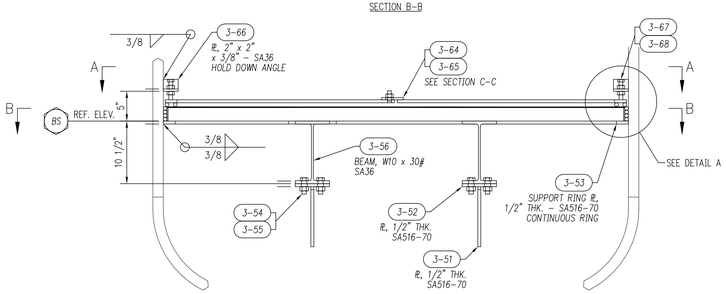
ITEM 3–73/3–74 DETAIL

REV	ITEM NO.	QTY FOR 2	DESCRIPTION	MAT'L SPEC.
	3-51	8	PLATE, 1/2" x 7 1/4" x 10 1/16" LONG - SHOP VERIFY LENGTH	SA516-70
	3-52	8	PLATE, 1/2" x 5 3/4" x 8 5/16" LONG	SA516-70
	3-53	2	PLATE, 1/2" x 78" O.D. x 74" I.D.	SA516-70
	3-54	16	BOLT, 3/4"-10NC x 2 1/4" LONG	A307
	3-55	16	NUT, 3/4"-10NC, HEAVY HEX	A325
	3-56	4	BEAM, W10 x 30# x 69" LONG	SA36
	3-57	4	GRATING, 2 1/4" x 3/16" BEARING BARS ON 1 3/16" SPACING W/ CROSS BARS ON 4" SPACING, McNICHOLS GW-225 OR EQUAL - SEE DETAIL FOR SIZE	A36
	3-58	4	GRATING, 2 1/4" x 3/16" BEARING BARS ON 1 3/16" SPACING W/ CROSS BARS ON 4" SPACING, McNICHOLS GW-225 OR EQUAL - SEE DETAIL FOR SIZE	A36
	3-59	2	GRATING, 2 1/4" x 3/16" BEARING BARS ON 1 3/16" SPACING W/ CROSS BARS ON 4" SPACING, McNICHOLS GW-225 OR EQUAL - SEE DETAIL FOR SIZE	A36
	3-60	4	MESH SCREEN, #3 MESH x 0.080" WIRE - SEE DETAIL FOR SIZE	304 S.S.
	3-61	4	MESH SCREEN, #3 MESH x 0.080" WIRE - SEE DETAIL FOR SIZE	304 S.S.
	3-62	2	MESH SCREEN, #3 MESH x 0.080" WIRE - SEE DETAIL FOR SIZE	304 S.S.
	3-63	4	MESH SCREEN, #20 MESH x 0.016" WIRE x 82" DIAMETER - MESH **MUST** EITHER BE MADE IN ONE PIECE, OR HAVE "PITTSBURGH SEAMS" AT ALL SPLICES - SEE UOPR SPEC. ENG-13p FOR DETAILS	304 S.S.
	3-64	8	RING SEGMENT, 1/2" x 77 3/8" O.D. x 73 3/8" I.D.	SA516-70
	3-65	8	FLAT BAR, 3/8" x 2" x 3 5/8" LONG	SA36
	3-66	24	ANGLE, 2" x 3/8" x 2 1/2" LONG	SA36
	3-67	24	BOLT, 5/8"-11NC x 3" LONG - FULLY THREADED	A307
	3-68	56	NUT, 5/8"-11NC, HEAVY HEX	A325
	3-69		INTENTIONALLY LEFT BLANK	
	3-70	2	PLATE, 1/2" x 12 5/8" O.D. x 6 5/8" I.D.	SA516-70
	3-71	2	PIPE, 6" A-STG x 6 1/8" LONG - LENGTH ADJUSTED FOR SETBACK AFTER FINAL MACHINING OF ITEM 3-70	SA106-B
	3-72	2	ROUND BAR, 3/4" DIA. x 5 3/4" LONG	SA36
	3-73	2	PIPE, 6" A-STG x 39 1/4" LONG - SHOP ADJUST LENGTH AS REQUIRED TO HOLD OVERALL LENGTH OF STINGER PIPE ASSEMBLY	SA106-B
	3-74	2	PLATE, 1/2" x 7" DIAMETER	SA516-70
	3-75	2	MESH SCREEN, #20 MESH x 0.016" WIRE x 8" x 26 1/2" LONG (MINIMUM)	316 S.S.
	3-76	4	BANDING STRAP, 3/4" x 24" LONG - SLIGHT OVERLAP AS REQ'D	316 S.S.
	3-77	8	BANDING STRAP, 3/4" x 8" LONG - SLIGHT OVERLAP AS REQ'D	316 S.S.
	3-78	32	RIVET, 3/16" DIA. x 0.787" LONG - McMASTER-CARR P/N 97550A330 OR EQUAL	316 S.S.
	3-79	8	STUD, 5/8"-11NC x 1 3/4" LONG	A307
	3-80			

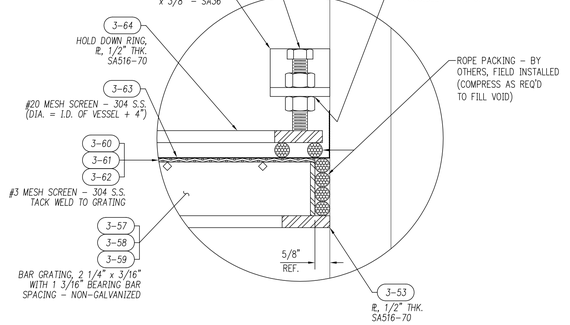
AS BUILT



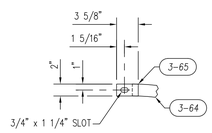
SECTION B–B



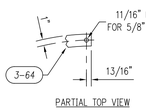
BS BED SUPPORT DETAIL



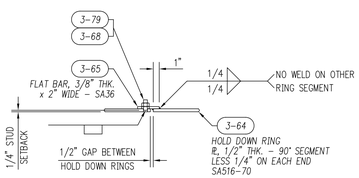
DETAIL A



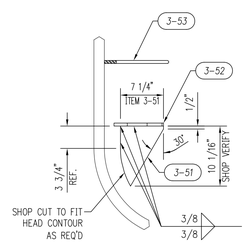
PARTIAL TOP VIEW



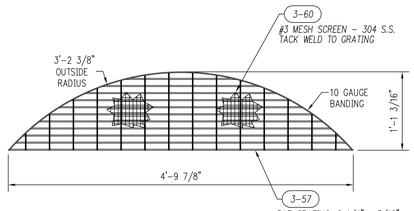
PARTIAL TOP VIEW



SECTION C–C



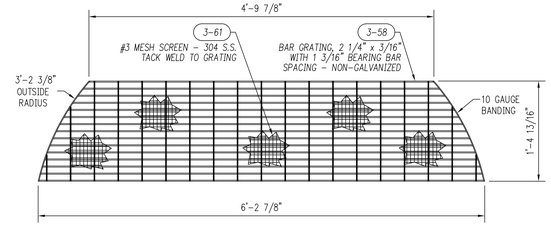
SECTION D–D



ITEM 3–57/3–60 DETAIL

(TYPICAL 4)

#3 MESH TO BE CUT TO MATCH GRATING AND TACK WELDED IN PLACE (TOP SIDE OF GRATING ONLY)



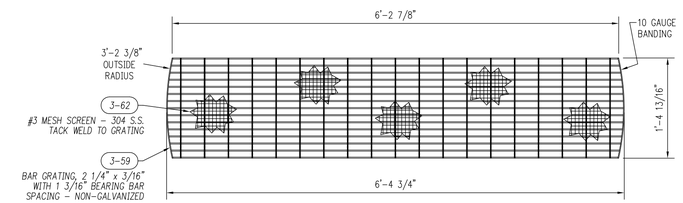
ITEM 3–58/3–61 DETAIL

(TYPICAL 4)

#3 MESH TO BE CUT TO MATCH GRATING AND TACK WELDED IN PLACE (TOP SIDE OF GRATING ONLY)

SHOP NOTES:

1. GRATING SECTIONS TO BE PRE ASSEMBLED AND DIAMETER TO BE VERIFIED.
2. I-BEAMS TO BE BOLTED AND SHIPPED IN PLACE.
3. BOLTING FOR HOLD DOWN ANGLES TO BE SHIPPED IN PLACE – TIGHTEN AS REQUIRED TO PREVENT THEM FROM COMING LOOSE DURING SHIPMENT.
4. HOLD DOWN RING PLATES, #20 MESH, AND #3 MESH/GRATING SECTIONS TO BE SHIPPED LOOSE FOR FIELD INSTALLATION BY OTHERS.
5. AN ADDITIONAL #20 MESH SCREEN (ITEM 3-63) IS REQUIRED AND WILL SHIP LOOSE FOR FIELD INSTALLATION BY OTHERS. LOCATION SHOWN ON SHEET #1.



ITEM 3–59/3–62 DETAIL

(TYPICAL 2)

#3 MESH TO BE CUT TO MATCH GRATING AND TACK WELDED IN PLACE (TOP SIDE OF GRATING ONLY)

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	REVISIONS	DATE	BY	REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/11/17	R W	

60 mm CRYO PLANT — ACAD FILE NAME 70699 — DATE PLOTTED 01/11/17

ORDER NO. 70699 — ITEM NO. V-442, V-443 — PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC – TULSA, OKLAHOMA
MISCELLANEOUS INTERNAL DETAILS

CUSTOMER UOP RUSSELL LLC — P.O. NO. 4500754152

DRAWN BY R. Wolff — SCALE 1"=1'-0" — DATE 01/05/17

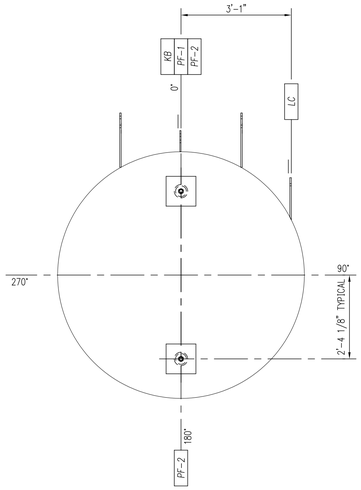
CHECKED BY WLF — DRAWING NO. D- 21564 — SHT 3 OF 5 — REV. 0

APPROVED BY

BILL OF MATERIAL						
	ITEM	QTY	LEGEND	ITEM	QTY	LEGEND
	PF	2	PLATFORM CLIP GROUP	LC	1	LADDER CLIP GROUP
	KB	1	KNEE BRACE CLIP			

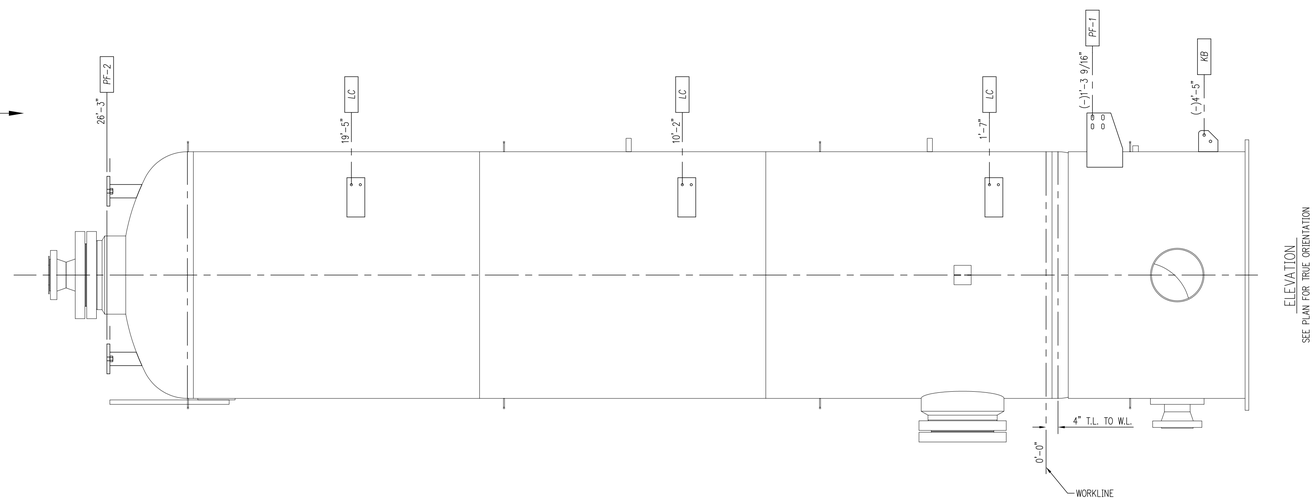
REV	ITEM NO.	QTY FOR 2	DESCRIPTION	MAT'L SPEC.
	4-81	2	PLATE, 1/2" x 6 1/2" x 7 1/8" LONG	SA516-70
	4-82	4	PLATE, 1/2" x 12" x 18 3/16" LONG	SA516-70
	4-83	4	PIPE, 4" SCH. 120 x 12" LONG - SHOP TRIM TO LENGTH AS REQ'D	SA106
	4-84	4	PLATE, 1" x 10" x 10" LONG	SA516-70
	4-85	4	NUT, 1"-8NC, HEAVY HEX	A325
	4-86	6	PLATE, 1/2" x 6" x 14 3/16" LONG	SA516-70
	4-87			
	4-88			
	4-89			
	4-90			

AS BUILT

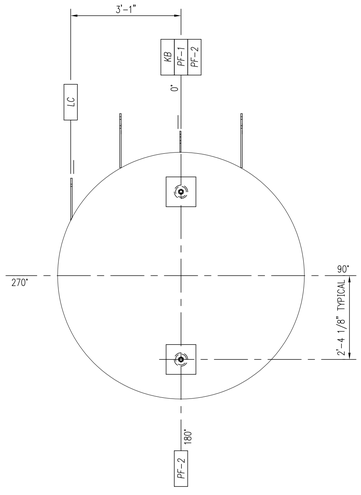


PLAN
V-442

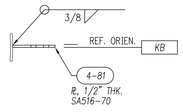
PLAN VIEW ORIENTATION

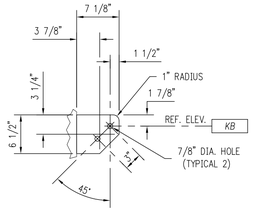


ELEVATION
SEE PLAN FOR TRUE ORIENTATION

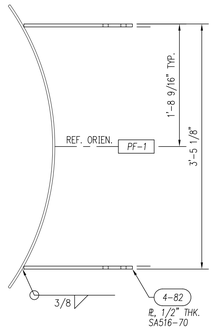


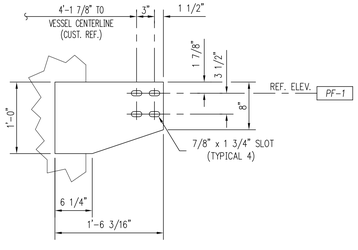
PLAN
V-443



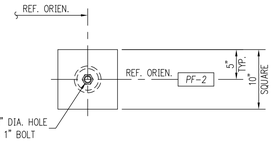


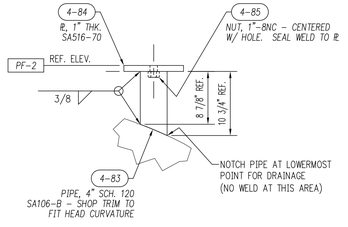
KNEE BRACE CLIP DETAIL
(SCALE: 1"=1'-0")
TYPICAL (1) PER VESSEL



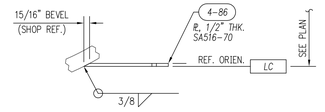


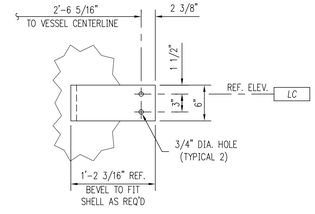
PLATFORM CLIP DETAIL
(SCALE: 1"=1'-0")
TYPICAL (2) PER VESSEL





PLATFORM CLIP DETAIL
[SCALE: 1"=1'-0"]
TYPICAL (2) PER VESSEL





LADDER CLIP DETAIL
[SCALE: 1"=1'-0"]
TYPICAL (3) CLIPS PER VESSEL
V-442 AS SHOWN
V-443 OPPOSITE HAND

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	REVISIONS	DATE	BY		REFERENCE DRAWINGS
0	ISSUED FOR CUSTOMER INFORMATION	01/11/17	R	W	

60 mm CRYO PLANT | ACAD FILE NAME 70699 | DATE PLOTTED 01/11/17

ORDER NO. 70699 | ITEM NO. V-442, V-443 | PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

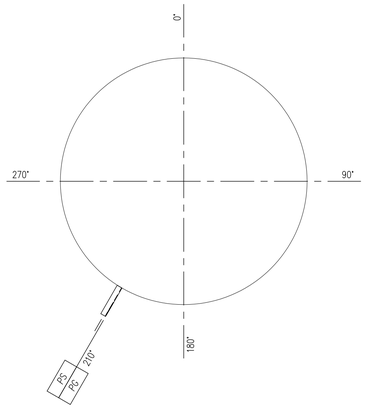
DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC - TULSA, OKLAHOMA
VESSEL LADDER & PLATFORM CLIP DETAILS

CUSTOMER UOP RUSSELL LLC | P.O. NO. 4500754152

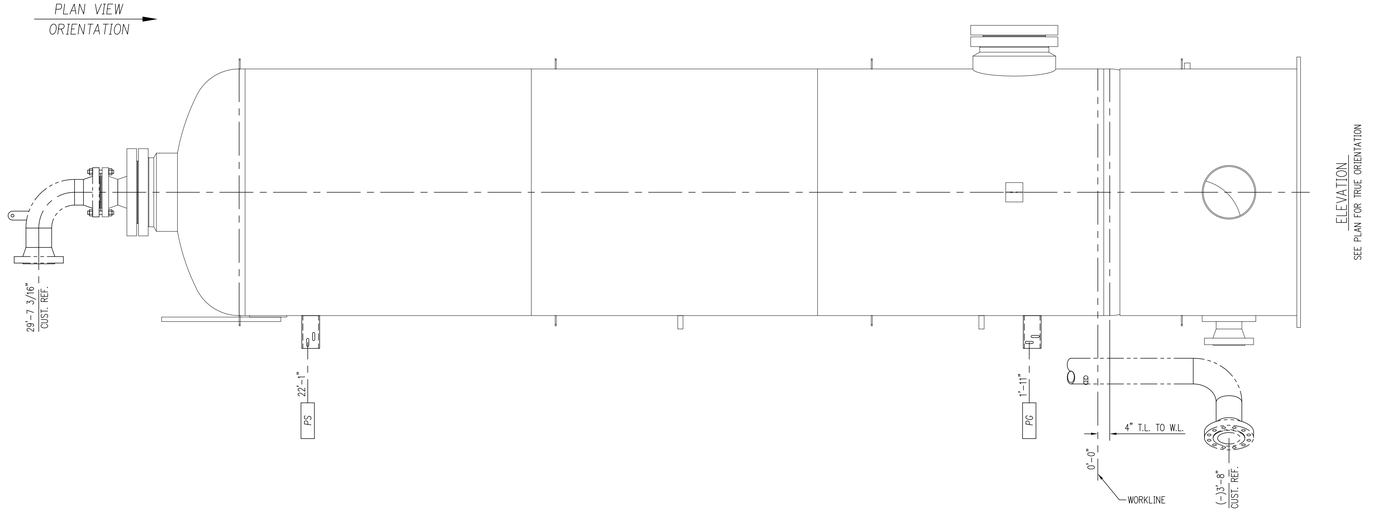
DRAWN BY R. Wolf | SCALE 1/2"=1'-0" | DATE 01/05/17

CHECKED BY WLF | DRAWING NO. D- 21564 SHT 4 OF 5 | REV. 0

APPROVED BY J. S

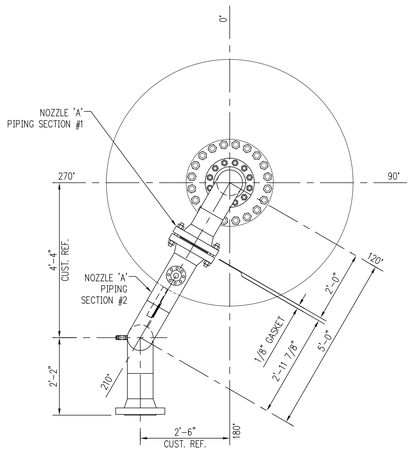


PLAN
PIPE SUPPORT/GUIDE CLIPS
V-442 & V-443

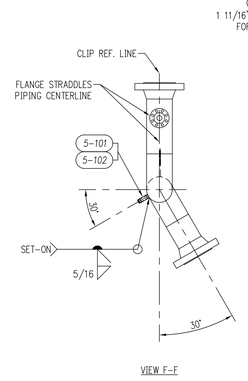


BILL OF MATERIAL						
	ITEM	QTY	LEGEND	ITEM	QTY.	LEGEND
	PS	1	PIPE SUPPORT CLIP	PG	1	PIPE GUIDE CLIP

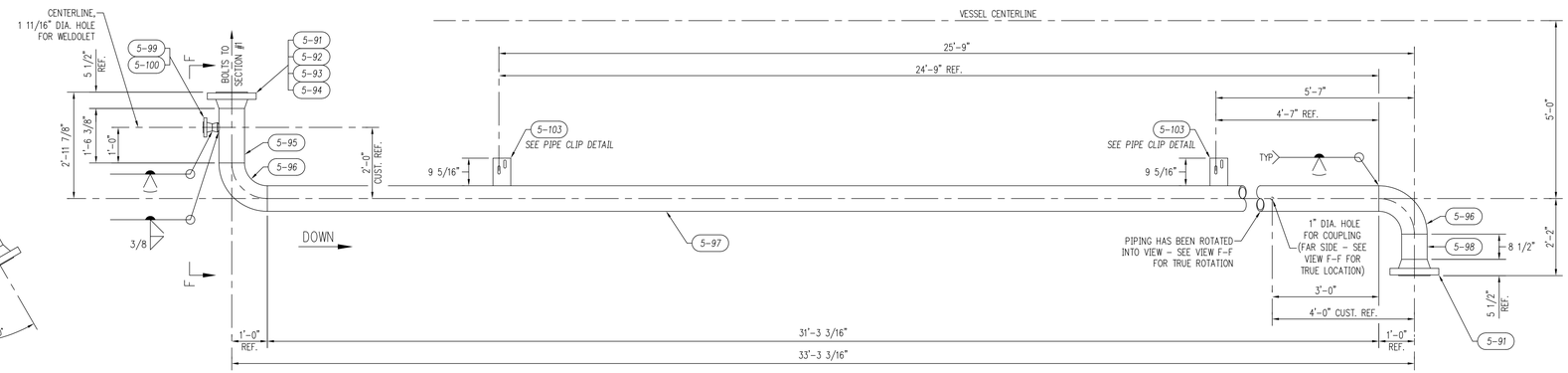
REV	ITEM NO.	QTY FOR 2	DESCRIPTION	MAT'L SPEC
	5-91	8	FLANGE, 8" CL. 600 RF/WN, X-STG BORE	SA105
	5-92	48	STUD, 1 1/8"-8NC x 8 3/4" LONG (ZINC OR CADMIUM PLATED)	SA193-B7
	5-93	96	NUT, 1 1/8"-8NC, HEAVY HEX (ZINC OR CADMIUM PLATED)	SA194-2H
	5-94	4	GASKET, 8" CL. 600 FLANGE, FLEXITALLIC STYLE "CG" OR EQUAL, 304 S.S. SPIRAL WOUND, W/ FLEXIBLE GRAPHITE FILLER & C.S. CENTERING RING FOR SERVICE	--
	5-95	2	PIPE, 8" X-STG x 18 3/8" LONG (BBE)	SA106-B
	5-96	6	LR WELD ELBOW, 8" X-STG, 90 DEGREE	SA234-WPB
	5-97	2	PIPE, 8" X-STG x 375 3/16" LONG (MAKE IN MULT. PIECES IF REQ'D) (BBE)	SA106-B
	5-98	2	PIPE, 8" X-STG x 8 1/2" LONG (BBE)	SA106-B
	5-99	2	WELDOLET, 2" SCH. 160, 8-6 RUN SIZE	SA105
	5-100	2	FLANGE, 2" CL. 600 RF/WN, SCH. 160 BORE	SA105
	5-101	2	SPECIAL CPLG, 3/4" 3000# NPT x 3 1/2" LONG - THRD'D ON ONE END ONLY	SA105
	5-102	2	HEX HEAD PLUG, 3/4" NPT - USE FOR HYDROTESTING AND SHIPPING	SA105
	5-103	4	PLATE, 3/8" x 6" x 9 5/16" LONG	SA516-70
	5-104	8	BOLT, 5/8"-11NC x 2" LONG	A307
	5-105	8	LOCK WASHER, 5/8" NOMINAL	A307
	5-106	16	FLAT WASHER, 5/8" NOMINAL	A307
	5-107	8	NUT, 5/8"-11NC	A307
	5-108	2	CHANNEL, C6 x 8.2# x 11" LONG	SA36
	5-109	2	CHANNEL, C6 x 8.2# x 11" LONG	SA36
	5-110	2	PIPE, 8" X-STG x 3" LONG (BBE)	SA106-B
	5-111	2	PIPE, 8" X-STG x 6 1/2" LONG (BBE)	SA106-B
	5-112	2	PLATE, 3/8" x 3" x 7" LONG	SA516-70
	5-113			
	5-114			
	5-115			
	5-116			
	5-117			
	5-118			
	5-119			
	5-120	6	GASKET, 8" CL. 600 FLANGE, SPIRAL WOUND, FOR TESTING	--



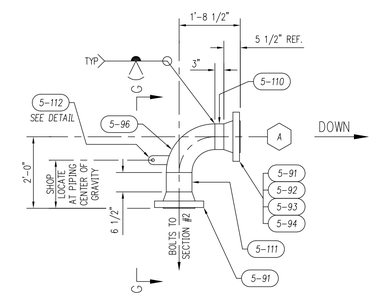
PLAN
PIPING
V-442 & V-443



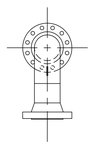
VIEW F-F



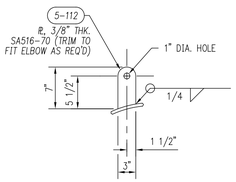
DOWNCOMER PIPING DETAIL
SECTION #2 FOR NOZZLE 'A'
(TYPICAL 2)



DOWNCOMER PIPING DETAIL
SECTION #1 FOR NOZZLE 'A'
(TYPICAL 2)



VIEW G-G

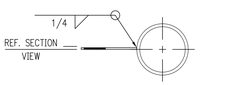


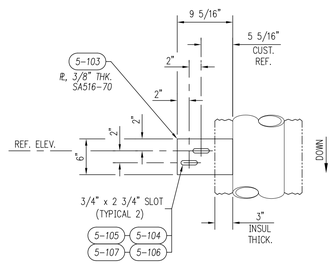
ITEM 5-112 DETAIL
[SCALE: 1"=1'-0"]
TYPICAL 2

PIPING NOTES:

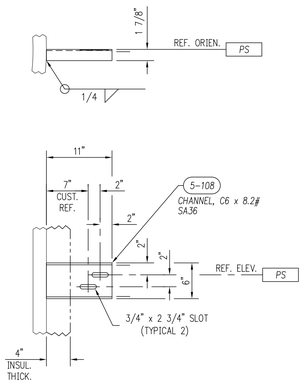
1. INSPECTION AND TESTING TO FOLLOW B31.3 REQUIREMENTS. SEE NOTE #4 FOR RADIOGRAPHY.
2. ALL PIPING SPLICES TO BE FULL PENETRATION WELDED.
3. FLANGE BOLT HOLES TO STRADDLE VESSEL CENTERLINES UNLESS NOTED OTHERWISE. DETAILS ARE NOTED WHERE SPECIAL ROTATIONS ARE REQ'D.
4. RADIOGRAPHY: 100% REQ'D.
5. TEST FIT TO VESSEL.
6. STRESS RELIEVE: NONE REQ'D.
7. HYDROTEST PRESSURE: 1,643 PSIG. HOLD FOR ONE HOUR.
8. PAINT: PER NOTE #15, SHEET 1, UOPR PAINT SYSTEM #2. ONLY THE CLIPS AND FLANGES REQUIRE FINISH PAINT.

AS BUILT

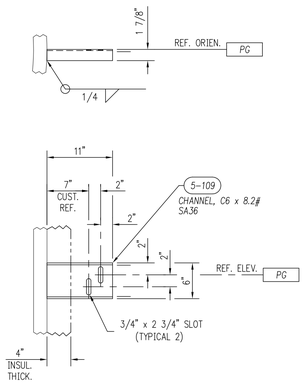




PIPE CLIP DETAIL
[SCALE: 1"=1'-0"]
(TYPICAL 4)



PIPE SUPPORT DETAIL
TOWER PIPE DROP ANCHOR
[SCALE: 1"=1'-0"]
(TYPICAL 2)



PIPE GUIDE DETAIL
TOWER PIPE DROP GUIDE
[SCALE: 1"=1'-0"]
(TYPICAL 2)

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REVISIONS	DATE	BY		REFERENCE DRAWINGS
0 ISSUED FOR CUSTOMER INFORMATION	01/11/17	R	W	

60 mm CRYO PLANT | ACAD FILE NAME 70699 | DATE PLOTTED 01/11/17

ORDER NO. 70699 | ITEM NO. V-442, V-443 | PROJECT: J447XX

BOARDMAN
OKLAHOMA CITY, OKLAHOMA

DESCRIPTION
78" I.D. x 24'-4" TANGENT TO TANGENT
MOL SIEVE DEHYDRATOR
UOP RUSSELL LLC - TULSA, OKLAHOMA
VESSEL PIPING & CLIP DETAILS

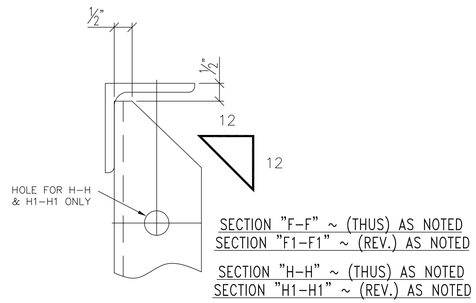
CUSTOMER UOP RUSSELL LLC | P.O. NO. 4500754152

DRAWN BY R. Wolf | SCALE 1/2"=1'-0" | DATE 01/05/17

CHECKED BY WLF

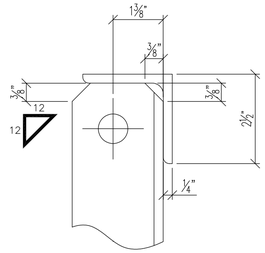
APPROVED BY

DRAWING NO. D- 21564 | SHT 5 OF 5 | REV. 0

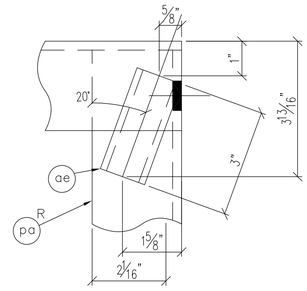


SECTION "F-F" ~ (THUS) AS NOTED
SECTION "F1-F1" ~ (REV.) AS NOTED

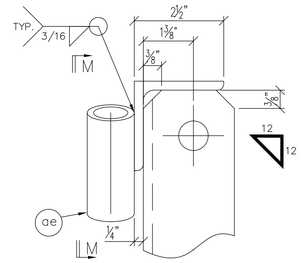
SECTION "H-H" ~ (THUS) AS NOTED
SECTION "H1-H1" ~ (REV.) AS NOTED



SECTION "G-G"



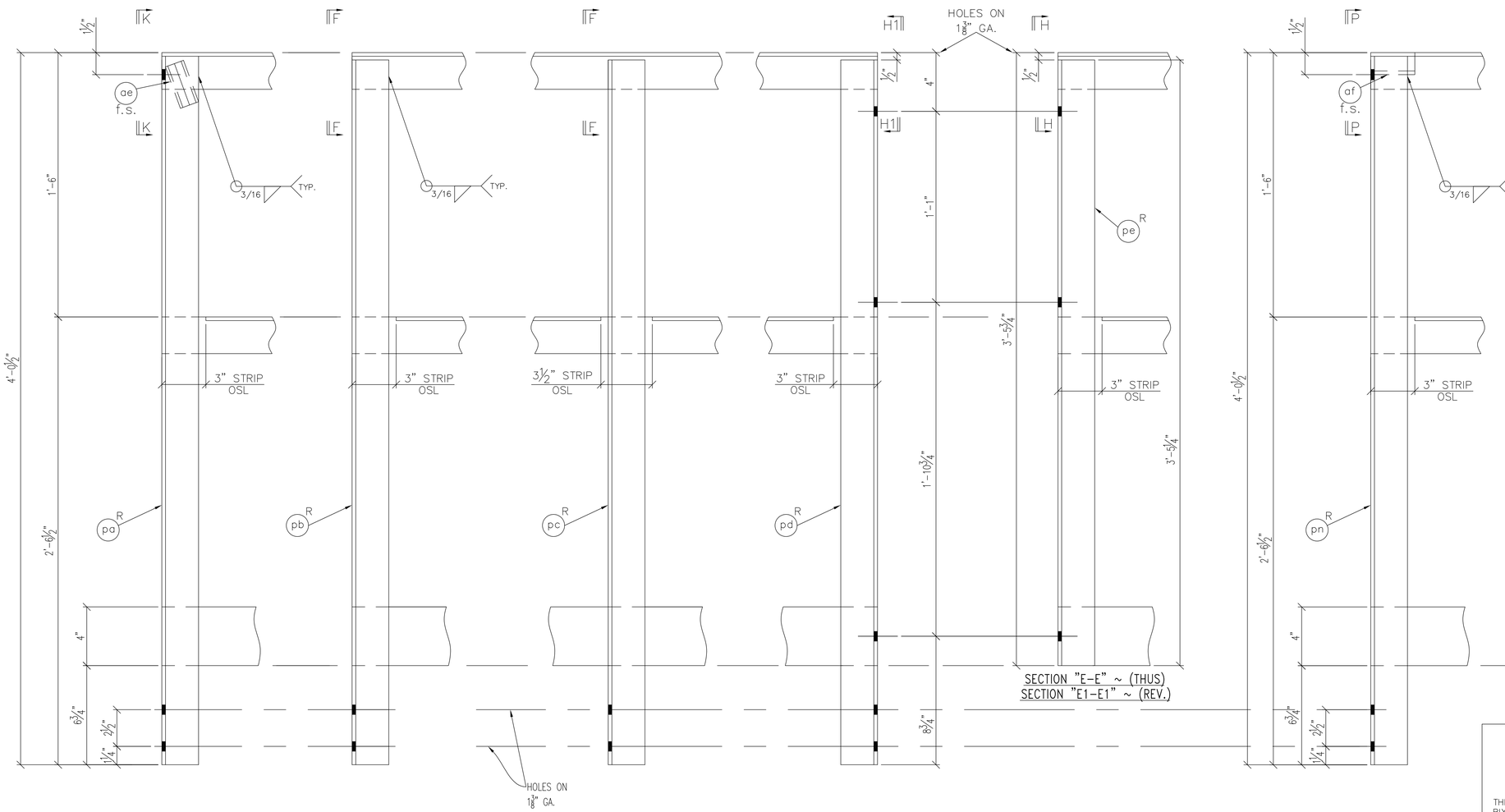
SECTION "M-M"



SECTION "K-K"

AS BUILT

BILL OF MATERIAL						
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
pa^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
pa^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
pb^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pb^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pc^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pc^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pd^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pd^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pe^R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
pe^L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
pn^R	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
pn^L	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
ps	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
ae	1	1" Sch. 80 Pipe	0	3	A36	1
af	1	L 1 1/2 x 1 1/2 x 3/16	0	3	A36	1



SECTION "A-A" ~ (THUS)
SECTION "A1-A1" ~ (REV.)

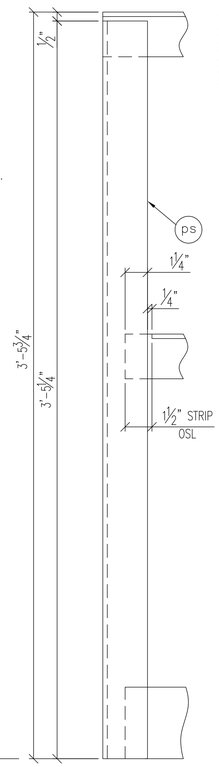
SECTION "B-B" ~ (THUS)
SECTION "B1-B1" ~ (REV.)

SECTION "C-C" ~ (THUS)
SECTION "C1-C1" ~ (REV.)

SECTION "D-D" ~ (THUS)
SECTION "D1-D1" ~ (REV.)

SECTION "E-E" ~ (THUS)
SECTION "E1-E1" ~ (REV.)

SECTION "N-N" ~ (THUS)
SECTION "N1-N1" ~ (REV.)



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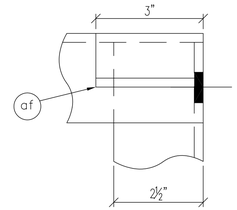

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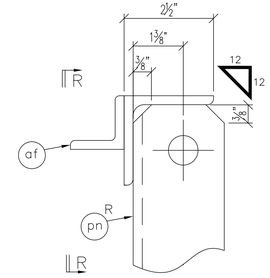

SECTION "P-P"

NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. SEAL WELD CONSTRUCTION. (TYP U.O.N.)
4. GALVANIZE PER ASTM-A-123.
5. WORK w/ DRAWING 6805-D2.
6. B.O.M. THIS DRAWING IS REFERENCE ONLY.
7. SECTION T-T ON DRAWING 6805-D2

BIXBY Fabco STEEL FABRICATORS

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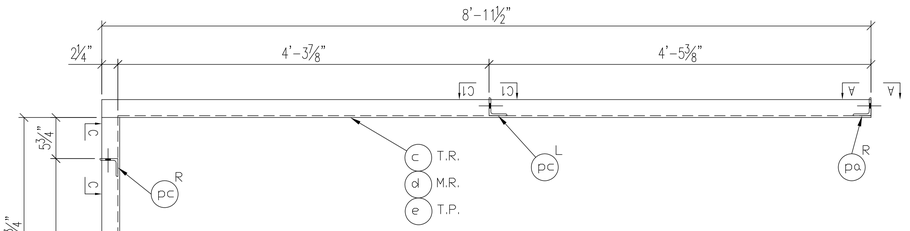
BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN INC, 61237/61238

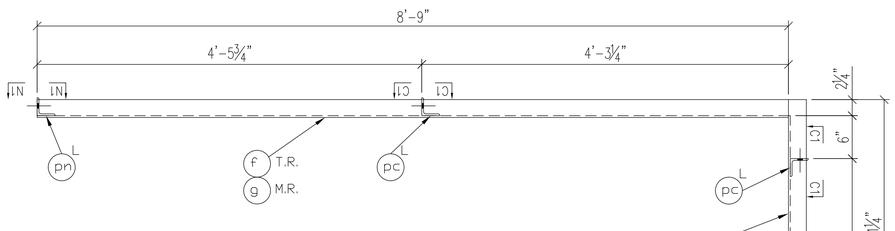
HANDRAIL POST DETAILS

6805

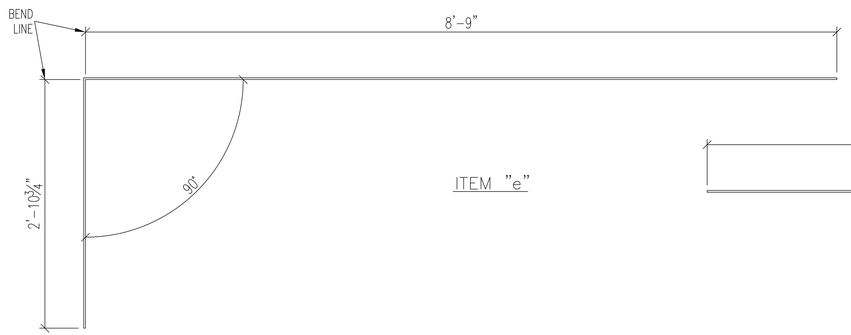
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D1	–	0



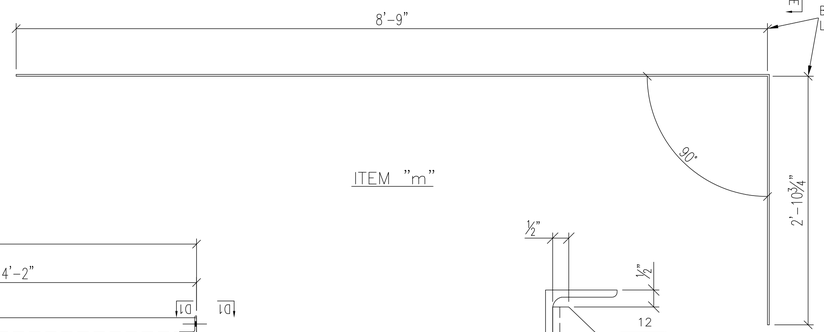
(ONE) HANDRAIL MK D2-A



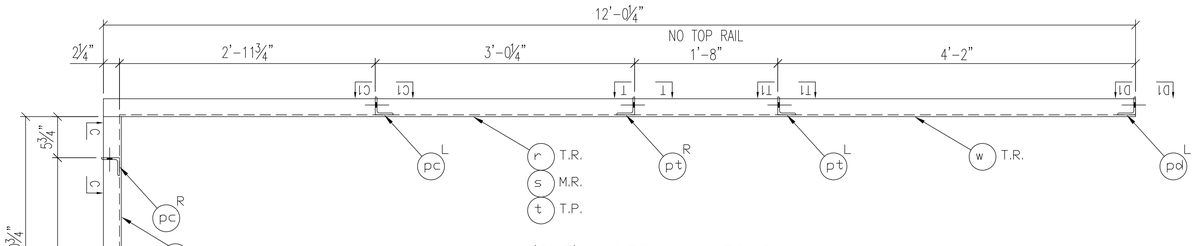
(ONE) HANDRAIL MK D2-B



ITEM "e"



ITEM "m"



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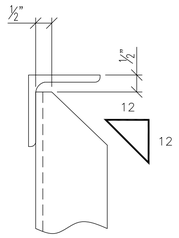
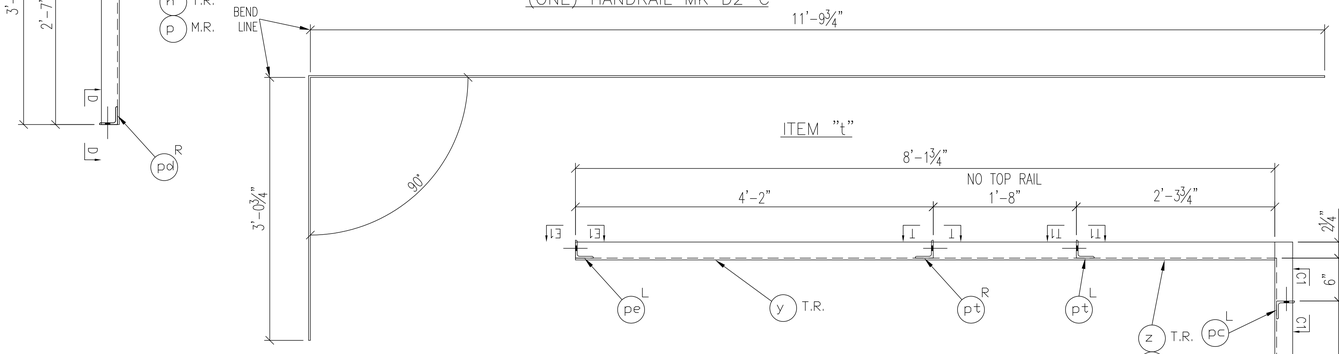


SECTION "F-F" ~ (THUS) AS NOTED
SECTION "F1-F1" ~ (REV.) AS NOTED



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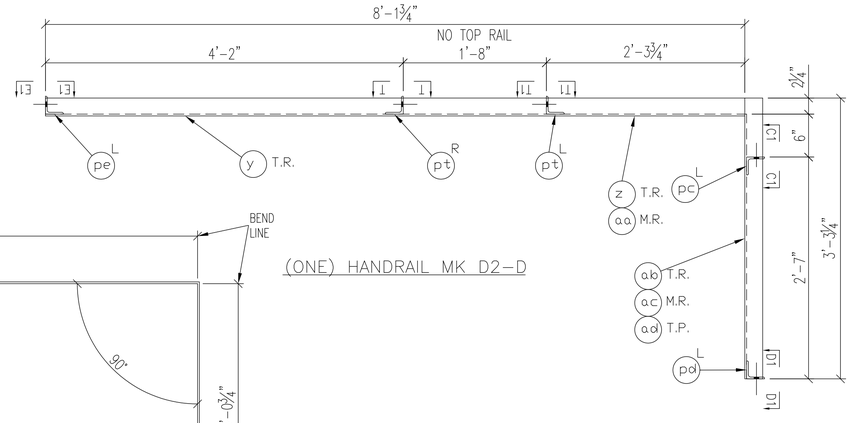
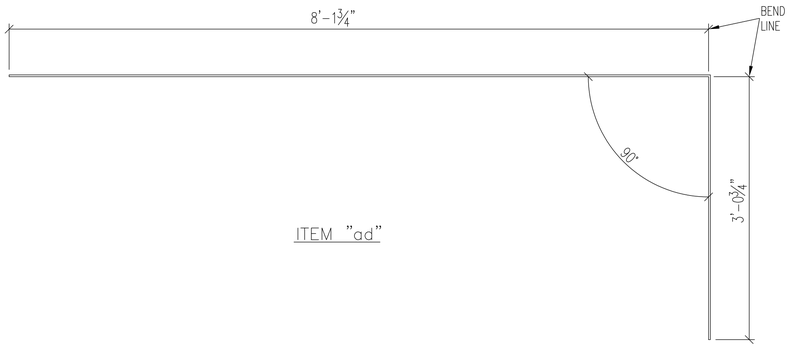
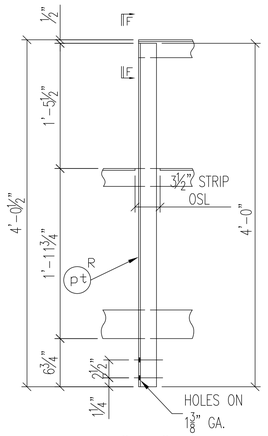




ITEM "ad"

(ONE) HANDRAIL MK D2-D



SECTION "T-T" ~ THUS
SECTION "T1-T1" ~ REV

BILL OF MATERIAL

MK.		DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
D2-A	ONE	HANDRAIL				
a	1	L 2 1/2 x 2 1/2 x 1/4	2	10 3/4	A36	12
b	1	L 2 1/2 x 2 1/2 x 1/4	2	10 3/4	A36	12
c	1	L 2 1/2 x 2 1/2 x 1/4	8	11 1/2	A36	37
d	1	L 2 1/2 x 2 1/2 x 1/4	8	11 1/2	A36	37
e	1	BAR 4 x 1/4 (BEND)	11	7 3/4	A36	40
ae	1	1" Sch. 80 Pipe	0	3	A36	1
pa R	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
pc L R	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
pe L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
					TOTAL	202
D2-B	ONE	HANDRAIL				
f	1	L 2 1/2 x 2 1/2 x 1/4	8	9	A36	36
g	1	L 2 1/2 x 2 1/2 x 1/4	8	9	A36	36
h	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
k	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
m	1	BAR 4 x 1/4 (BEND)	11	7 3/4	A36	40
af	1	L 1 1/2 x 1 1/2 x 3/16	0	3	A36	1
pc L	2	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
pe R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
pn L	1	L 2 1/2 x 2 1/2 x 1/4	4	0 1/4	A36	16
					TOTAL	202
D2-C	ONE	HANDRAIL				
n	1	L 2 1/2 x 2 1/2 x 1/4	3	0 3/4	A36	13
p	1	L 2 1/2 x 2 1/2 x 1/4	3	0 3/4	A36	13
r	1	L 2 1/2 x 2 1/2 x 1/4	6	2 1/4	A36	25
s	1	L 2 1/2 x 2 1/2 x 1/4	12	0 1/4	A36	49
t	1	BAR 4 x 1/4 (BEND)	14	10 1/2	A36	51
w	1	L 2 1/2 x 2 1/2 x 1/4	4	2	A36	17
pc R R	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
pd R R	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
pt L L	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
					TOTAL	267
D2-D	ONE	HANDRAIL				
y	1	L 2 1/2 x 2 1/2 x 1/4	4	2	A36	17
z	1	L 2 1/2 x 2 1/2 x 1/4	2	3 3/4	A36	10
aa	1	L 2 1/2 x 2 1/2 x 1/4	8	1 3/4	A36	33
ab	1	L 2 1/2 x 2 1/2 x 1/4	3	3 1/4	A36	13
ac	1	L 2 1/2 x 2 1/2 x 1/4	3	3 1/4	A36	13
ad	1	BAR 4 x 1/4 (BEND)	11	2 1/2	A36	38
pc L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pd L	1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	16
pe L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 1/4	A36	14
pt R L	1/1	L 2 1/2 x 2 1/2 x 1/4	4	0	A36	33
					TOTAL	203
		FIELD MATERIAL				
+4	48	5/8Ø x 1 3/4 HEX BOLTS w/ NUT & HFW GALV.			A325	19
		TOTAL				893

NOTES:
1. REFERENCE 6805-D1 FOR SECTIONS & DETAILS.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP U.N.O.)
5. GALV. PER ASTM A-123.
6. ALL HOLE TO BE (3/4)"ø UNLESS NOTED OTHERWISE.

AS BUILT

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BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

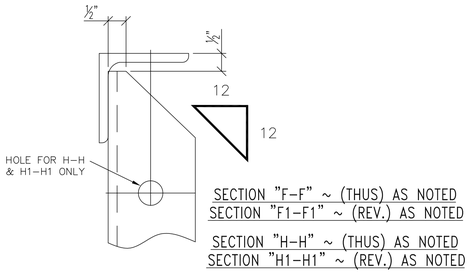
CLIENT: BOARDMAN INC, 61237/61238

HANDRAIL DETAILS

FOR PLATFORM @ EL. 32'-6" T/G

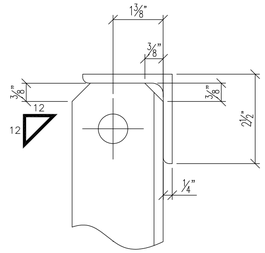
6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D2	–	0

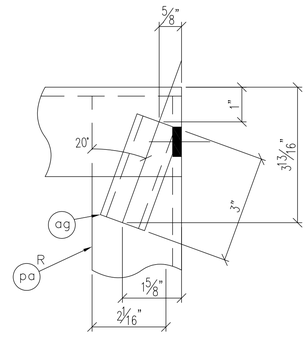


SECTION "F-F" ~ (THUS) AS NOTED
SECTION "F1-F1" ~ (REV.) AS NOTED

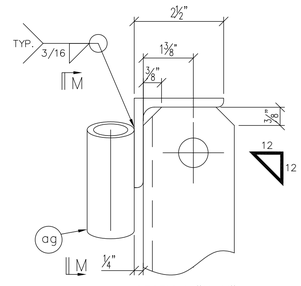
SECTION "H-H" ~ (THUS) AS NOTED
SECTION "H1-H1" ~ (REV.) AS NOTED



SECTION "G-G"

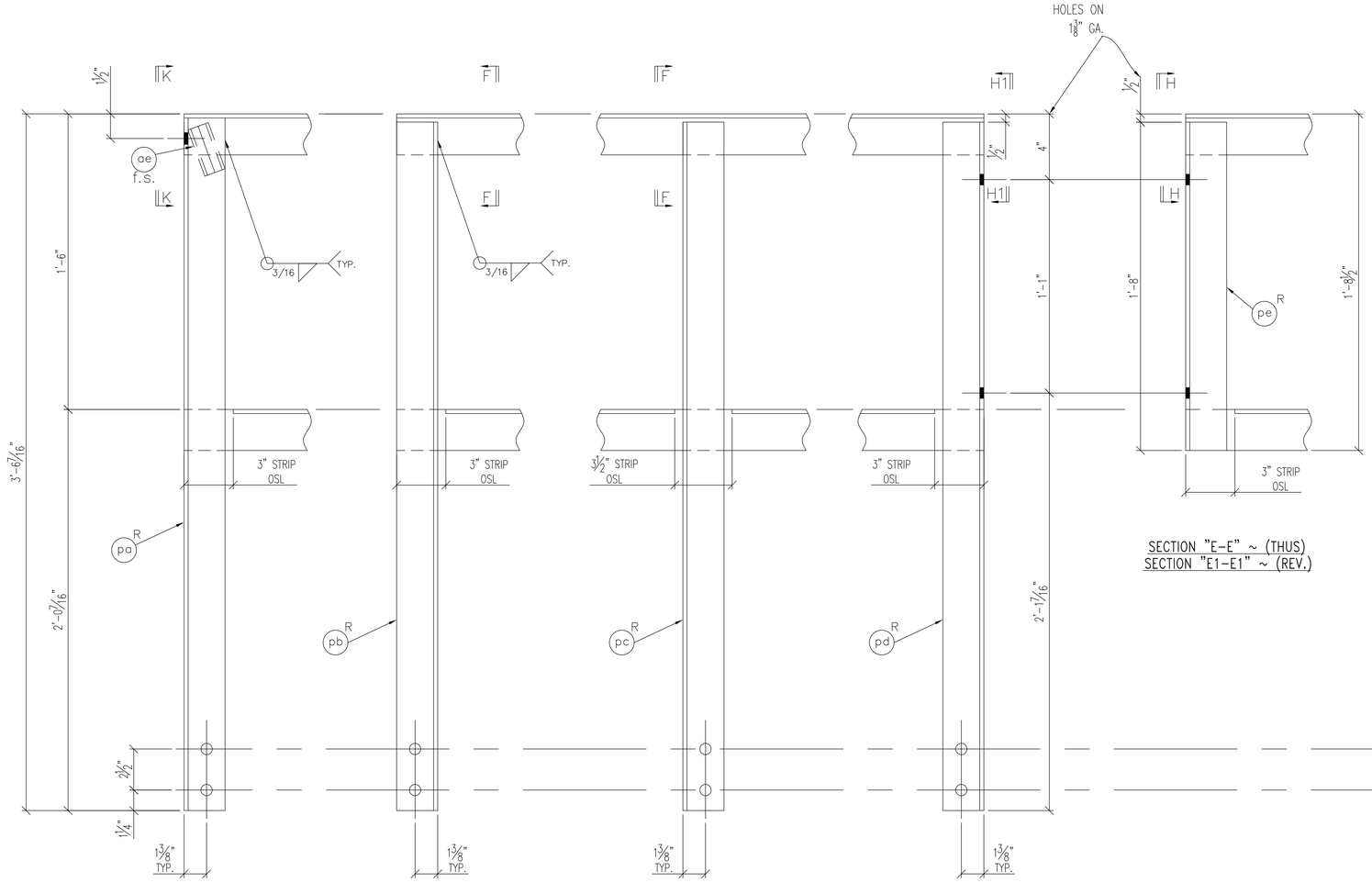


SECTION "M-M"



SECTION "K-K"

BILL OF MATERIAL						
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
pa R	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
pa L	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
pb R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pb L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pc R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pc L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pd R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pd L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pe R	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
pe L	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
pn R	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
pn L	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
ps	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
ag	1	1" Sch. 80 Pipe	0	3	A36	1
ah	1	L 1 1/2 x 1 1/2 x 3/16	0	3	A36	1



SECTION "A-A" ~ (THUS)
SECTION "A1-A1" ~ (REV.)

SECTION "B-B" ~ (THUS)
SECTION "B1-B1" ~ (REV.)

SECTION "C-C" ~ (THUS)
SECTION "C1-C1" ~ (REV.)

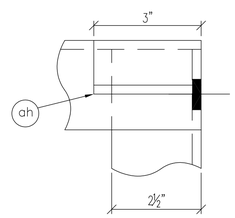
SECTION "D-D" ~ (THUS)
SECTION "D1-D1" ~ (REV.)

SECTION "E-E" ~ (THUS)
SECTION "E1-E1" ~ (REV.)

SECTION "N-N" ~ (THUS)
SECTION "N1-N1" ~ (REV.)

SECTION "S-S"

NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. SEAL WELD CONSTRUCTION. (TYP U.O.N.)
4. GALVANIZE PER ASTM-A-123.
5. WORK w/ DRAWING 6805-D4.
6. B.O.M. THIS DRAWING IS REFERENCE ONLY.



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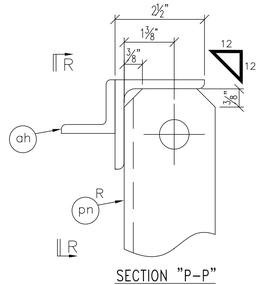

SECTION "P-P"

AS BUILT

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BIXBY FABCO
STEEL FABRICATORS

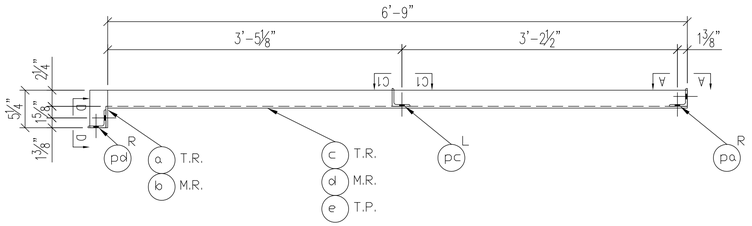
BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN INC, 61237/61238

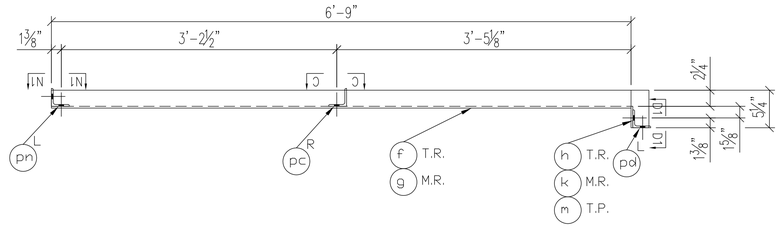
HANDRAIL POST DETAILS

6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D3	–	0



(ONE) HANDRAIL MK D4-A



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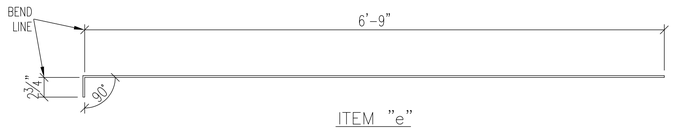
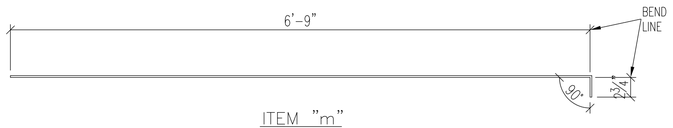
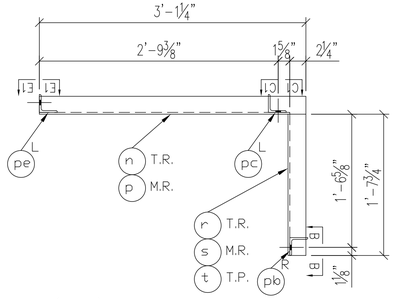


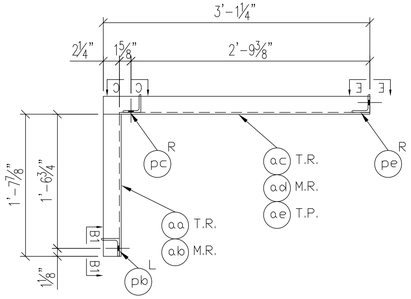
ITEM "e"



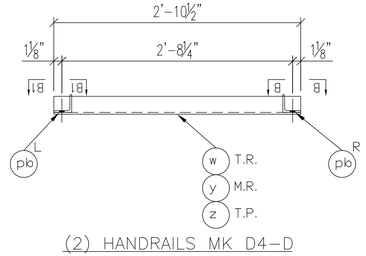
ITEM "m"



(ONE) HANDRAIL MK D4-C



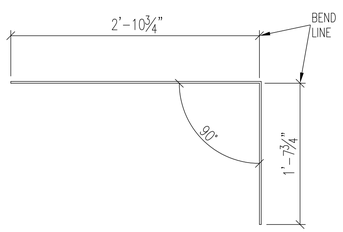
(ONE) HANDRAIL MK D4-E



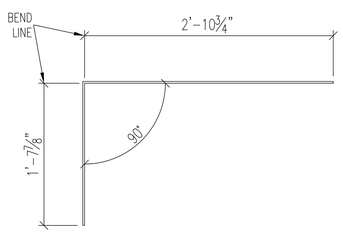
(2) HANDRAILS MK D4-D

BILL OF MATERIAL						
MK.		DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
D4-A	ONE	HANDRAIL				
a	1	L 2 1/2 x 2 1/2 x 1/4	0	5 1/4	A36	2
b	1	L 2 1/2 x 2 1/2 x 1/4	0	5 1/4	A36	2
c	1	L 2 1/2 x 2 1/2 x 1/4	6	9	A36	28
d	1	L 2 1/2 x 2 1/2 x 1/4	6	9	A36	28
e	1	BAR 4 x 1/4 (BEND)	6	11 3/4	A36	24
ae	1	1" Sch. 80 Pipe	0	3	A36	1
pa R	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
pc L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pd R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
					TOTAL	127
D4-B	ONE	HANDRAIL				
f	1	L 2 1/2 x 2 1/2 x 1/4	6	9	A36	28
g	1	L 2 1/2 x 2 1/2 x 1/4	6	9	A36	28
h	1	L 2 1/2 x 2 1/2 x 1/4	0	5 1/4	A36	2
k	1	L 2 1/2 x 2 1/2 x 1/4	0	5 1/4	A36	2
m	1	BAR 4 x 1/4 (BEND)	6	11 3/4	A36	24
af	1	L 1 1/2 x 1 1/2 x 3/16	0	3	A36	1
pc R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pd L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pn L	1	L 2 1/2 x 2 1/2 x 1/4	3	6 3/16	A36	14
					TOTAL	127
D4-C	ONE	HANDRAIL				
n	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
p	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
r	1	L 2 1/2 x 2 1/2 x 1/4	1	7 3/4	A36	7
s	1	L 2 1/2 x 2 1/2 x 1/4	1	7 3/4	A36	7
t	1	BAR 4 x 1/4 (BEND)	4	6 1/2	A36	16
pb R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pc L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pe L	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
					TOTAL	91
D4-D	2	HANDRAILS				
w	2	L 2 1/2 x 2 1/2 x 1/4	2	10 1/2	A36	12
y	2	L 2 1/2 x 2 1/2 x 1/4	2	10 1/2	A36	12
z	2	BAR 4 x 1/4 (BEND)	2	10 1/2	A36	10
pb R L	2/2	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	57
					TOTAL	91
D4-E	ONE	HANDRAIL				
aa	1	L 2 1/2 x 2 1/2 x 1/4	1	7 7/8	A36	7
ab	1	L 2 1/2 x 2 1/2 x 1/4	1	7 7/8	A36	7
ac	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
ad	1	L 2 1/2 x 2 1/2 x 1/4	3	1 1/4	A36	13
ae	1	BAR 4 x 1/4 (BEND)	4	6 5/8	A36	16
pb L	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pc R	1	L 2 1/2 x 2 1/2 x 1/4	3	5 15/16	A36	14
pe R	1	L 2 1/2 x 2 1/2 x 1/4	1	8	A36	7
					TOTAL	91
D4-F	2	SAFETY GATES				
aa	2	1" Pipe SCH 80	0	0 1/4	A36	1
ag	2	3/4" Bar	3	1 1/8	A36	9
					TOTAL	10
		FIELD MATERIAL				
+3	35	5/8ø x 1 3/4 HEX BOLTS w/ NUT & HFW GALV.			A325	14
+0	2	3/16ø x 1 3/4 LNG. COTTER PIN			A325	
		TOTAL				551

NOTES:
1. REFERENCE 6805-D3 FOR SECTIONS & DETAILS.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP U.N.O.)
5. GALV. PER ASTM A-123.
6. ALL HOLE TO BE (3/4)"ø UNLESS NOTED OTHERWISE.



ITEM "t"



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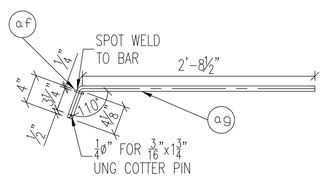

(TWO) SAFETY GATES D4-F

AS BUILT

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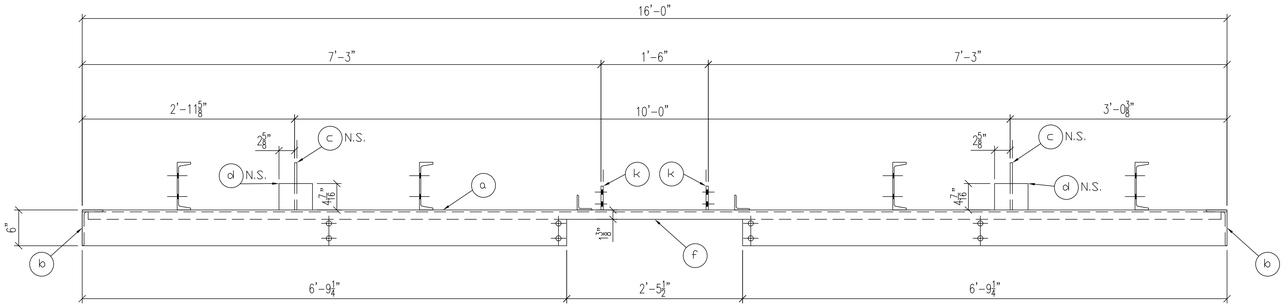
BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

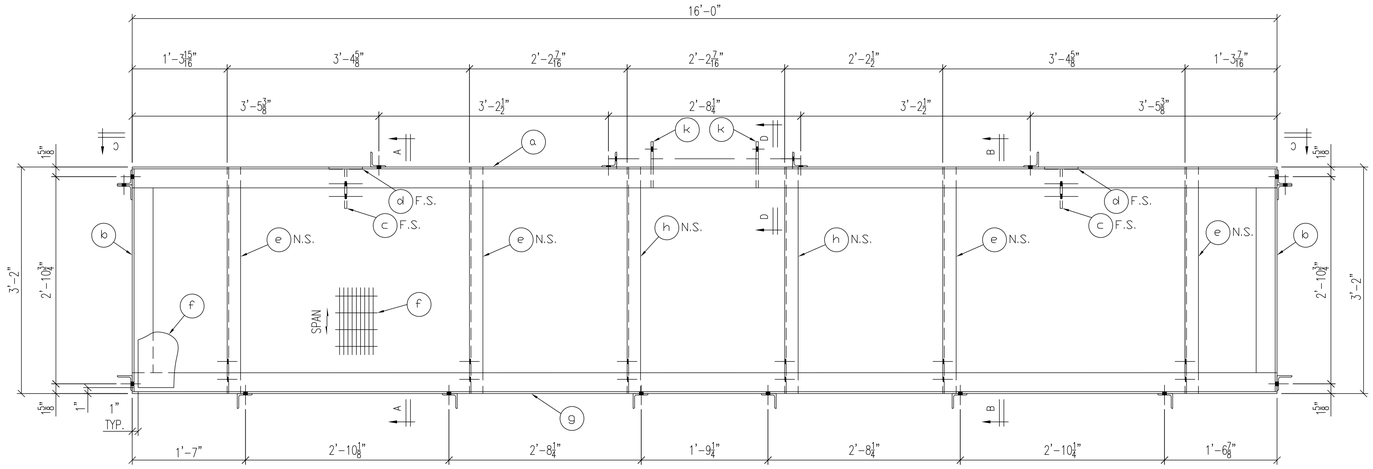
CLIENT: BOARDMAN 61237/61238

HANDRAIL DETAILS
FOR PLATFORM @ EL. 4'-8" T/G
6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D4	-	0



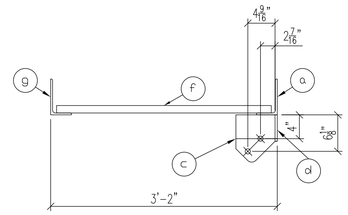
VIEW C-C



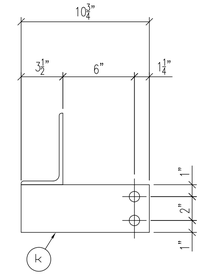
(ONE) PLATFORM MK D5-A

BILL OF MATERIAL						
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
D5-A	ONE	PLATFORM				
a	1	L 6 x 3 1/2 x 5/16	16	0	A36	157
b	2	L 6 x 3 1/2 x 5/16	3	1 3/8	A36	61
c	2	PL 3/8 x 6 9/16	0	7 15/16	A36	11
d	2	PL 3/8 x 4 7/16	0	5 5/8	A36	5
e	6	C8 x 11.5	3	2	A36	146
f	48	SQ. FT. 1 x 3/16 SERRATED BAR GRATING				360
g	1	L 6 x 3 1/2 x 5/16	16	0	A36	157
h	2	L 2 1/2 x 2 1/2 x 1/4	3	2	A36	26
k	2	PL 3/8 x 4	0	10 3/4	A36	9
					TOTAL	932
D5-B	2	KNEE BRACES				
m	2	L 3 x 3 x 1/4	4	8 1/2	A36	47
					TOTAL	47
		FIELD MATERIAL				
+2	22	3/4"ø x 1 3/4" HEX BOLTS W/ HHN & LW			A325	14
+1	9	3/4"ø x 2 1/4" HEX BOLTS W/ HHN & HFW			A325	6
					TOTAL	999

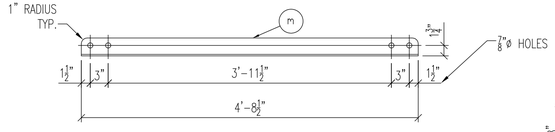
NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP. U.N.O.)
5. HOT DIP GALVANIZE.
6. ⅛" GAP BETWEEN GRATING & ANGLE FRAME.



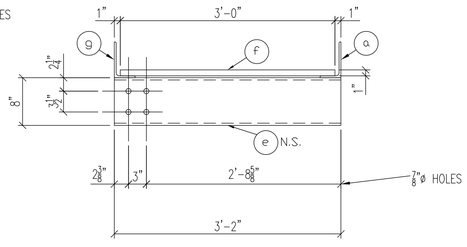
SECTION A-A



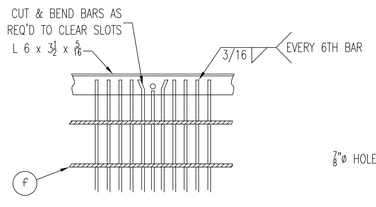
SECTION D-D



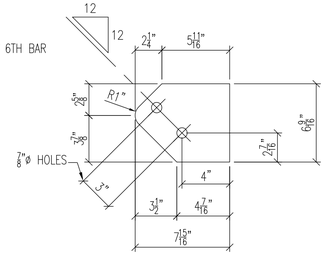
(2) KNEE BRACES MK D5-B



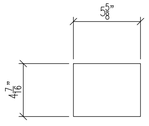
SECTION B-B



INSTALLATION DETAIL FOR GRATING



ITEM "c"



ITEM "d"

TYP. @ HR POST LOCATIONS

AS BUILT

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BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN 61237/61238

PLATFORM

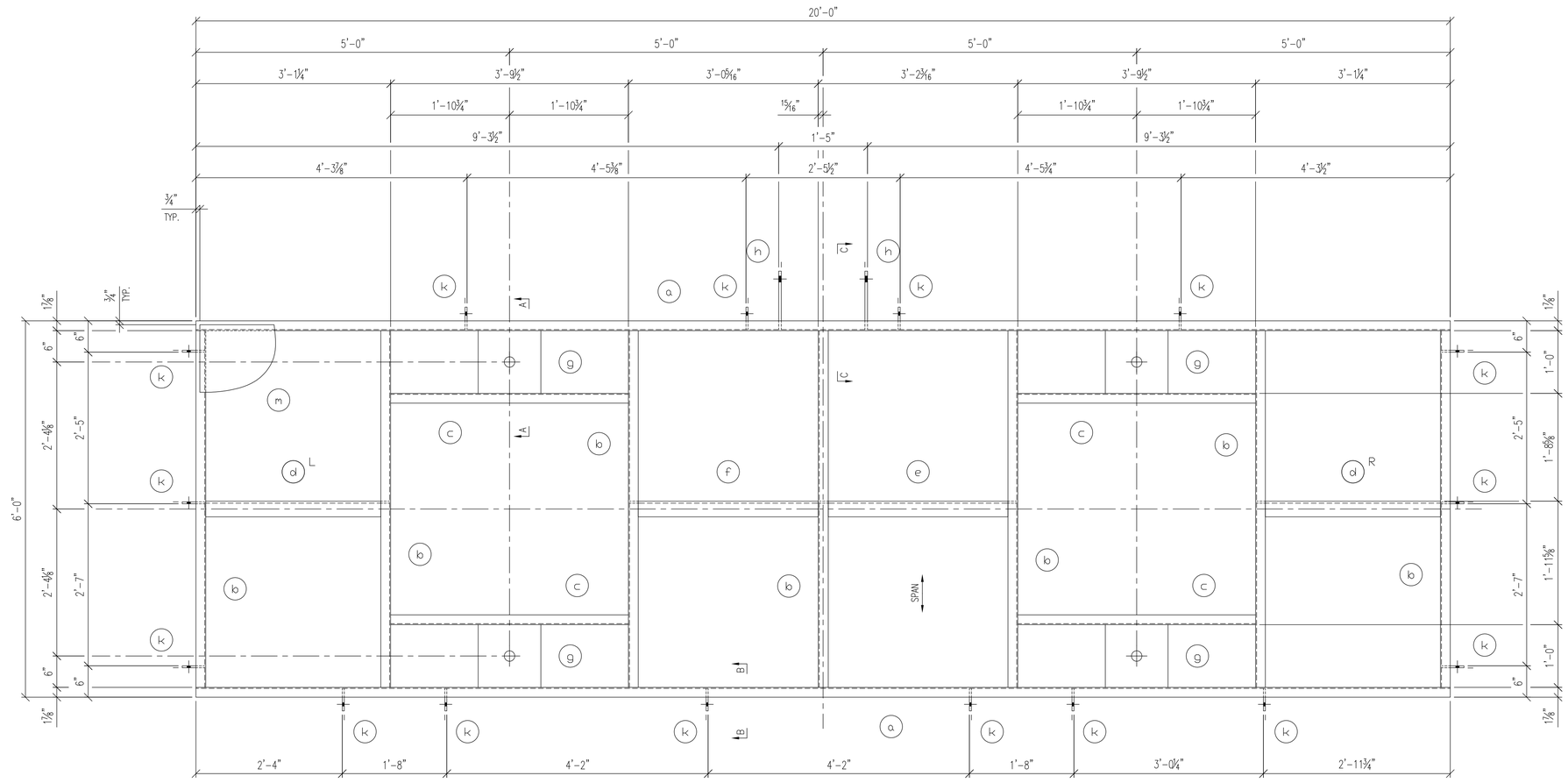
EL. 4'-8 T/G

6805

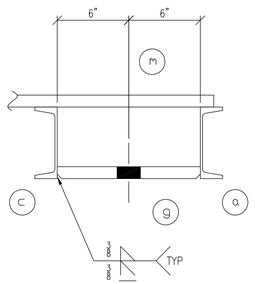
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D5	-	0

BILL OF MATERIAL						
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
D6-1	ONE	PLATFORM				
a	2	C6 x 8.2	20	0	A36	328
b	7	C6 x 8.2	5	8 1/4	A36	326
c	4	C6 x 8.2	3	9 1/2	A36	124
d L/R	1/1	L 3 x 3 x 3/8	2	11 3/16	A36	42
e	1	L 3 x 3 x 3/8	3	1 13/16	A36	23
f	1	L 3 x 3 x 3/8	3	0 1/8	A36	22
g	4	PL 1" x 12	1	0	A36	163
h	2	PL 1/2 x 5 1/2	0	11 3/16	A36	17
k	16	PL 3/8 x 4 7/16	0	5	A36	38
m	117	SQ.FT. 1" x 3/16 SERR. BAR GRTG. W/ SADDLE CLIPS			A36	878
n	2	BAR 1 x 1/4 (ROLL)	8	2 15/16	A36	14
					TOTAL	1975

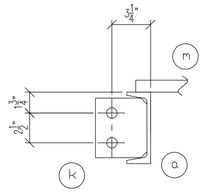
NOTES:
1. ALL HOLES TO BE AS NOTED
2. FABRICATE PER A.I.S.C.
3. SEAL WELD CONSTRUCTION. (TYP U.N.O.)
4. GALVANIZE PER A-123.
5. SPLIT GRATING @ PENETRATION
6. MIN. 4 SADDLE CLIPS PER PANEL



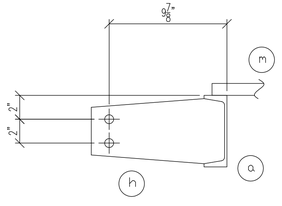
(ONE) PLATFORM MK D6-A



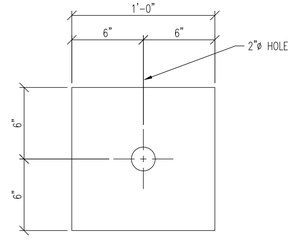
SECTION A-A



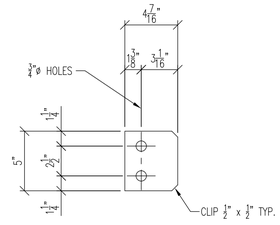
SECTION B-B



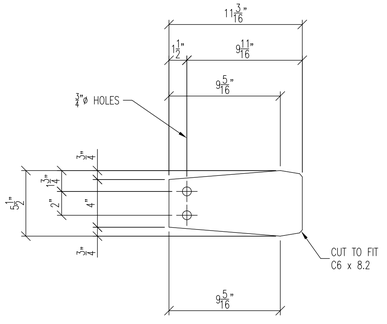
SECTION C-C



ITEM "g"



ITEM "k"



ITEM "h"

AS BUILT

WORK THIS DWG. W/ DWG D7.

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BIXBY FABCO, INC.

BIXBY Fabco STEEL FABRICATORS

BIXBY FABCO, INC.
BIXBY, OK.

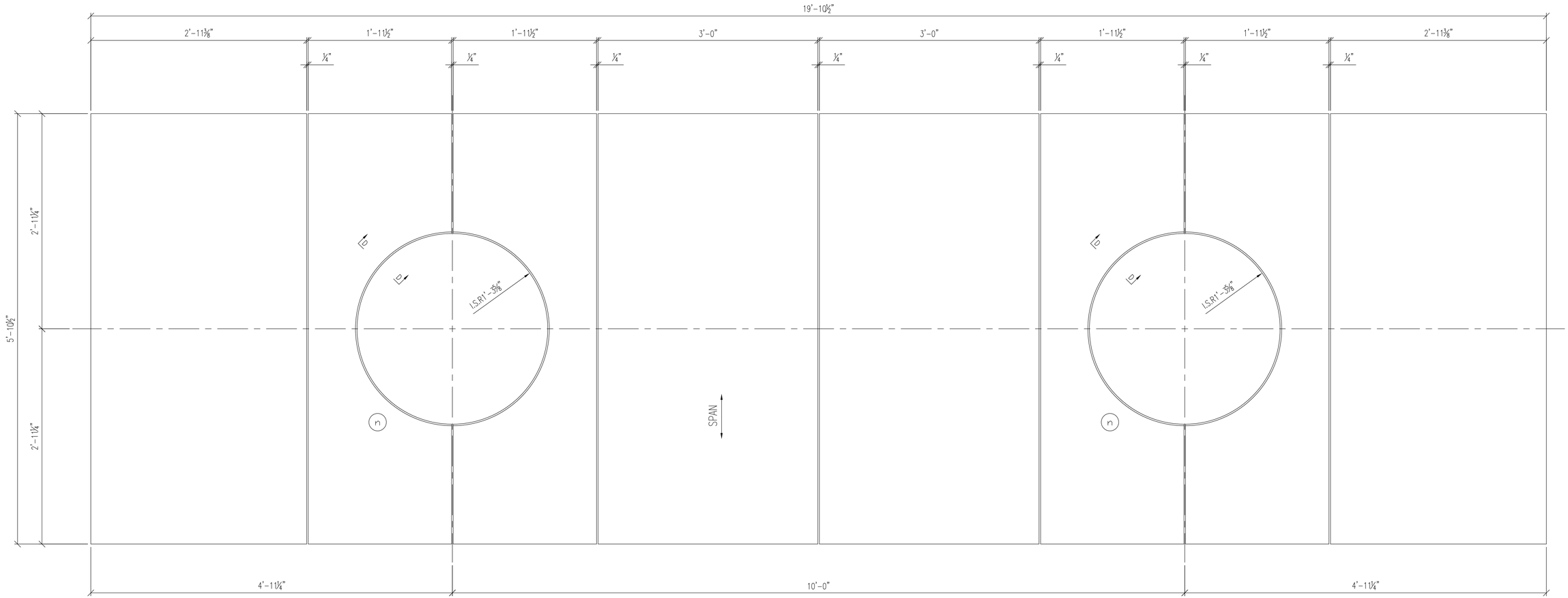
CLIENT: BOARDMAN, INC. 61237/61238

PLATFORM

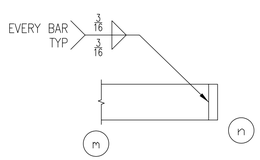
EL. 32'-6" T.O.G.

6805

TDOKC	9/23/13	R W	NTS	D6	–	0
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.



LAYOUT OF ITEM "m"



SECTION D-D

AS BUILT

WORK THIS DWG. W/ DWG D6.

THIS DRAWING IS THE PROPERTY OF BIXBY FABCO, INC. 8900 EAST 171ST STREET SOUTH, BIXBY, OK. 74008 AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OR EQUIPMENT EXCEPT WITH WRITTEN PERMISSION & AGREEMENT FROM:
BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

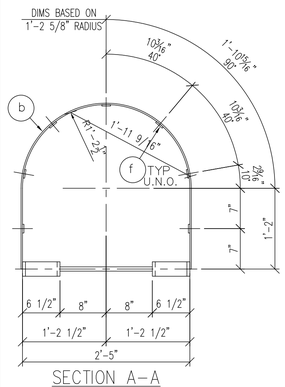
CLIENT: BOARDMAN, INC. 61237/61238

PLATFORM GRATING

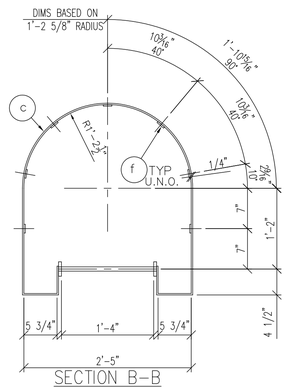
EL. 32'-6" T.O.G.

6805

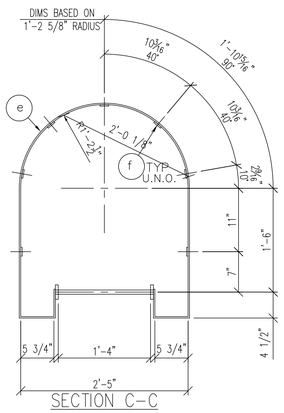
TDOKC	9/23/13	R W	NTS	D7	-	0
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.



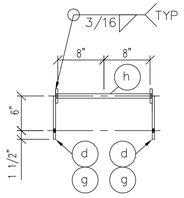
SECTION A–A



SECTION B–B

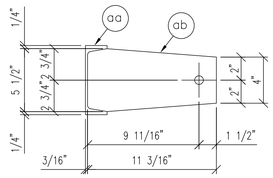


SECTION C–C

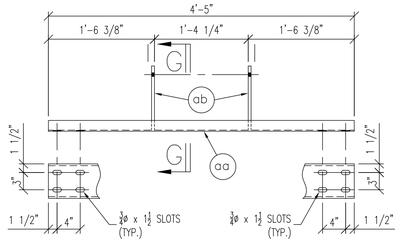


SECTION D–D

(10) 5/8ø x 2 HEX BOLTS W/ NUT & HFW

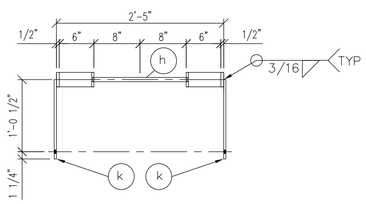


SECTION G–G



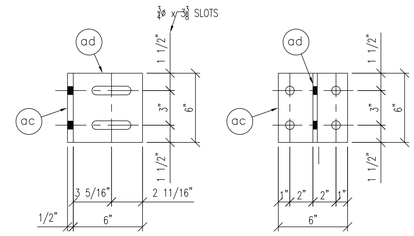
(3) LADDER SUPPORTS MK D8–B

(24) 5/8ø x 1 3/4 HEX BOLTS W/ NUT & HFW



SECTION E–E

(2) 1/2ø x 1 1/2 HEX BOLTS W/ NUT & HFW



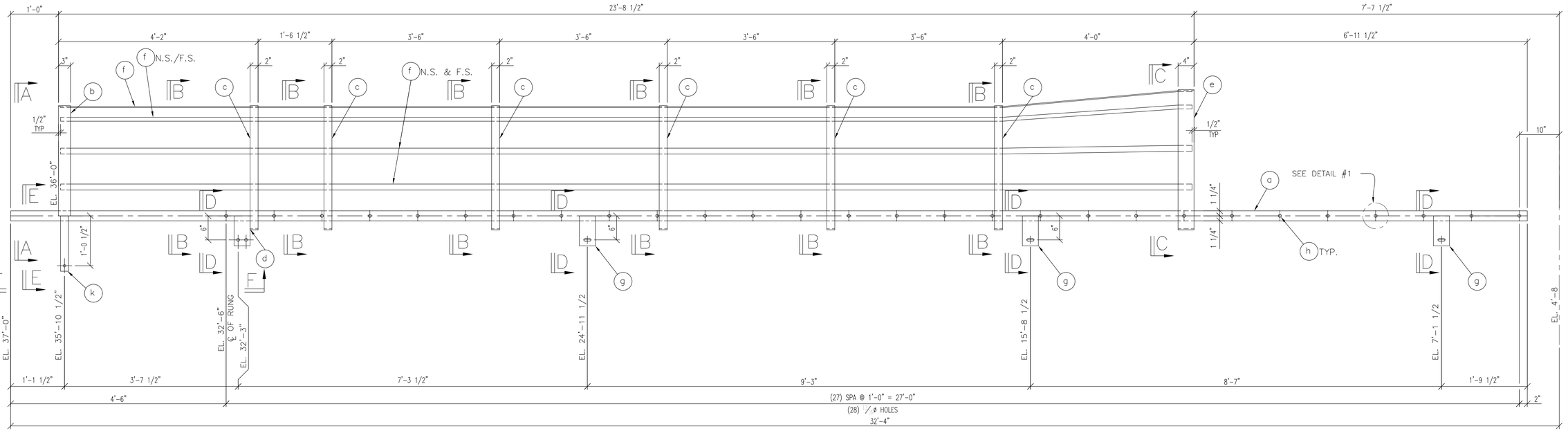
(6) LADDER SUPPORT CLIPS MK D8–C

(12) 5/8ø x 1 3/4 HEX BOLTS W/ NUT & HFW

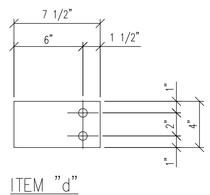
NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP U.O.N.)
5. GALVANIZE PER A-123.

BILL OF MATERIAL

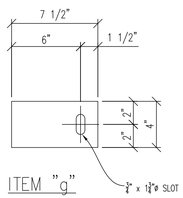
MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
L2	ONE	LADDER				
a	2	BAR 2 1/2 x 1/2 (BEND)	31	10	A36	271
b	1	BAR 3 x 1/4 (BEND)	6	1 15/16	A36	16
c	6	BAR 2 x 1/4 (BEND)	8	8 7/16	A36	89
d	2	BAR 4 x 3/8	0	7 1/2	A36	6
e	1	BAR 4 x 1/4 (BEND)	9	4 7/16	A36	32
f	7	BAR 1 1/2 x 1/4 (BEND)	23	7 11/16	A36	211
g	6	BAR 4 x 3/8	0	7 1/2	A36	19
h	28	3/4"ø RD. BAR	1	4 1/2	A36	59
k	2	BAR 2 x 3/8	1	1 3/4	A36	6
					TOTAL	709
D8–B	3	LADDER SUPPORTS				
aa	3	C6 x 8.2	4	5	A36	109
ab	6	BAR 5 1/2 x 1/2	0	11 3/16	A36	52
					TOTAL	161
D8–C	6	LADDER SUPPORT CLIPS				
ac	6	BAR 6 x 1/2	0	6	A36	31
ad	6	BAR 6 x 3/8	0	6	A36	23
					TOTAL	54
		FIELD MATERIAL				
+1	3	1/2ø x 1 1/2 HEX BOLTS w/ HHN & HFW				1
+4	40	5/8ø x 1 3/4 HEX BOLTS w/ HHN & HFW				16
+1	11	5/8ø x 2 HEX BOLTS w/ HHN & HFW				5
					TOTAL	946



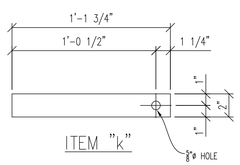
(ONE) LADDER MK L2



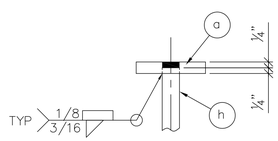
ITEM "d"



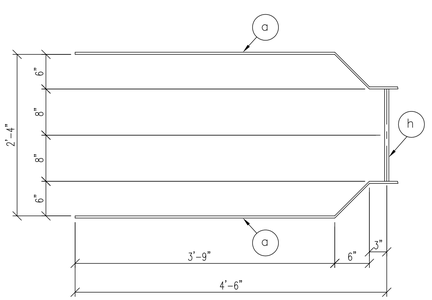
ITEM "g"



ITEM "k"



DETAIL #1



SECTION F–F

AS BUILT

BIXBY FABCO
STEEL FABRICATORS
BIXBY, OK.

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BIXBY FABCO, INC.
BIXBY, OK.

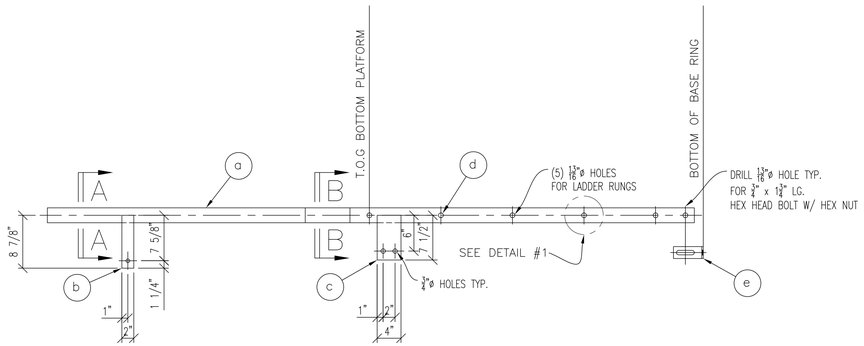
CLIENT: BOARDMAN INC, 61237/61238

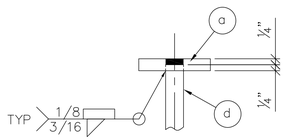
LADDER #2

EL. 4'-8" TO 32'-6" T/G

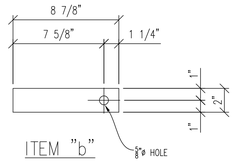
6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D8		0

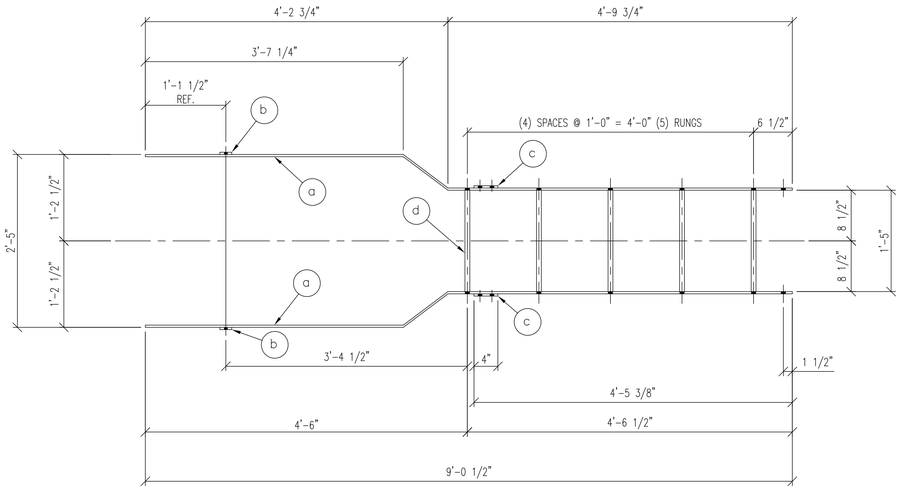




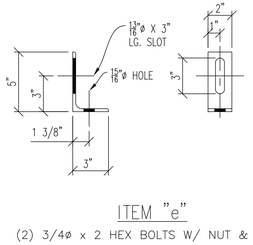
DETAIL #1



ITEM "b"

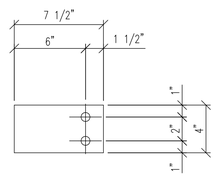


(ONE) LADDER MK L1

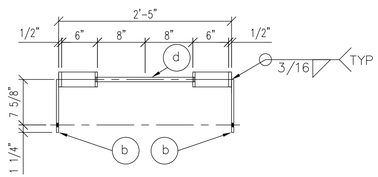


ITEM "e"

(2) 3/4ø x 2 HEX BOLTS W/ NUT & HFW

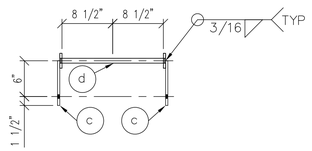


ITEM "c"



SECTION A-A

(2) 1/2ø x 1 1/2 HEX BOLTS W/ NUT & HFW



SECTION B-B

(4) 5/8ø x 2 HEX BOLTS W/ NUT & HFW

BILL OF MATERIAL

MK.	QTY.	DESCRIPTION	FT.	IN'S.	MAT'L.	WT.
L1	ONE	LADDER				
a	2	BAR 2 1/2 x 1/2 (BEND)	9	3	A36	79
b	2	BAR 2 x 3/8	0	8 7/8	A36	4
c	2	BAR 4 x 3/8	0	7 1/2	A36	6
d	5	3/4"ø RD. BAR	1	5 1/2	A36	11
e	2	L 5 x 3 x 1/4	0	2	A36	2
		TOTAL				102
		FIELD MATERIAL				
+1	3	1/2ø x 1 1/2 HEX BOLTS w/ HHN & HFW				1
+1	5	5/8ø x 2 HEX BOLTS w/ HHN & HFW				2
+1	3	3/4ø x 2 HEX BOLTS w/ HHN & HFW				2
		TOTAL				107

NOTES:
1. ALL HOLES TO BE (3/4)"ø UNLESS NOTED OTHERWISE.
2. FABRICATE PER A.I.S.C.
3. NOTHING ADDED FOR ROLLING, LENGTH CALCULATED TO RADIUS ARC DIMENSIONS AS NOTED.
4. SEAL WELD CONSTRUCTION. (TYP U.O.N.)
5. GALVANIZE PER A-123.

AS BUILT

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BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN INC, 61237/61238

LADDER #1

EL. 0'-0 TO 4'-8 T/G

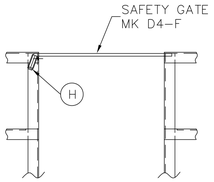
6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	D9		0

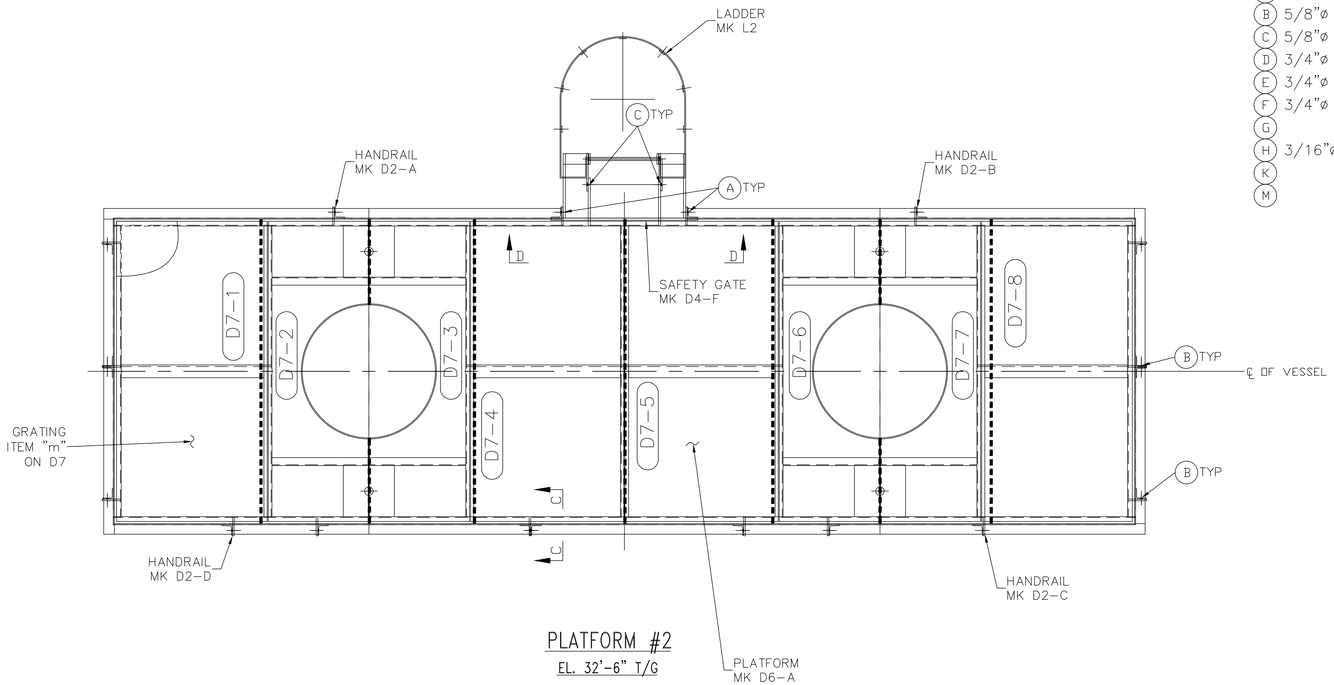
0°
270° 90°
180°

BOLT LIST (10% ADDED)
(ALL BOLTS TO BE GALVANIZED)

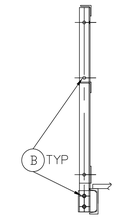
- (A) 1/2"ø x 1 1/2" (A307) HEX BOLTS W/ HHN & HFW (6)
- (B) 5/8"ø x 1 3/4" (A307) HEX BOLTS W/ HHN & HFW (83)
- (C) 5/8"ø x 2" (A307) HEX BOLTS W/ HHN & HFW (16)
- (D) 3/4"ø x 1 3/4" (A325) HEX BOLTS W/ HHN & LW (22)
- (E) 3/4"ø x 2 " (A325) HEX BOLTS W/ HHN & HFW (3)
- (F) 3/4"ø x 2 1/4" (A325) HEX BOLTS W/ HHN & HFW (9)
- (G)
- (H) 3/16"ø x 1 3/4" LG. COTTER PIN (2)
- (K)
- (M)



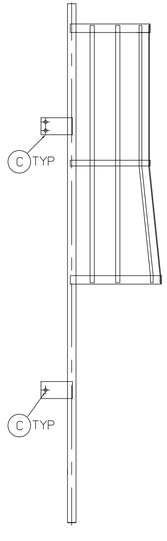
SECTION D-D



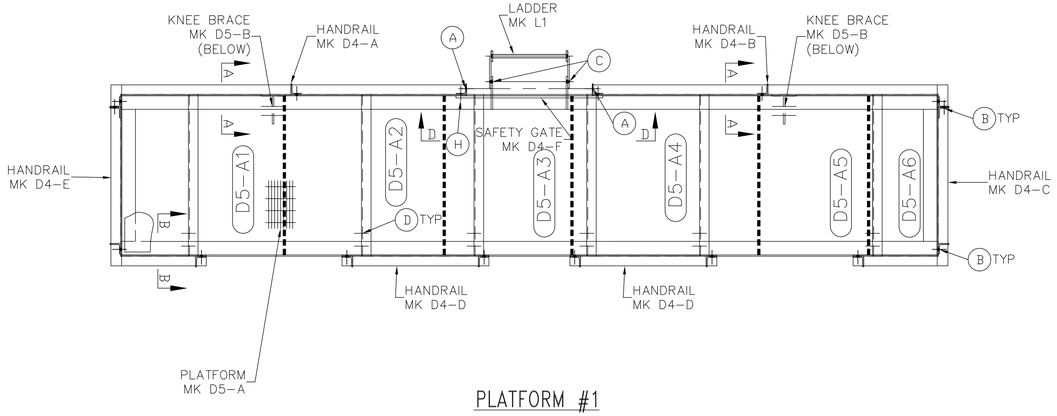
PLATFORM #2
EL. 32'-6" T/G



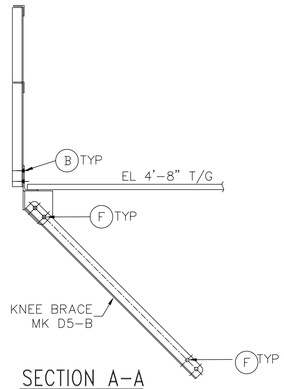
SECTION C-C



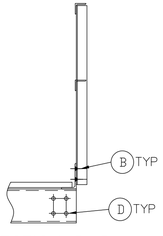
LADDER DETAIL



PLATFORM #1
EL. 4'-8" T/G



SECTION A-A



SECTION B-B

AS BUILT

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BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

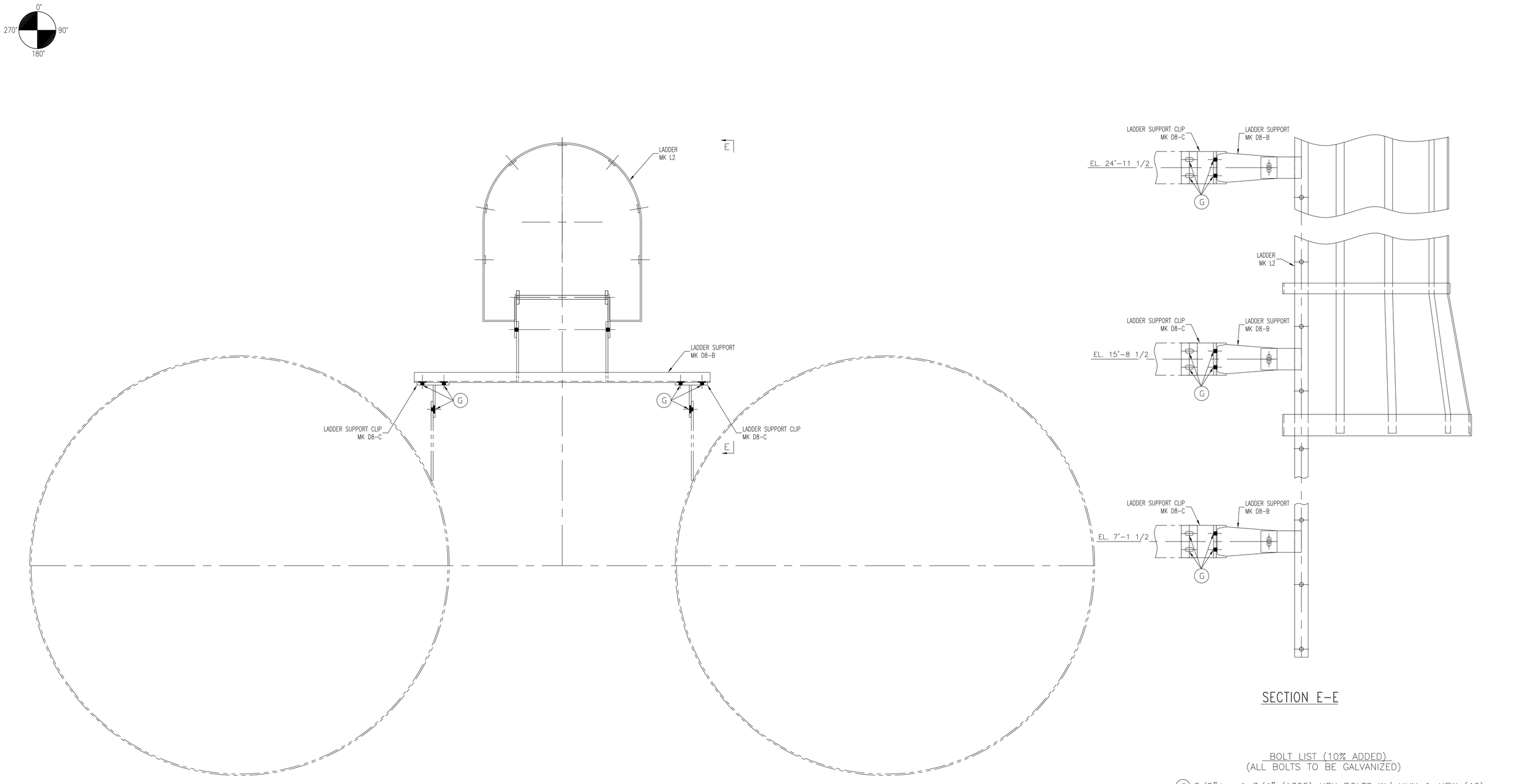
CLIENT: BOARDMAN INC. 61237/61238

PLATFORM ERECTION DRAWING

ELEVATIONS AS NOTED

6805

TDOKC	9/23/13	R W	NTS	EI	–	0
DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.



SECTION E-E

BOLT LIST (10% ADDED)
(ALL BOLTS TO BE GALVANIZED)

(G) 5/8"ø x 1 3/4" (A325) HEX BOLTS W/ HHN & HFW (40)

AS BUILT

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BIXBY FABCO, INC.

BIXBY FABCO, INC.
BIXBY, OK.

CLIENT: BOARDMAN INC. 61237/61238

PLATFORM ERECTION DRAWING

ELEVATIONS AS NOTED

6805

DRAWN	DATE	APP'D.	SCALE	DRAWING NUMBER	SHT. NO.	REV.
TDOKC	9/23/13	R W	NTS	E2	–	0