REVIEWED
By Jake Mowat at 12:42 pm, Jul 24, 2019

Eaton Metal Products Company LLC
ENGINEERS DESIGNERS FABRICATORS
PETROLEUM EQUIPMENT
(303) 296-4800 FAX: (303) 296-5736

MANUFACTURER DATA REPORT

132” OD x 82’-10” S/S INLET SLUG CATCHER

for

ANADARKO E&P ONSHORE LLC

EMP JOB # 5361-1

TAG # V-1000

May 8, 2019

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EATON METAL PRODUCTS

Eaton Metal Products Company LLC
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Document Index Log

EATON METAL PRODUCTS COMPANY LLC
Document Index Log

JOB NUMBER 5361-1 DATA SHEET REGISTERED YES ☒ X NO ☐

DOCUMENT	STORAGE LOCATION	RETENTION DATE	QAM	AI
☑ Manufacturer's Data Report	PWA - electronic	5/15/2024	*Data Reports*	
☑ Nameplate Picture	PWA - electronic	5/15/2024	*Data Reports*	
☑ Manufacturer's Drawings	PWA - electronic	5/15/2024	*Drawings*	
☑ Design Calculations	PWA - electronic	5/15/2024	*Calculations*	
☑ MTRs	PWA - electronic	5/15/2024	*Material Records*	
☑ WPS / PQR	PWA - electronic	5/15/2024	*WPS, WPQ*	
☑ WPQ / Continuity Records	PWA - electronic	5/15/2024	*WPS, WPQ*	
☑ NDE Reports	PWA - electronic	5/15/2024	*NDE Records*	
☐ Repair Procedure / Records	PWA - electronic	N/A	*N/A*	N/A
☑ Process Control Sheets (ITP)	PWA - electronic	5/15/2024	*Inspection Records*	
☑ Weld Map Description	PWA - electronic	5/15/2024	*Inspection Records*	
☑ Paint Inspection Records	PWA - electronic	5/15/2024	*Inspection Records*	N/A
☑ Hydrostatic Test Records	PWA - electronic	5/15/2024	*Inspection Records*	
☐ PWHT Records	PWA - electronic	N/A	*N/A*	N/A
☐ NCRs	PWA - electronic	N/A	*N/A*	N/A

Eaton Metal Products Company LLC
ENGINEERS DESIGNERS FABRICATORS
PETROLEUM EQUIPMENT
(303) 296-4800 FAX: (303) 296-5736

ASME Data Reports

5361-1
Job #
282
Serial #

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

Corrected Copy

Page 1 of 2

1. Manufactured and certified by Eaton Metal Products Company LLC Plant #3, 669 West Quinn Road Building #16, Pocatello, Idaho, 83201
(Name and address of Manufacturer)

2. Manufactured for ANADARKO E&P ONSHORE LLC, UNKOWN, Colorado
(Name and address of Purchaser)

3. Location of Installation Johnstown Compressor Station, Colorado
(Name and address)

4. Type

Horizontal	**282**	N/A	D-5361-1	**274**	2019
(Horizontal or vertical, tank)	(Manufacturer's serial number)	(CRN)	(Drawing number)	(National Board number)	(Year built)

5. ASME Code, Section VIII, Division 1

2017/ N/A	N/A	N/A
[Edition and Addenda, if applicable (date)]	(Code Case numbers)	[Special service per UG-120(d)]

6. Shell:

SA-516-70	.875 in	0 in	11' (OD)	82' 10"
(Material spec. number, grade)	(Nominal thickness)	(Corr. allow.)	(Inner diameter)	[Length (overall)]

Body Flanges on Shells

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

7. Seams:

Type 1, Butt	Full	100	N/A	N/A	Type 1, Butt	Spot	85	8
[Long. (welded, dbl., sngl., lap, butt)]	[R.T.(spot or full)]	(Eff.,%)	(H.T. temp)	(Time, hr)	[Girth. (welded, dbl., sngl., lap, butt)]	[R.T. (spot or full)]	(Eff., %)	(No. of courses)

8. Heads: (a) Material SA-516-70 (Spec. no., grade) (b) Material SA-516-70 (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)	End	.85	0	N/A	N/A	2:1	N/A	N/A	N/A	Concave
(b)	End	.85	N/A	N/A	N/A	2:1	N/A	N/A	N/A	Concave

Body Flanges on Heads

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

9. MAWP 250 psi (Internal) N/A (External) at max. temp. 125 °F (Internal) N/A (External)

Min. design metal temp. -20 °F at 250 psi . Hydro, pneu., or comb. test pressure HYDRO at 325 psi .

Proof test N/A .

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain, etc.)	No.	Diameter or Size	Type	Material		Nozzle Thickness		Reinforcement Material	Attachment Details		Location (Insp. Open.)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
Manway	**3**	**20**	**RF150WN**	**SA-106B**	**SA-105**	**.5**	**0**	**SA-516-70**	**UW-16.1 (d)**	**Butt weld**	**In Shell/ Head**
Inlet/Outlet	**2**	**24**	**RF150WN**	**SA-106B**	**SA-105**	**.5**	**0**	**SA-516-70**	**UW-16.1 (d)**	**Butt weld**	
Various	**3**	**2**	**RF150LWN**	**SA-105**		**.53**	**0**	**Inherent**	**UW-16.1 (d)**		
Various	**3**	**3**	**RF150LWN**	**SA-105**		**1.02**	**0**	**Inherent**	**UW-16.1 (d)**		
Various	**3**	**6**	**RF150LWN**	**SA-105**		**1.245**	**0**	**Inherent**	**UW-16.1 (d)**		
Level Gauge	**1**	**2**	**CPLG6000**	**SA-105**		**.625**	**0**	**Inherent**	**UW-16.1 (d)**		
LAHH	**1**	**4**	**RF150LWN**	**SA-105**		**1.305**	**0**	**Inherent**	**UW-16.1 (d)**		
Boot	**1**	**36**	**RF150WN**	**SA-106B**	**SA-105**	**.5**	**0**	**SA-516-70**	**UW-16.1 (d)**	**Butt weld**	

Additional Nozzles - See Attached U-4...

11. Supports: Skirt **No** (Yes or no) Lugs 0 (Number) Legs 0 (Number) Other **Saddles** (Describe) Attached **Welded to Wear Pad** (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:

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

Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F
Safety Relief Device By Others
(3) 20" RF150BLIND attached to vessel with (20) 1 - 1/8" Full Thread Studs (SA-193-B7) and (40) 1 - 1/8" Heavy Hex Studs (SA-194-2H) each

Manufactured by Eaton Metal Products Company LLC Plant #3, 669 West Quinn Road Building #16, Pocatello, Idaho, 83201
Manufacturer's Serial No. **282** CRN N/A National Board No. **274**

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 32962 expires December 13, 2019 .

Date 07/25/2019 Co. name **Eaton Metal Products Company LLC Plant #3** (Manufacturer) Signed (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by **Eaton Metal Products Company LLC Plant #3** at **669 West Quinn Road Building #16, Pocatello, Idaho, 83201**

I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and employed by The Hartford Steam Boiler Inspection and Insurance Company, of Hartford, CT have inspected the component described in this Manufacturer's Data Report on July 25, 2019 , 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 07/25/2019 Signed (Authorized Inspector) Commissions 14735, UTS0635 (National Board Authorized Inspector Commission number)

5361-1
Job #
282
Serial #

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

Corrected Copy

1. Manufactured and certified by Eaton Metal Products Company LLC Plant #3, 669 West Quinn Road Building #16, Pocatello, Idaho, 83201
(Name and address of Manufacturer)

2. Manufactured for ANADARKO E&P ONSHORE LLC, UNKOWN, Colorado
(Name and address of Purchaser)

3. Location of installation Johnstown Compressor Station, Colorado
(Name and address)

4. Type

Horizontal	N/A	282
(Horizontal, vertical, or sphere)	(Tank, separator, heat exch., etc.)	(Manufacturer's serial number)

N/A	D-5361-1	274	2019
(CRN)	(Drawing number)	(National Board number)	(Year built)

Data Report Item Number	Remarks

Additional 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	
Boot Interface	**1**	**3**	**RF150LWN**	**SA-105**		**.6**	**0**	**Inherent**	**UW-16.1 (d)**		

Certificate of Authorization: Type "U" No. 32962 Expires December 13, 2019

Date 07/25/2019 Name **Eaton Metal Products Company LLC Plant #3**
(Manufacturer)

Signed
(Representative)

Date 07/25/2019 Name
(Authorized Inspector)

Commissions 14735, UTS0635
(National Board Authorized Inspector Commission number)

NB 274

CERTIFIED BY:

EATON METAL PRODUCTS

EATON METAL PRODUCTS COMPANY LLC, PLANT #3

U

W

RT-4

250 psig at 125 °F

MAWP

N/A psig at N/A °F

-20 °F at 250 psig

MDMT

282

Serial Number

2019

Year

EMP JOB 5361-S01

Vessel Tag # V-1000

Anadarko E&P Onshore LLC

P.O. # 4500100246

132" OD x 82'-10" S/S Inlet Slug Catcher

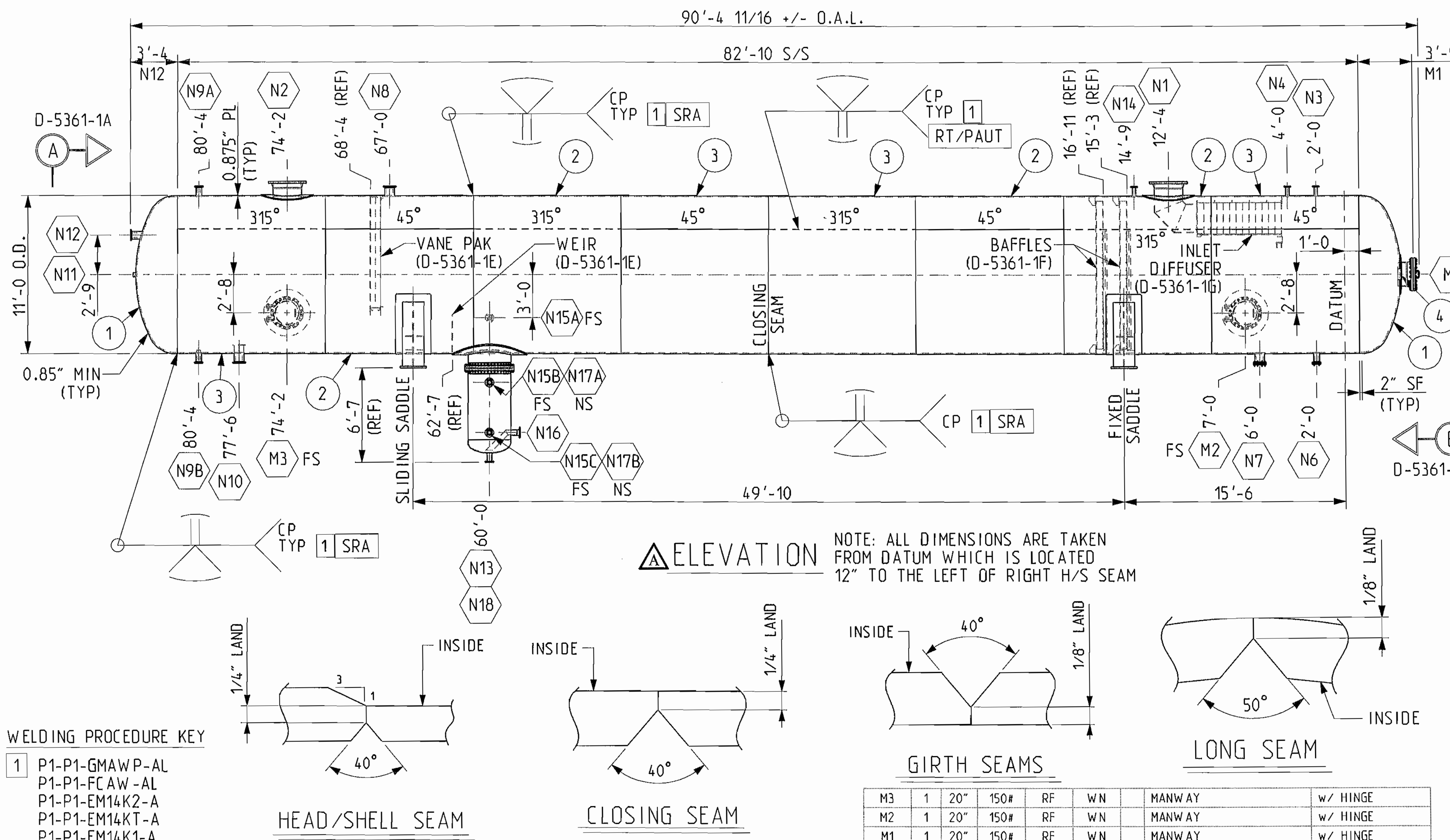
Shell thickness: 0.875"

Head thickness: 0.85" min.

C.A. = 0"

Hydro tested at 325 psig

Fabrication Drawings



ELEVATION

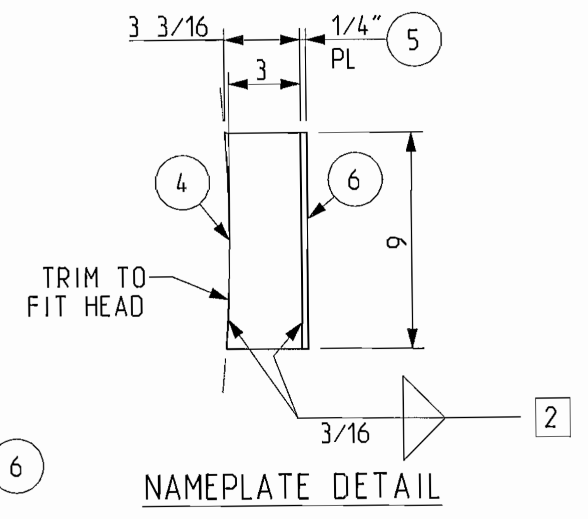
NOTE: ALL DIMENSIONS ARE TAKEN FROM DATUM WHICH IS LOCATED 12" TO THE LEFT OF RIGHT H/S SEAM

HEAD/SHELL SEAM

CLOSING SEAM

GIRTH SEAMS

LONG SEAM



NAMEPLATE DETAIL

SHOP NOTE: ALL INTERNAL WELDS MUST BE SUITABLY PREPPED FOR INTERNAL LINING. ALL SHARP EDGES & ROUGH WELD CONTOURS ARE TO BE ROUNDED/SMOOTHED OUT. POROSITY & WELD SPATTER SHALL BE REMOVED.

WELDING PROCEDURE KEY

1 P1-P1-GMAWP-AL
P1-P1-FCAW-AL
P1-P1-EM14K2-A
P1-P1-EM14KT-A
P1-P1-EM14K1-A

2 P1-P1-FCAW-AL
P1-P1-GMAWP-AL

NDE KEY

SRA SPOT RT OR PAUT REQUIRED ON EVERY GIRTH SEAM

RT/PAUT WELD TO BE 100% EXAMINED BY RT OR PHASED ARRAY UT

SEE DWG D-5361-1A FOR END VIEWS
SEE DWG D-5361-1B FOR SADDLE DETAILS
SEE DWG D-5361-1C FOR MANWAY M1 DETAILS
SEE DWG D-5361-1D & -1DA FOR NOZZLE DETAILS
SEE DWG D-5361-1E FOR VANE PAK & WEIR DETAILS
SEE DWG D-5361-1F & -1FA FOR BAFFLE DETAILS
SEE DWG D-5361-1G & -1GA FOR INLET DIFFUSER DETAILS
SEE DWG D-5361-1H FOR BOOT DETAILS
SEE DWG D-5361-1J FOR MANWAY M2 & M3 DETAILS

CONSTRUCTION : ALL WELDED ASME CODE SECTION VIII DIV. 1			2017 EDITION			
INSPECTED BY : HSB CT						
STAMP REQ'D: YES	SERIAL NO.: LATER		NAT'L BOARD NO.: LATER			
INT DESIGN PRESS:	250	PSIG	INT DESIGN TEMP:	125	°F	
EXT DESIGN PRESS:	N/A	PSIG	EXT DESIGN TEMP:	N/A	°F	
OPERATING PRESS:	130	PSIG	OPERATING TEMP:	60	°F	
MINIMUM DESIGN METAL TEMP:	-20	°F				
RADIOGRAPHY: LONG SEAMS: FULL / GIRTH SEAMS: SPOT PER UW-11(a)(5)(b)						
COMPONENT EFFICIENCY:	HEAD: 1.00		SHELL: 1.00			
CORROSION ALLOWANCE:	HEAD: NONE		SHELL: NONE		NOZZLES: NONE	
STRESS RELIEVE:	NO					
			INTERNAL COATING	PER 5361-PS1		
HYDRO TEST PRESS:	325 PSIG @ 40°F		SURF PREP:			
	HOLD FOR 1 HOUR		COATING:			
EST SHIP WGT:	138000	LBS				
EST OPER WGT:		LBS				
EST TEST WGT:	639000	LBS	EXTERNAL COATING	PER 5361-PS1		
			SURF PREP:			
INSULATION THK:	2"		COATING:			
SPECIFIC GRAVITY:	1.00					
EST CAPACITY:	60000	GALS				

DESIGN DATA

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

Nozzle	Qty	Size	Rating	Flange Face	Flange Type		Service	Remarks
M3	1	20"	150#	RF	WN		MANWAY	w/ HINGE
M2	1	20"	150#	RF	WN		MANWAY	w/ HINGE
M1	1	20"	150#	RF	WN		MANWAY	w/ HINGE
N18	1	3"	150#	RF	LWN		DRAIN (IN BOOT)	
N17A/B	2	3"	150#	RF	LWN		SPARE LEVEL (IN BOOT)	
N16	1	4"	150#	RF	WN		WATER OUTLET (IN BOOT)	w/ INT PIPE
N15B/C	2	3"	150#	RF	LWN		LEVEL GAUGE (IN BOOT)	
N15A	1	3"	150#	RF	WN		LEVEL (BOOT INTERFACE)	
N14	1	2"	150#	RF	LWN		HP DRAIN RECYCLE	
N13	1	36"	150#	RF	WN		BOOT	SERIES "B"
N12	1	4"	150#	RF	LWN		LAHH	
N11	1	2"	6000#	FNPT	CPLG		SPARE	
N10	1	6"	150#	RF	LWN		LIQUID OUTLET (OIL)	w/ V.B.
N9A/B	2	3"	150#	RF	LWN		BRIDLE	w/ STINGER (N9B)
N8	1	6"	150#	RF	LWN		PSV	
N7	1	6"	150#	RF	LWN		DRAIN	w/ BLIND
N6	1	3"	150#	RF	LWN		DRAIN	w/ BLIND
N4	1	2"	150#	RF	LWN		PUMP RECYCLE	
N3	1	2"	150#	RF	LWN		VRU RECYCLE	
N2	1	24"	150#	RF	WN		OUTLET	
N1	1	24"	150#	RF	WN		INLET	w/ DIFFUSER

A NOZZLE SCHEDULE

BILL OF MATERIAL

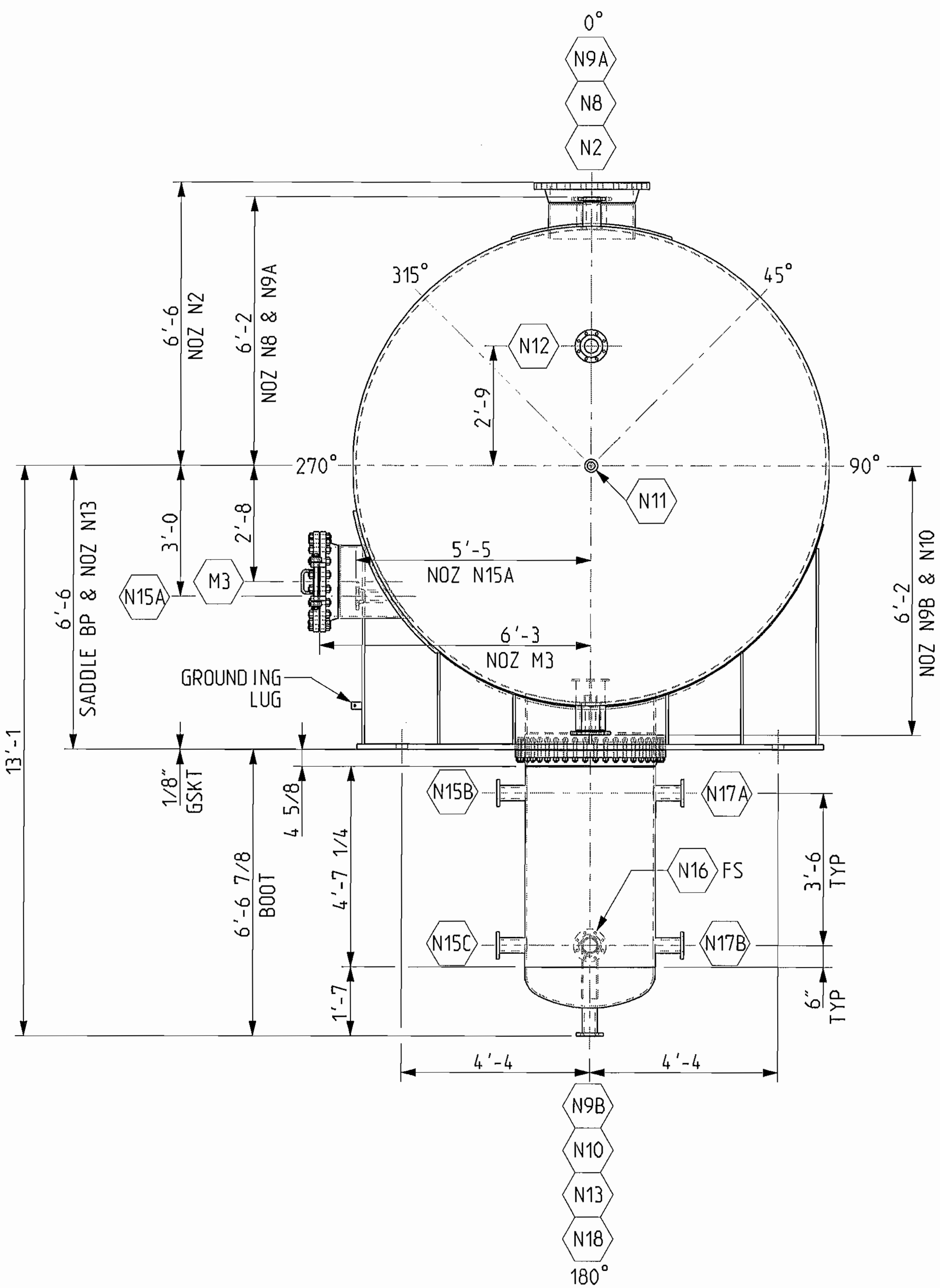
Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
ONE	V-1000		VESSEL	132" OD INLET SLUG CATCHER							
	5361-1-1	2	HEAD	0.85" MIN x 132" OD ASME 2:1 SF=2"				SA-516-70		X	11263
	5361-1-2	4	PLATE	0.875" SHELL, ROLLED	0.875	124.25	411.938	SA-516-70		X	50805
	5361-1-3	4	PLATE	0.875" SHELL, ROLLED	0.875	124.25	411.938	SA-516-70		X	50805
	5361-1-4	1	PLATE	1/4" PLATE SK	0.250	3.188	9	A-36		X	2
	5361-1-5	1	PLATE	1/4" PLATE	0.250	6	9	A-36			4
	5361-1-6	1	NAMEPL	ASME NAMEPLATE (EMP STD)				STN STL			-

No.	Date	By	Chk'd	Revision Description
A	10/23/18	RT	DB	REVISED PER CUSTOMER MARK-UPS

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

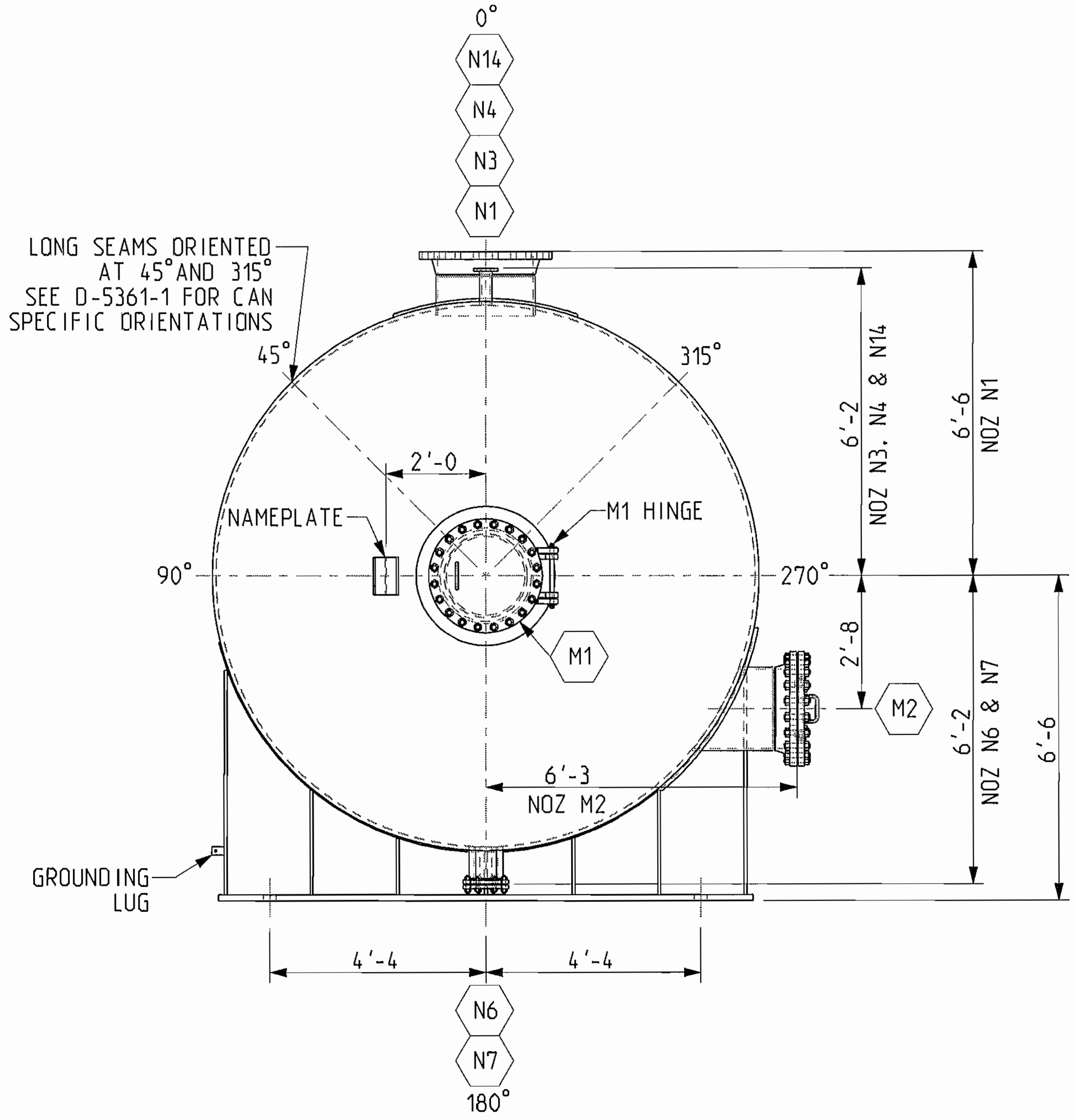
GENERAL ARRANGEMENT
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1
REV A



LEFT END VIEW (A)

D-5361-1



△A RIGHT END VIEW (B)

D-5361-1

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

A	10/23/18	RT	DB	ADDED BLIND FLANGES TO NOZZLES N6 & N7
No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

END VIEWS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

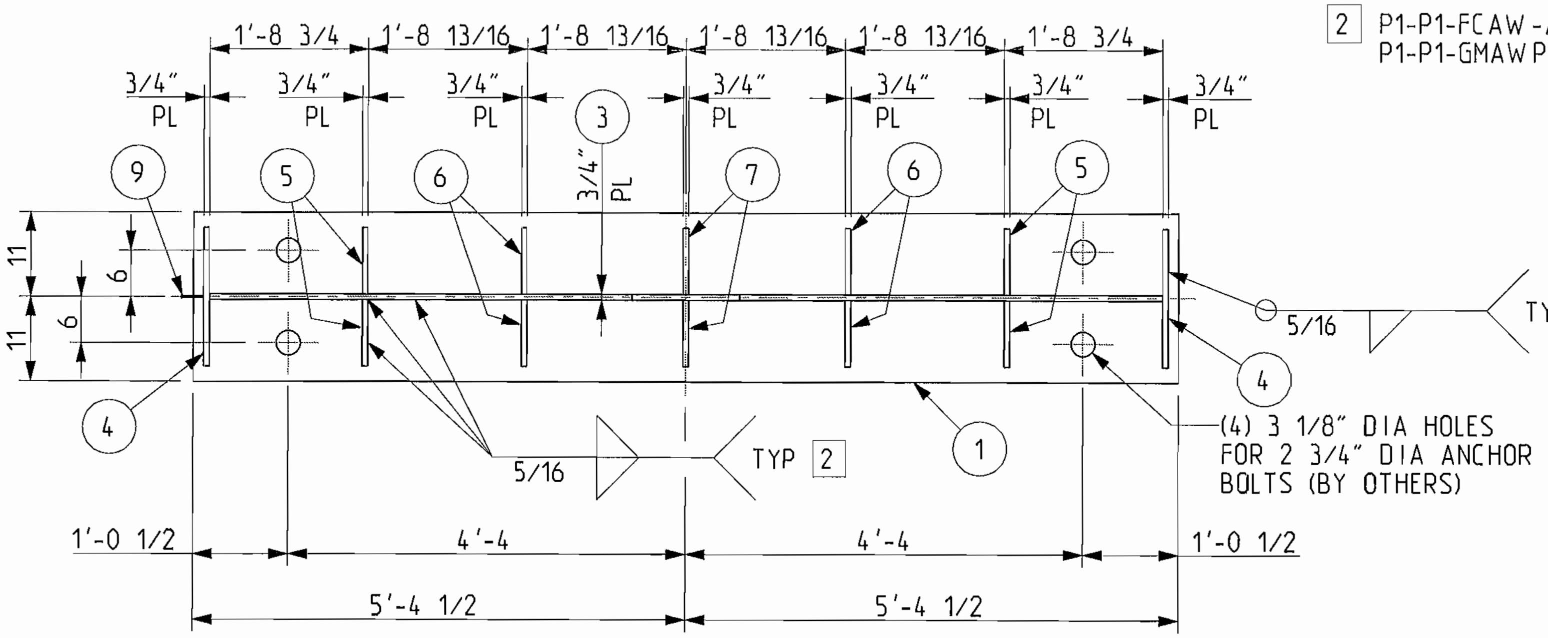
Drawn By:	RT
Date:	9/18/2018
Chk'd By:	DB
Date:	10/5/18

EMP Job No. 5361-S01
Dwg. No. D-5361-1A
REV A

WORK THIS DWG WITH D-5361-1

WELDING PROCEDURE KEY

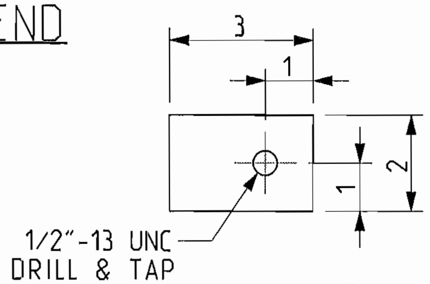
2 P1-P1-FCAW-AL
P1-P1-GMAW P-AL



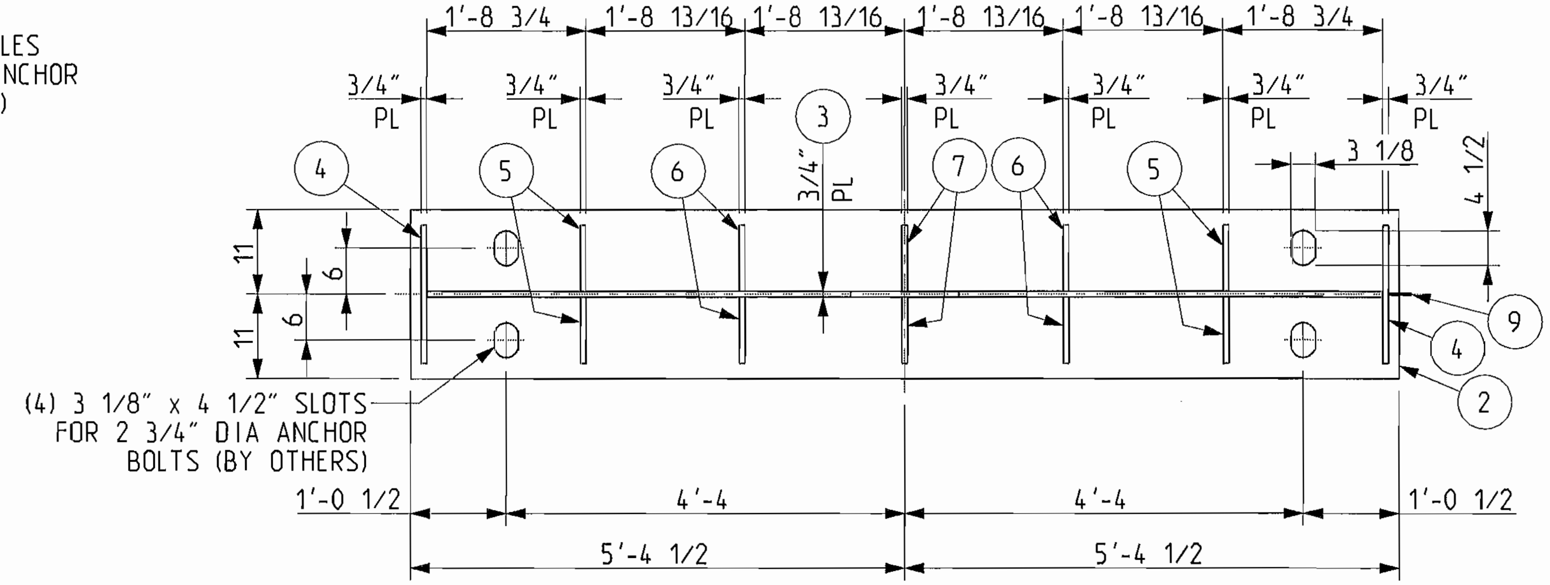
SADDLE BASE PLAN - FIXED END

BILL OF MATERIAL

Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
	5361-1B-1	1	PLATE	1-1/2" BASEPLATE W/ HOLES	1.500	22	129	A-36			1194
	5361-1B-2	1	PLATE	1-1/2" BASEPLATE W/ SLOTS	1.500	22	129	A-36			1187
	5361-1B-3	2	PLATE	3/4" WEB PLATE SKETCH	0.750	53.813	124.75	A-36			1168
	5361-1B-4	4	PLATE	3/4" END PLATE	0.750	18	53.813	A-36			824
	5361-1B-5	8	PLATE	3/4" RIB PLATE	0.750	8.625	25.375	A-36			368
	5361-1B-6	8	PLATE	3/4" RIB PLATE	0.750	8.625	13.688	A-36			199
	5361-1B-7	4	PLATE	3/4" RIB PLATE	0.750	8.625	10.125	A-36			74
	5361-1B-8	2	PLATE	3/8" WEAR PLATE, ROLL	0.375	30	175.688	SA-516-70		X	1121
	5361-1B-9	2	PLATE	1/4" PLATE W/HOLE	0.250	2	3	A-36			-

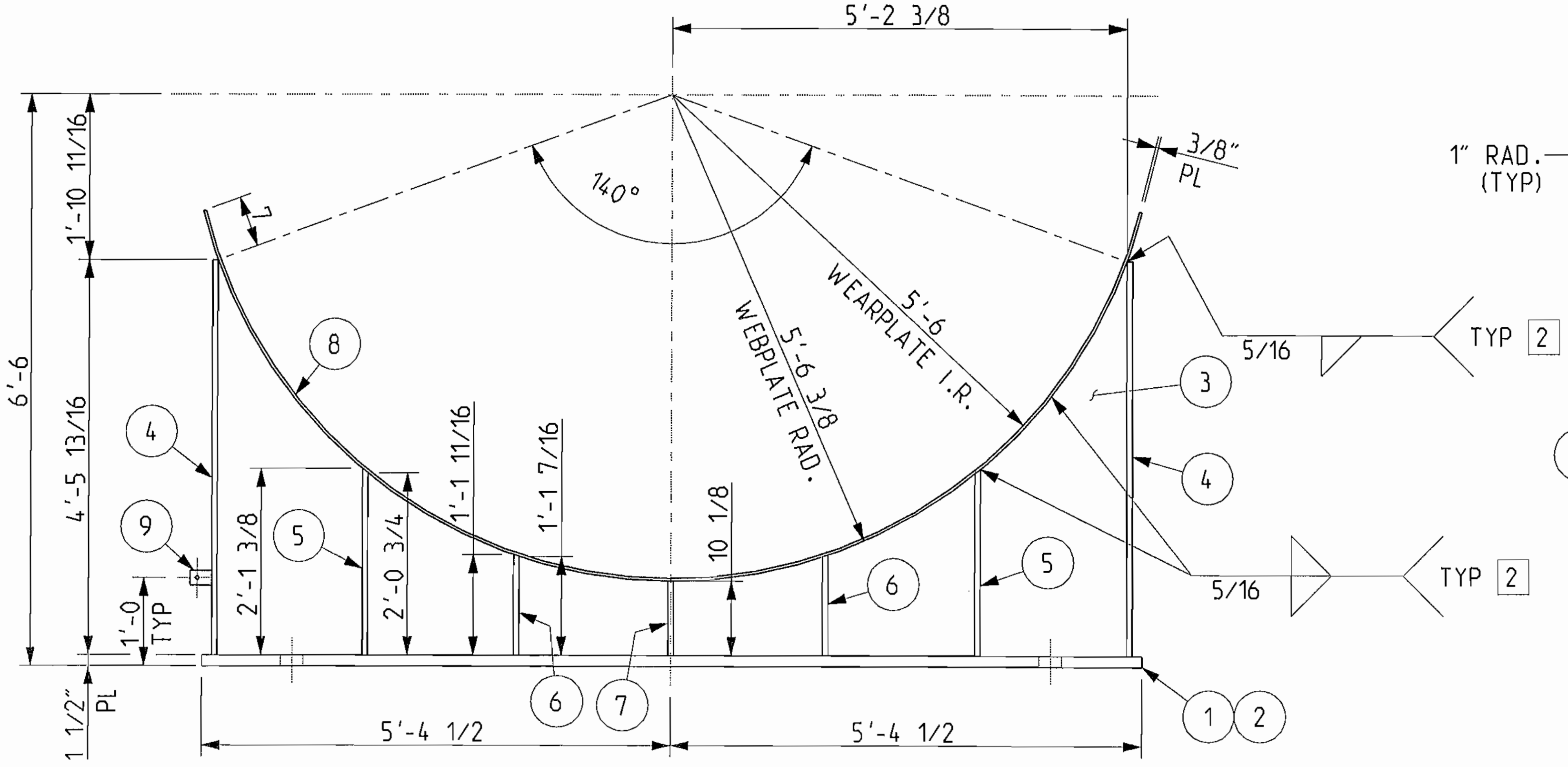


DETAIL 9

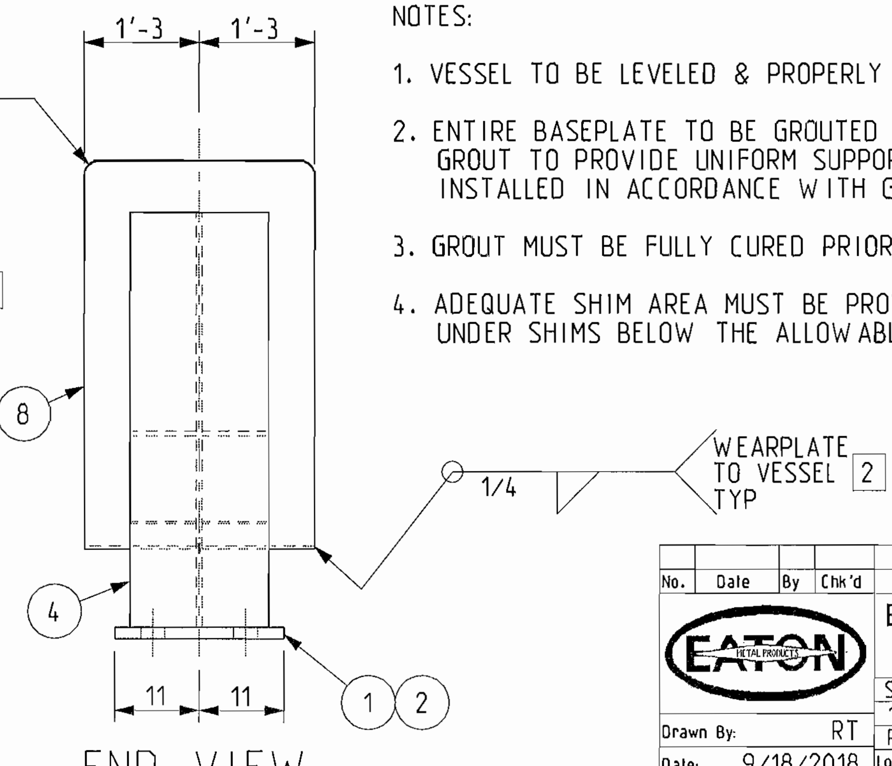


SADDLE BASE PLAN - SLIDING END

SEE FIXED END FOR WELDING DETAILS



SADDLE ELEVATION



END VIEW

WORK THIS DWG WITH D-5361-1 & -1A

NOTES:

1. VESSEL TO BE LEVELED & PROPERLY SHIMMED UNDER BOTH BASEPLATES.
2. ENTIRE BASEPLATE TO BE GROUTED USING HIGH QUALITY NON-SHRINK GROUT TO PROVIDE UNIFORM SUPPORT UNDER ENTIRE BASE. GROUT TO BE INSTALLED IN ACCORDANCE WITH GROUT MANUFACTURER'S INSTRUCTIONS.
3. GROUT MUST BE FULLY CURED PRIOR TO LOADING VESSEL WITH CONTENTS.
4. ADEQUATE SHIM AREA MUST BE PROVIDED TO KEEP CONCRETE STRESSES UNDER SHIMS BELOW THE ALLOWABLE PRIOR TO GROUTING.

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

SADDLE DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18

EMP Job No. 5361-S01
Dwg. No. D-5361-1B
REV

SHOP NOTE: ALL INTERNAL WELDS MUST BE SUITABLY PREPPED FOR INTERNAL LINING. ALL SHARP EDGES & ROUGH WELD CONTOURS ARE TO BE ROUNDED/SMOOTHED OUT. POROSITY & WELD SPATTER SHALL BE REMOVED.

✱ REPAD NOTE:
1/4" NPT TELL-TALE HOLE LOCATED AT LOWEST POINT WHEN INSTALLED

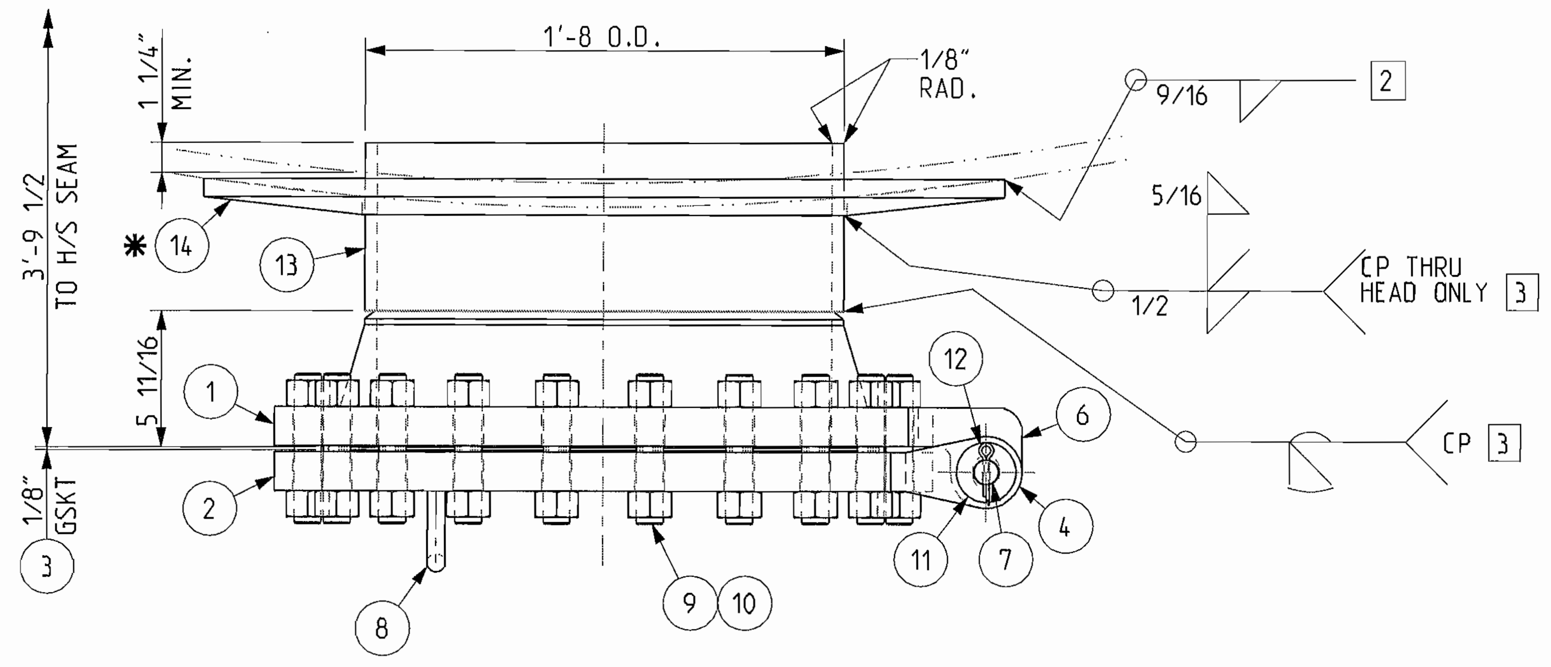
WELDING PROCEDURE KEY

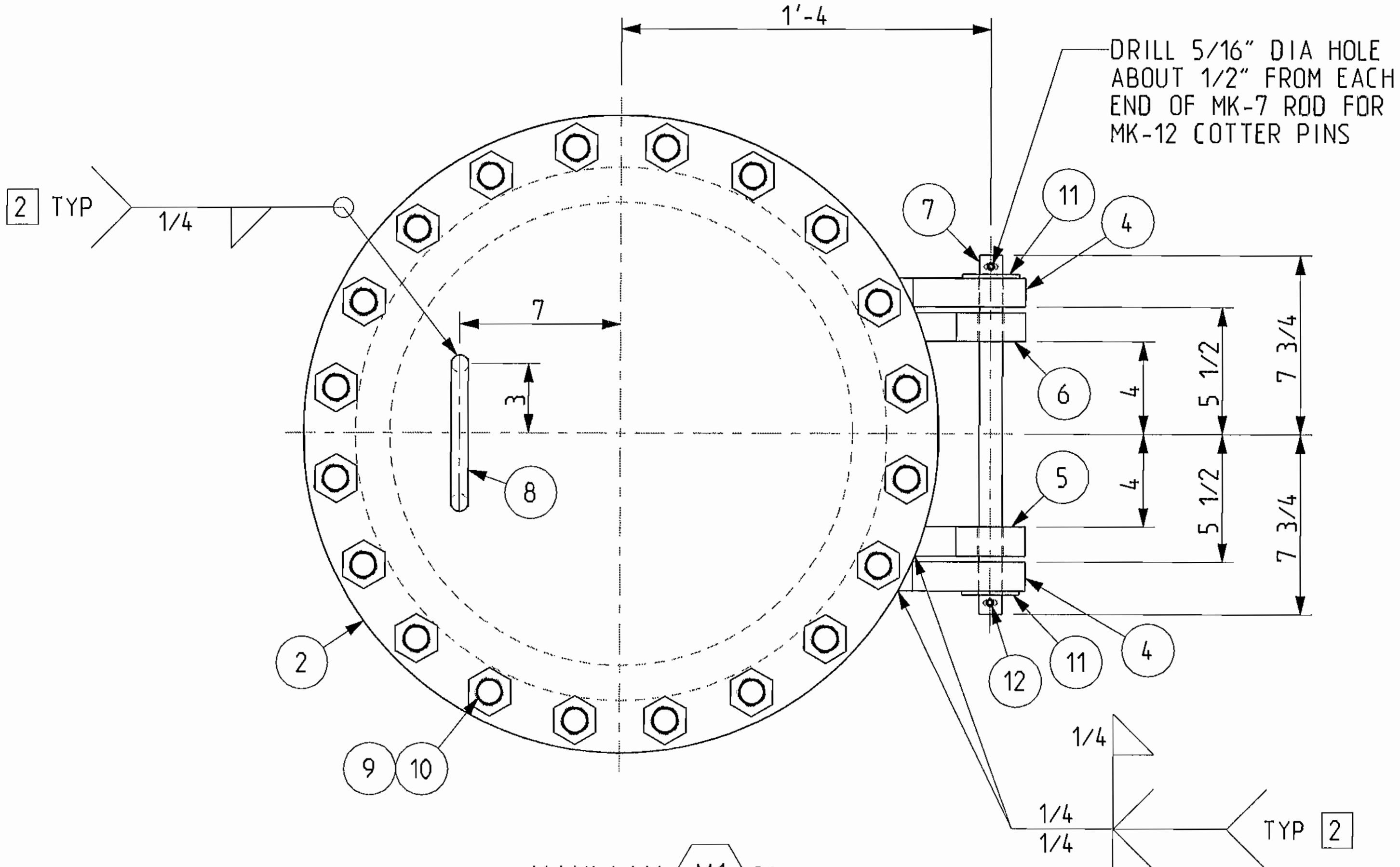
2 P1-P1-FCAW-AL
P1-P1-GMAWP-AL

3 P1-P1-GMAWP-AL
P1-P1-FCAW-AL
P1-P1-EM14K1-A

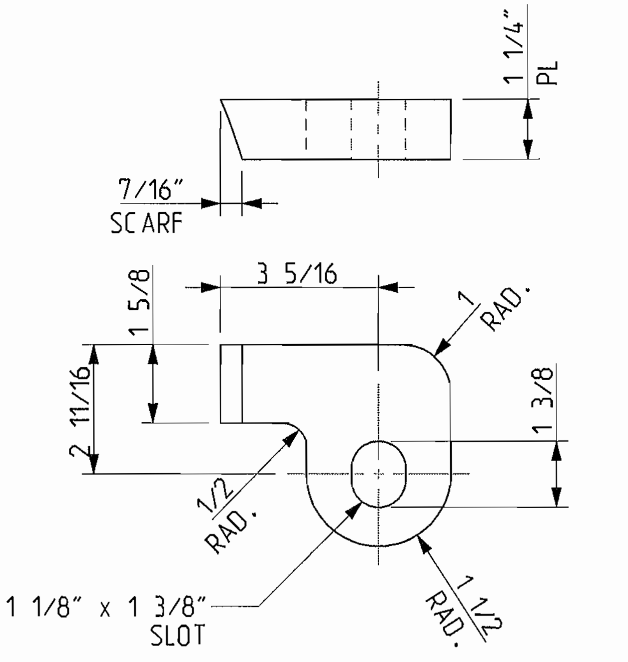
BILL OF MATERIAL

Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
	5361-1C-1	1	FLANGE	20" - 150# RFWN XH BORE				SA-105		X	199
	5361-1C-2	1	FLANGE	20" - 150# RF BLIND				SA-105		X	271
	5361-1C-3	1	GASKET	1/8" - 20" - 150# RING TYPE KLINGERSIL C-4401				KLINGERSIL			1
	5361-1C-4	2	PLATE	1-1/4" SKETCH PL W/ HOLE	1.250	3	5.5	A-36		X	8
	5361-1C-5	1	PLATE	1-1/4" SKETCH PL W/ SLOT	1.250	4.188	4.813	A-36		X	5
	5361-1C-6	1	PLATE	1-1/4" SKETCH PL W/ SLOT	1.250	4.188	4.813	A-36		X	5
	5361-1C-7	1	ROD	1" DIA ROD W/ HOLES			15.5	A-36			3
	5361-1C-8	1	ROD	3/4" DIA ROD, BEND			12	A-36		X	1
	5361-1C-9	20	STUD	1-1/8" DIA FULL THREAD			6.25	SA-193-B7			35
	5361-1C-10	40	NUT	1-1/8" HEAVY HEX				SA-194-2H			23
	5361-1C-11	2	WASHER	1" STANDARD ROUND				STEEL			-
	5361-1C-12	2	COTTER	1/4" DIA COTTER PIN			1.5	STEEL			-
	5361-1C-13	1	PIPE	20" NOM XH	0.500		8	SA-106-B		X	69
	5361-1C-14	1	PLATE	3/4" CIRC PL 20.25" ID x 33.5" OD	0.750	SHOP TO FORM		SA-516-70		X	119



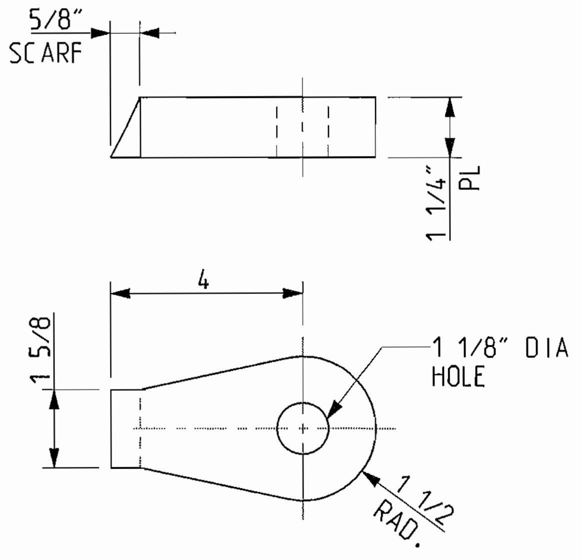


MANWAY M1 20"

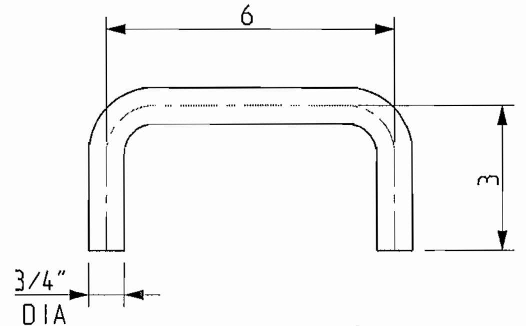


DETAIL 5 (AS SHOWN)

DETAIL 6 (OPP HAND)



DETAIL 4



DETAIL 8

WORK THIS DWG WITH D-5361-1 & -1A

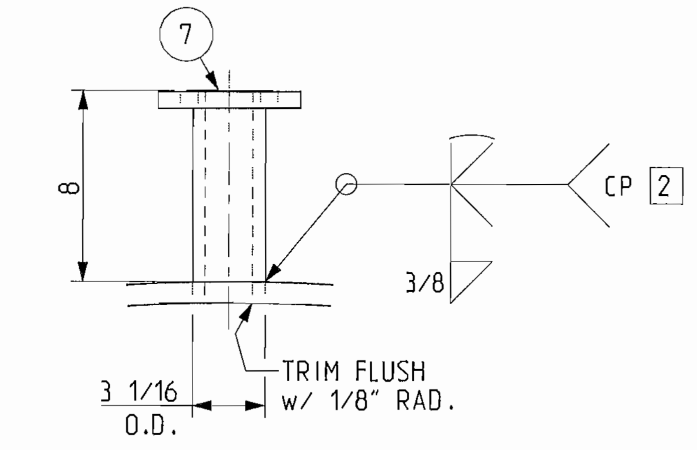
APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

MANWAY M1 DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1C
REV



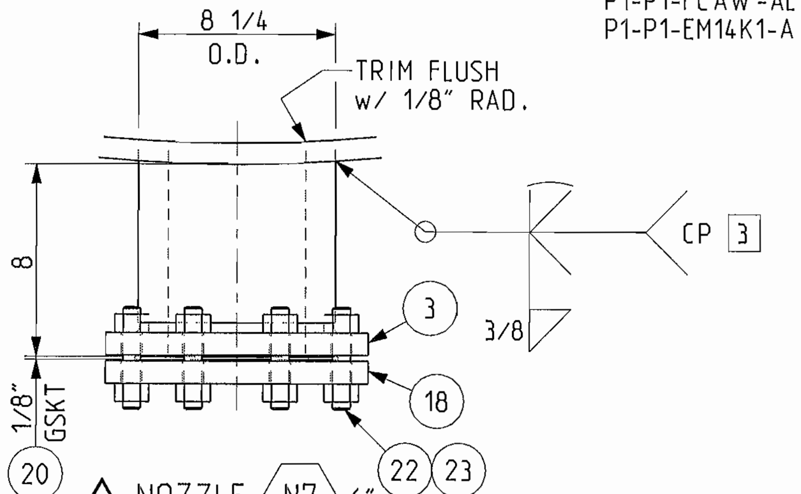
NOZZLE N3 N4 N14 2"

SHOP NOTE: ALL INTERNAL WELDS MUST BE SUITABLY PREPPED FOR INTERNAL LINING. ALL SHARP EDGES & ROUGH WELD CONTOURS ARE TO BE ROUNDED/SMOOTHED OUT. POROSITY & WELD SPATTER SHALL BE REMOVED.

WELDING PROCEDURE KEY

2 P1-P1-FCAW-AL
P1-P1-GMAWP-AL

3 P1-P1-GMAWP-AL
P1-P1-FCAW-AL
P1-P1-EM14K1-A

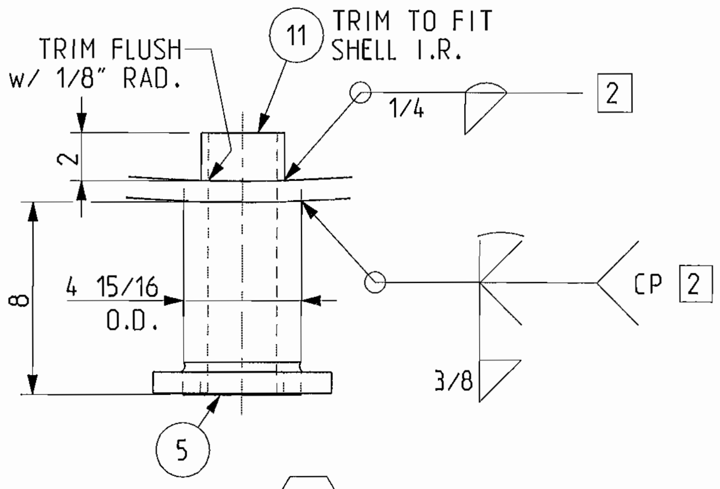


A NOZZLE N7 6"
w/ BLIND

NOZZLE N8 6"
MK-3 ONLY

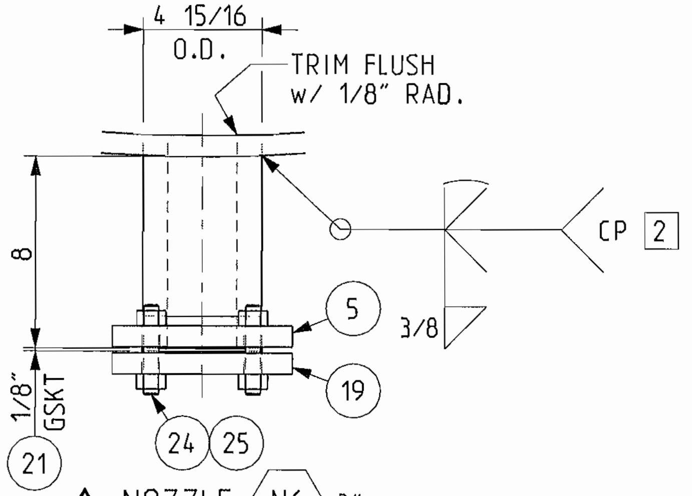
A BILL OF MATERIAL

Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
	5361-1D-1	1	FLANGE	36" - 150# SERIES "B" RFWN XH BORE (35" I.D.)				SA-105		X	270
	5361-1D-2	2	FLANGE	24" - 150# RFWN XH BORE				SA-105		X	542
	5361-1D-3	3	FLANGE	6" - 150# RF HB LWN NS			9	SA-105		X	239
	5361-1D-4	1	FLANGE	4" - 150# RF HB LWN NS			12.25	SA-105		X	80
	5361-1D-5	3	FLANGE	3" - 150# RF HB LWN NS			9	SA-105		X	114
	5361-1D-6	1	FLANGE	3" - 150# RFWN XXH BORE				SA-105		X	13
	5361-1D-7	3	FLANGE	2" - 150# RF LWN			9	SA-105		X	44
	5361-1D-8	1	COUPLING	2" - 6000# FULL SCRD			3.375	SA-105		X	8
	5361-1D-9	2	PIPE	24" NOM XH	0.500		9.5	SA-106-B		X	199
	5361-1D-10	1	PIPE	3" NOM XXH	0.600		10	SA-106-B		X	16
	5361-10-11	1	PIPE	3" NOM XH, SKETCH	0.300		2	SA-106-B		X	2
	5361-1D-12	1	PLATE	1/2" PLATE, ROLLED w/4" TANS	0.500	10.938	119.5	SA-516-70		X	173
	5361-1D-13	1	PLATE	CIRC 36.25 ID x 63 OD ROLL	1.000			SA-516-70		X	616
	5361-1D-14	2	PLATE	CIRC 24.25 ID x 44.5 OD ROLL	0.750			SA-516-70		X	474
	5361-1D-15	1	PLATE	PLATE CIRC 10.50" DIA	0.500			A-36			12
	5361-1D-16	1	PLATE	1/2" PLATE (VORTEX BRK)	0.500	6	8	SA-516-70		X	7
	5361-1D-17	2	PLATE	1/2" SKETCH PL (VORTEX BRK)	0.500	3.75	6	SA-516-70		X	6
	5361-1D-18	1	FLANGE	6" - 150# RF BLIND				SA-105		X	25
	5361-1D-19	1	FLANGE	3" - 150# RF BLIND				SA-105		X	11
	5361-1D-20	1	GASKET	1/8" - 6" - 150#, RING TYPE, C-4401				KLINGERSIL			1
	5361-1D-21	1	GASKET	1/8" - 3" - 150#, RING TYPE, C-4401				KLINGERSIL			-
	5361-1D-22	8	STUD	3/4" DIA. FULL THREAD			4.25	SA-193-B7			4
	5361-1D-23	16	NUT	3/4" HEAVY HEX				SA-194-2H			3
	5361-1D-24	4	STUD	5/8" DIA. FULL THREAD			3.75	SA-193-B7			1
	5361-1D-25	8	NUT	5/8" HEAVY HEX				SA-194-2H			-

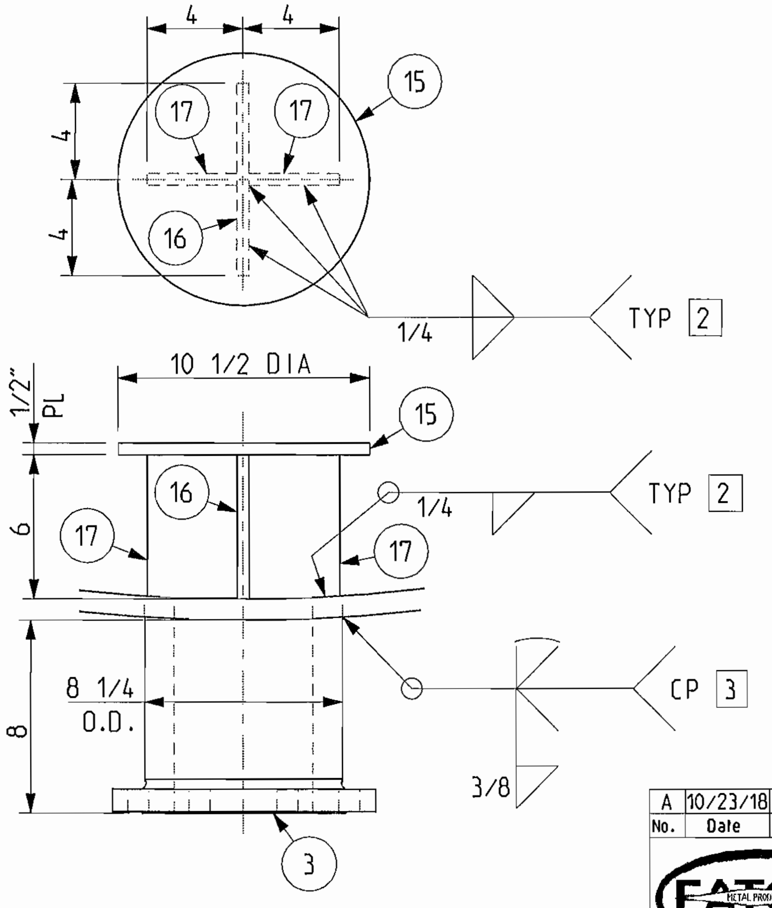


NOZZLE N9B 3"
w/ 2" STINGER

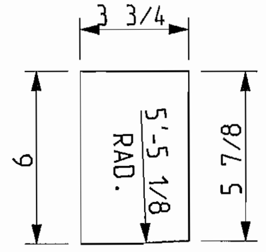
A NOZZLE N9A 3"
MK-5 ONLY



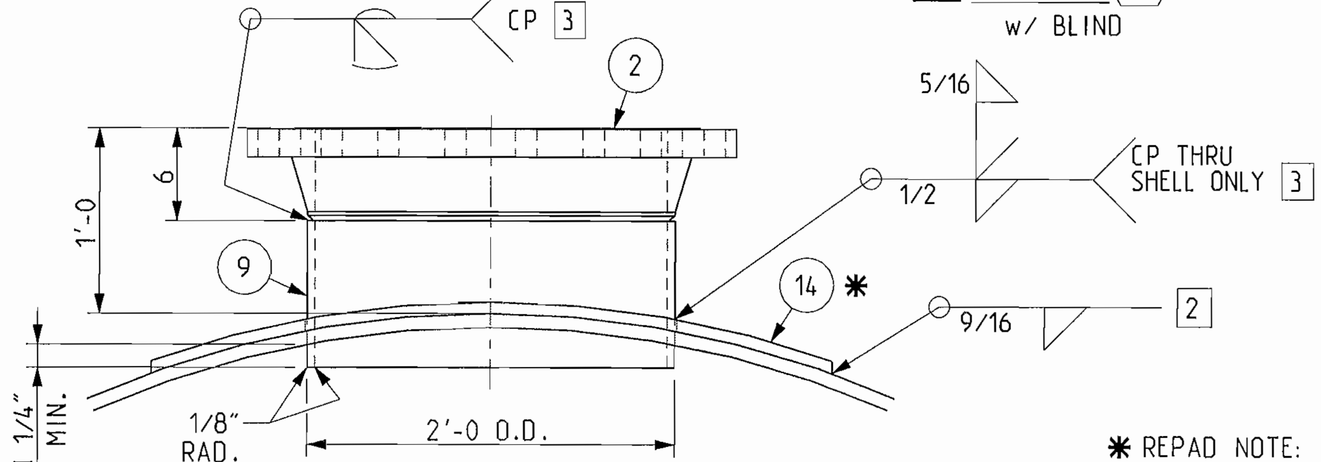
A NOZZLE N6 3"
w/ BLIND



NOZZLE N10 6"
w/ VORTEX BREAK



DETAIL 17
1/2" PL



NOZZLE N1 N2 24"

✱ REPAD NOTE:
1/4" NPT TELL-TALE HOLE
LOCATED AT LOWEST POINT
WHEN INSTALLED

WORK THIS DWG WITH D-5361-1, -1A & -1DA

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

No.	Date	By	Chk'd	Revision Description
A	10/23/18	RT	DB	ADDED BLIND FLANGES TO NOZZLES N6 & N7

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

NOZZLE DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1D
REV A

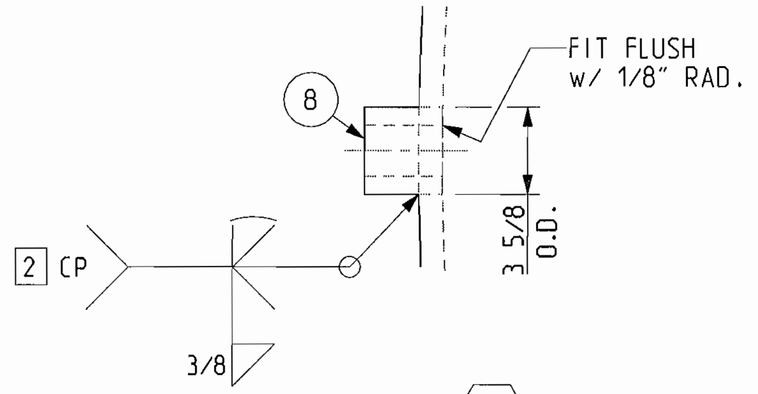
WELDING PROCEDURE KEY

2 P1-P1-FCAW-AL
P1-P1-GMAWP-AL

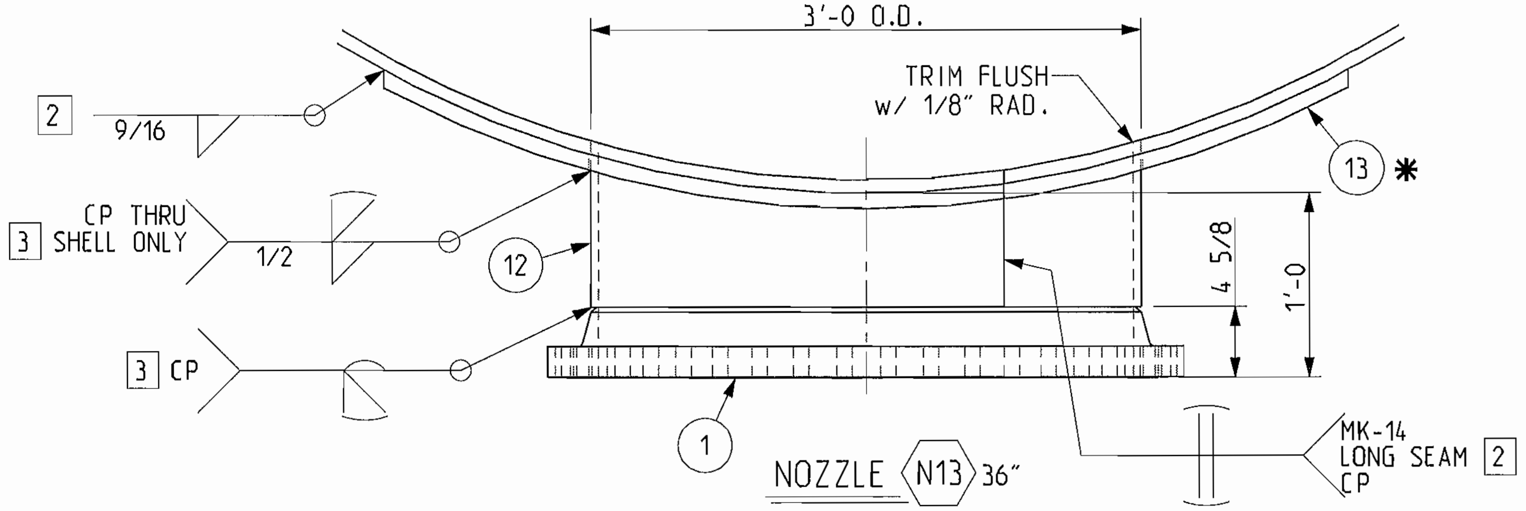
3 P1-P1-GMAWP-AL
P1-P1-FCAW-AL
P1-P1-EM14K1-A

4 P1-P1-FCAW-AL
P1-P1-GTAW-AL
P1-P1-GMAWP-AL
P1-P1-GMAWP-STT-A

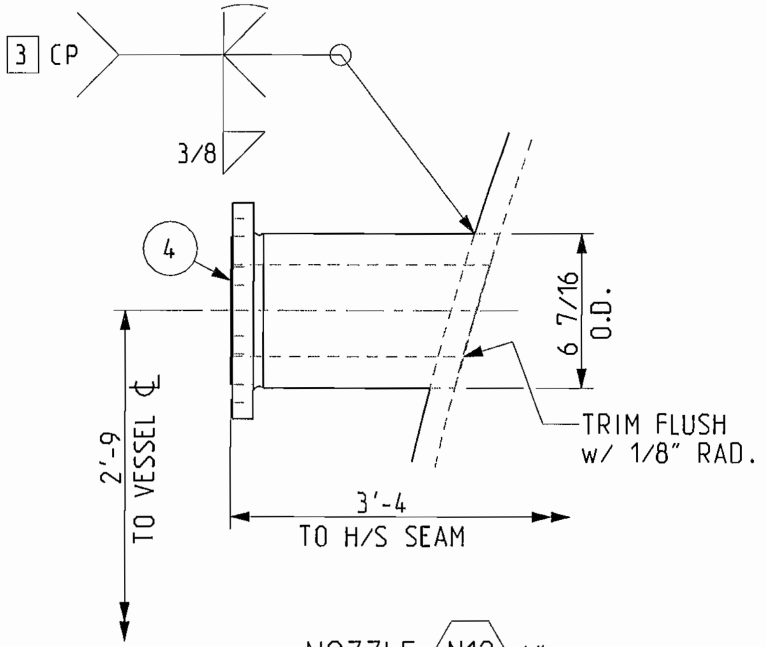
✱ REPAD NOTE:
1/4″ NPT TELL-TALE HOLE
LOCATED AT LOWEST POINT
WHEN INSTALLED



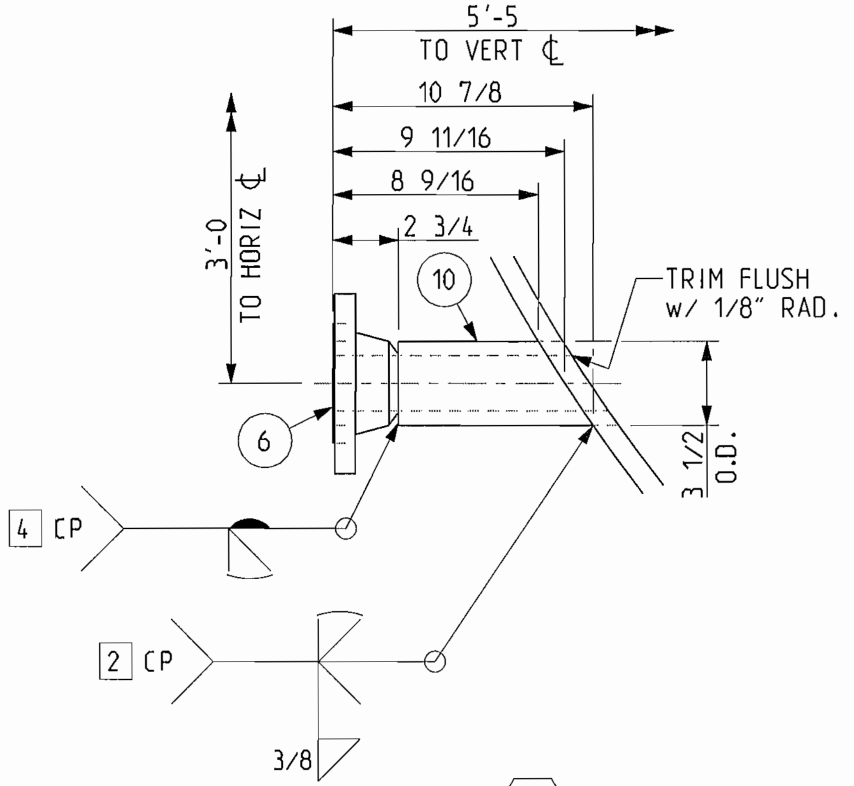
NOZZLE N11 2″



NOZZLE N13 36″



NOZZLE N12 4″



NOZZLE N15A 3″

SHOP NOTE: ALL INTERNAL WELDS MUST BE SUITABLY PREPPED FOR INTERNAL LINING. ALL SHARP EDGES & ROUGH WELD CONTOURS ARE TO BE ROUNDED/SMOOTHED OUT. POROSITY & WELD SPATTER SHALL BE REMOVED.

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

WORK THIS DWG WITH D-5361-1, -1A & -1D

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

NOZZLE DETAILS
132″ OD x 82'-10″ S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18

EMP Job No. 5361-S01
Dwg. No. D-5361-1DA
REV

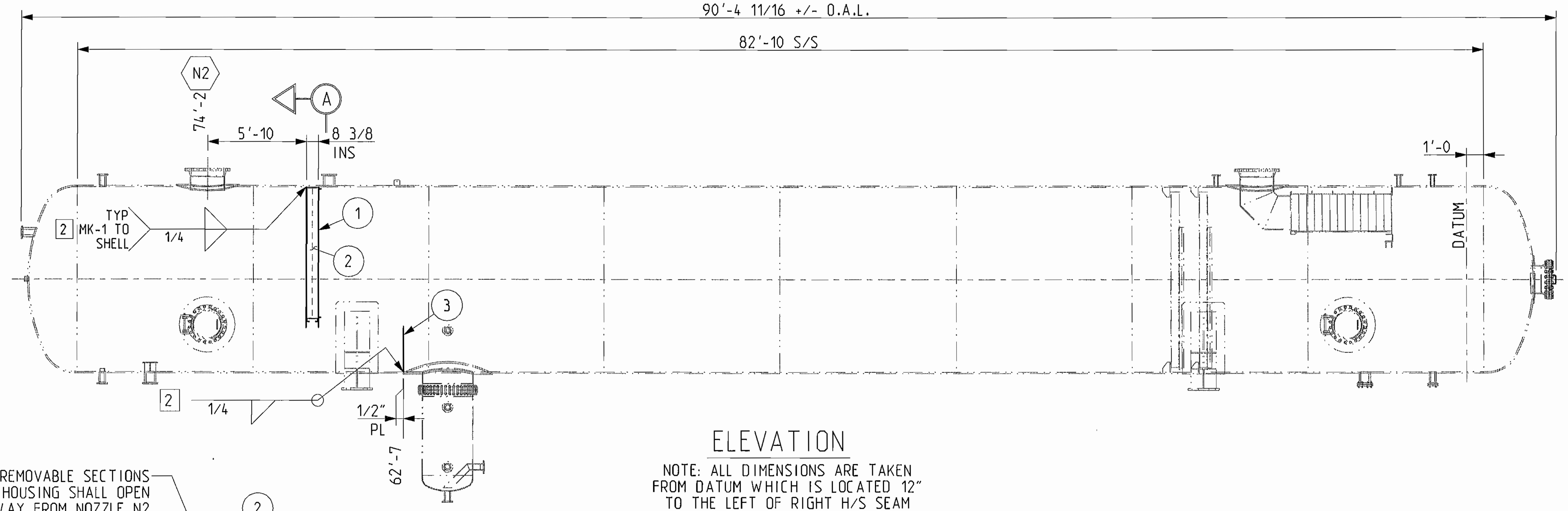
SHOP NOTE: INSTALL MK-2 VANE PAK
SO THAT FLOW DISTRIBUTOR IS
POINTED TOWARDS NOZZLE N2

WELDING PROCEDURE KEY

2 P1-P1-FCAW-AL
P1-P1-GMAWP-AL

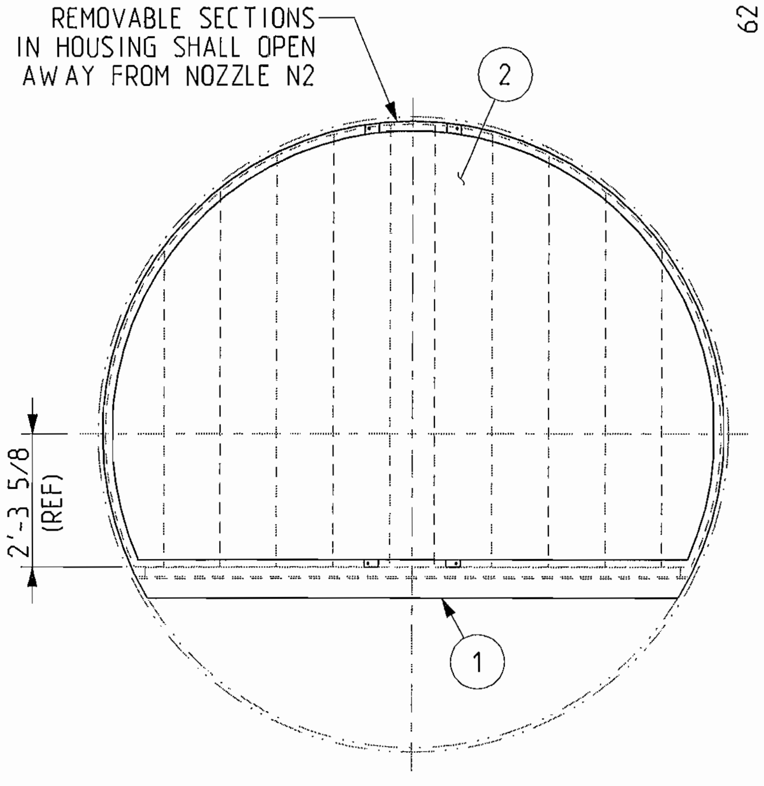
BILL OF MATERIAL

Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
	5361-1E-1	1	HOUSING	VANE PAK HOUSING (BY AMACS)				SA-516-70		X	393
	5361-1E-2	1	VANE PAK	VANE PAK W/ DISTRIBUTOR (BY AMACS)				304L SS			500
	5361-1E-3	1	PLATE	1/2" WEIR PLATE, SKETCH	0.500	32	112.125	SA-516-70		X	360

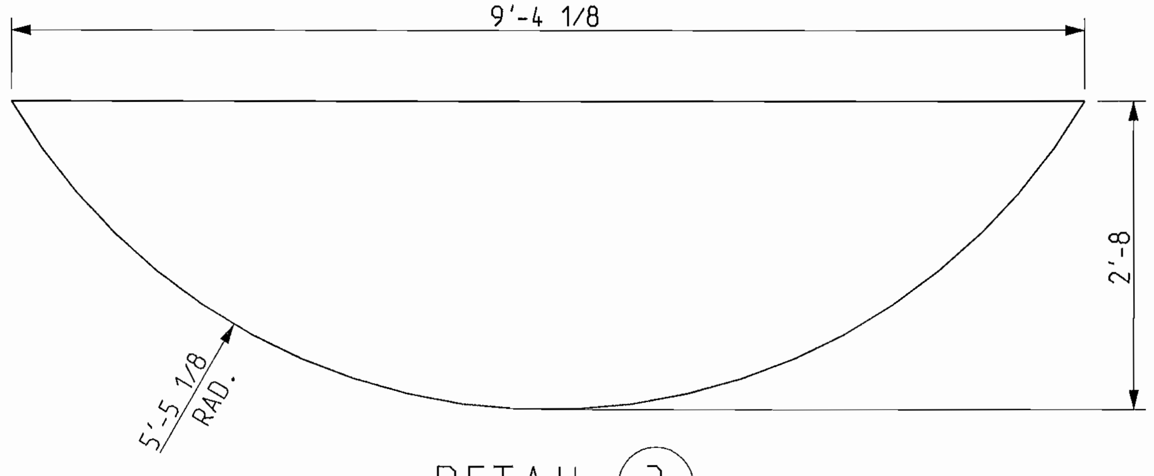


ELEVATION

NOTE: ALL DIMENSIONS ARE TAKEN
FROM DATUM WHICH IS LOCATED 12"
TO THE LEFT OF RIGHT H/S SEAM



SECT Ⓐ



DETAIL ③

1/2" PL

SHOP NOTE: ALL INTERNAL WELDS MUST BE
SUITABLY PREPPED FOR INTERNAL LINING.
ALL SHARP EDGES & ROUGH WELD CONTOURS
ARE TO BE ROUNDED/SMOOTHED OUT.
POROSITY & WELD SPATTER SHALL BE REMOVED.

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

VANE PAK & WEIR DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1E
REV

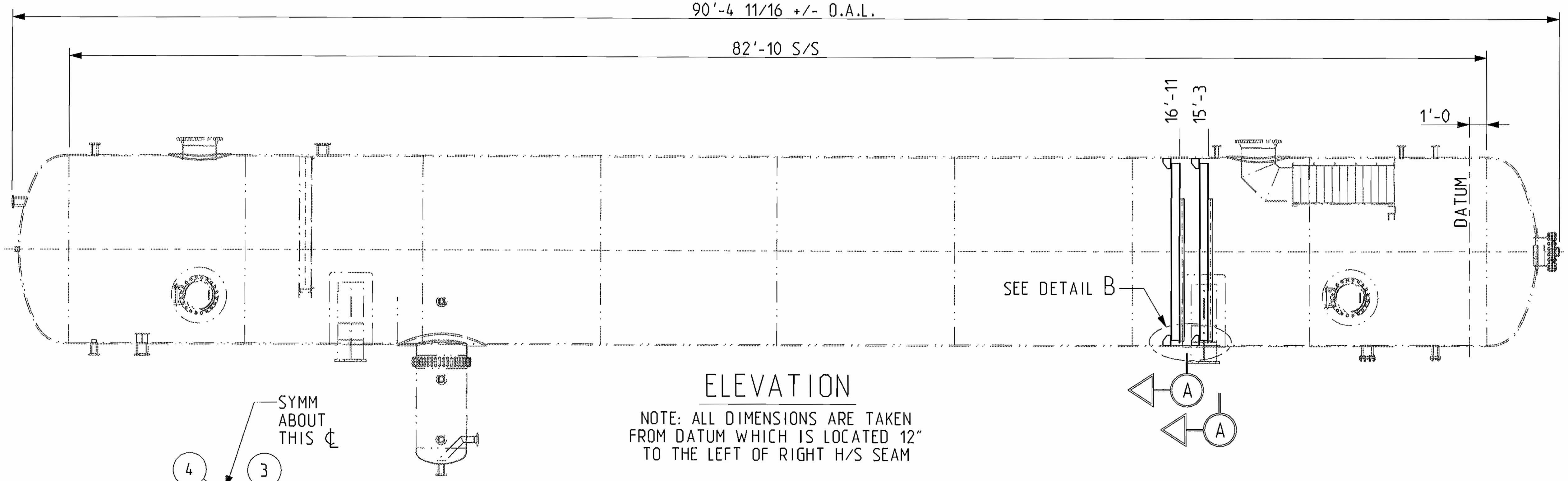
WORK THIS DWG WITH D-5361-1 & -1A

WELDING PROCEDURE KEY

- 5 P1-P8-FCAW-AL
  P1-P8-GMAWP-A
  P1-P8-GTAW-AL
- 6 P8-P8-GMAWP-A
  P8-P8-GTAW-AL
  P8-P8-SMAW-A

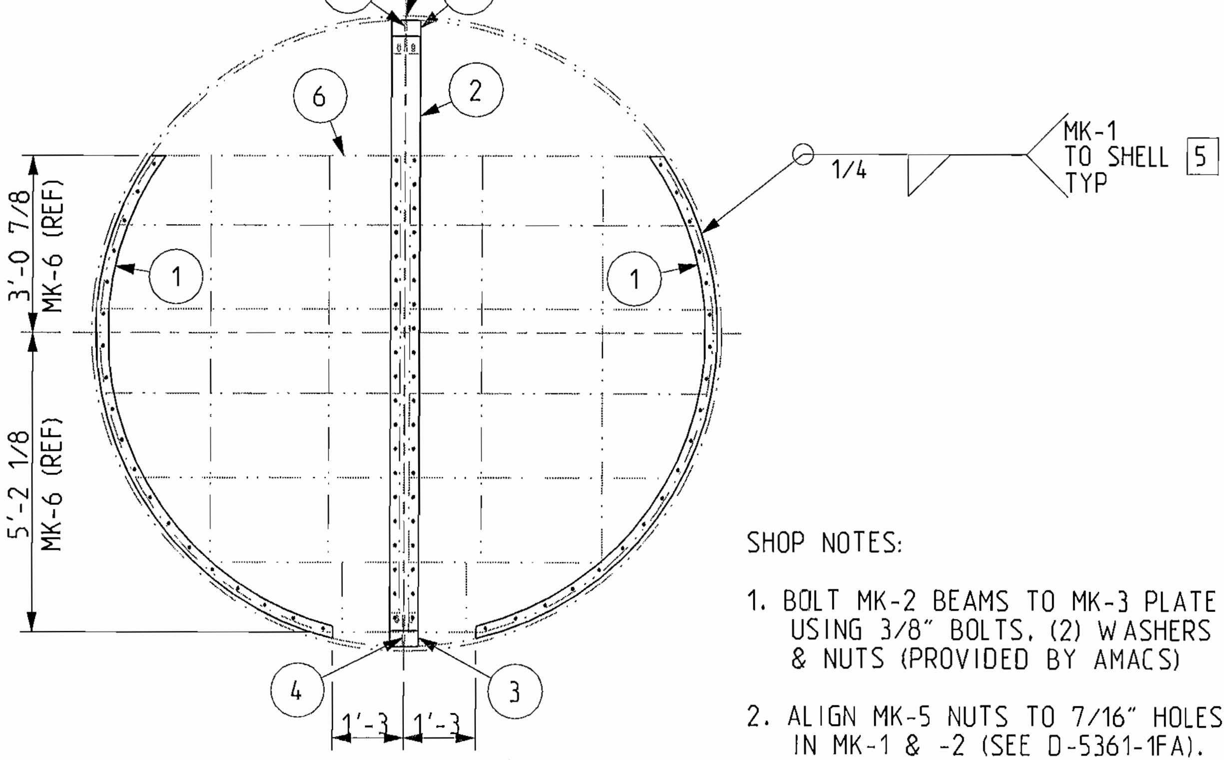
BILL OF MATERIAL

Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
	5361-1F-1	4	PLATE	1/2" PLATE, SKETCH W/HOLES	0.500	50.125	100.25	SA-240-304		X	175
	5361-1F-2	2	BEAM	W6 x 20 W/HOLES & SLOTS			123.5	304 SS			412
	5361-1F-3	4	PLATE	1/2" PLATE, SKETCH W/HOLES	0.500	6	7	SA-240-304		X	23
	5361-1F-4	4	PLATE	1/2" PLATE, SKETCH	0.500	5.25	7	SA-240-304		X	17
	5361-1F-5	156	NUT	3/8" HEAVY HEX				304 SS			5
	5361-1F-6	2	BAFFLE	DISTRIBUTION BAFFLE (BY AMACS)				304L SS			900



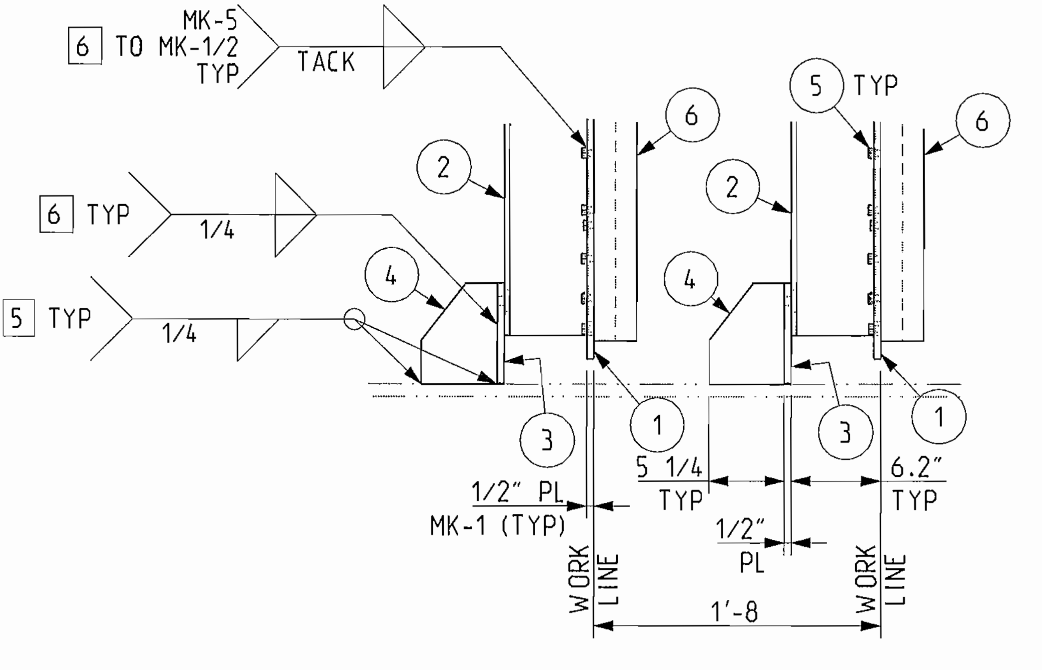
ELEVATION

NOTE: ALL DIMENSIONS ARE TAKEN FROM DATUM WHICH IS LOCATED 12" TO THE LEFT OF RIGHT H/S SEAM



SECT A

TYP (2) PLACES



DETAIL "B"

SHOP NOTES:

1. BOLT MK-2 BEAMS TO MK-3 PLATE USING 3/8" BOLTS, (2) WASHERS & NUTS (PROVIDED BY AMACS)
2. ALIGN MK-5 NUTS TO 7/16" HOLES IN MK-1 & -2 (SEE D-5361-1FA). BOLT MK-6 BAFFLE TO MK-1 RING AND MK-2 BEAM USING 3/8" BOLTS & WASHERS (PROVIDED BY AMACS)

SHOP NOTE: ALL INTERNAL WELDS MUST BE SUITABLY PREPPED FOR INTERNAL LINING. ALL SHARP EDGES & ROUGH WELD CONTOURS ARE TO BE ROUNDED/SMOOTHED OUT. POROSITY & WELD SPATTER SHALL BE REMOVED.

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

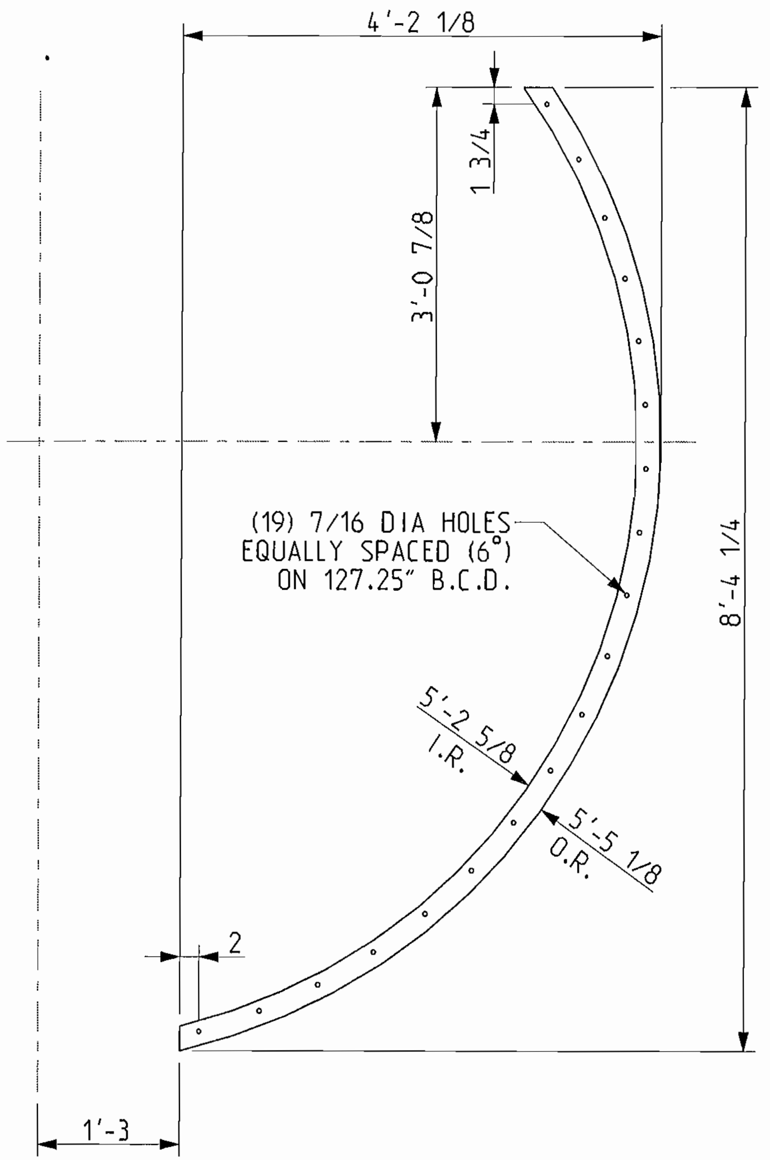
WORK THIS DWG WITH D-5361-1, -1A & -1FA

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

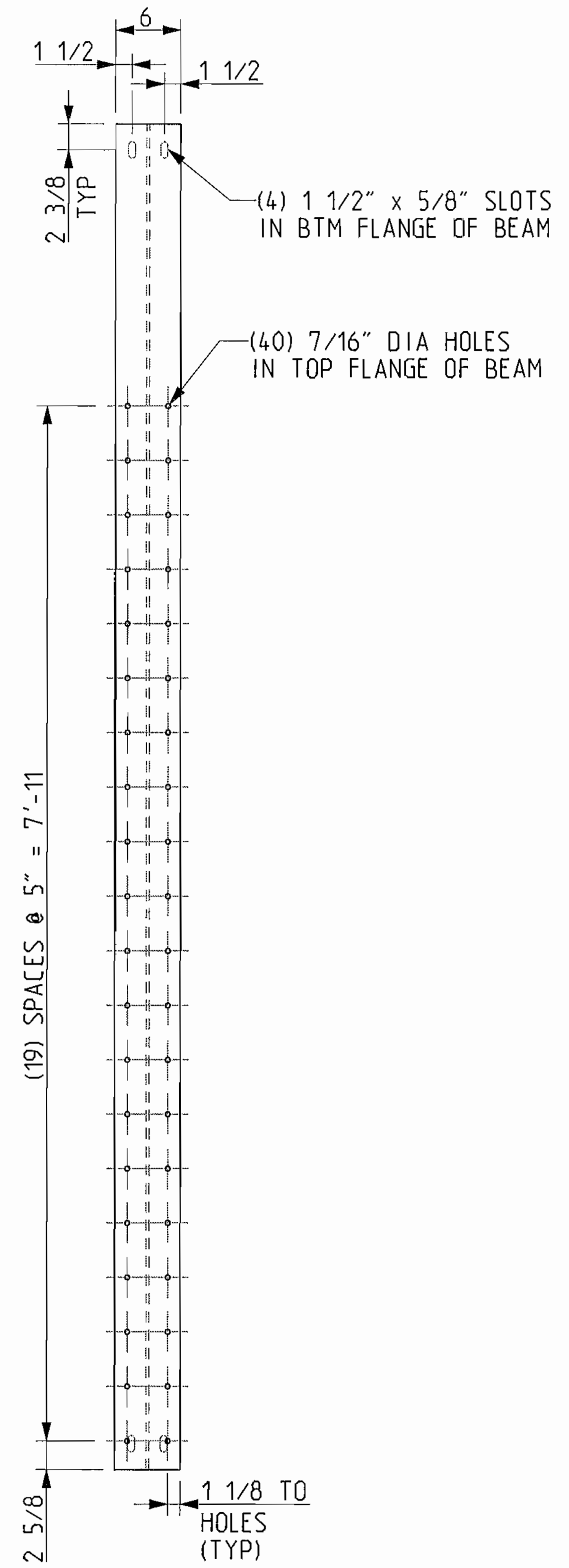
Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18

BAFFLE DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC
EMP Job No. 5361-S01
Dwg. No. D-5361-1F
REV

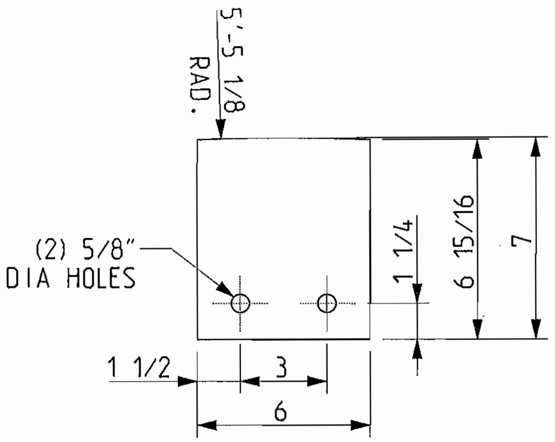


DETAIL ①

1/2" PL

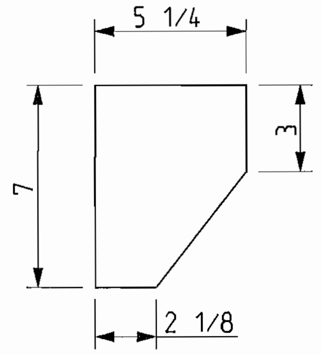


DETAIL ②



DETAIL ③

1/2" PL



DETAIL ④

1/2" PL

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

WORK THIS DWG WITH D-5361-1F

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY
BAFFLE DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC
Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1FA
Rev

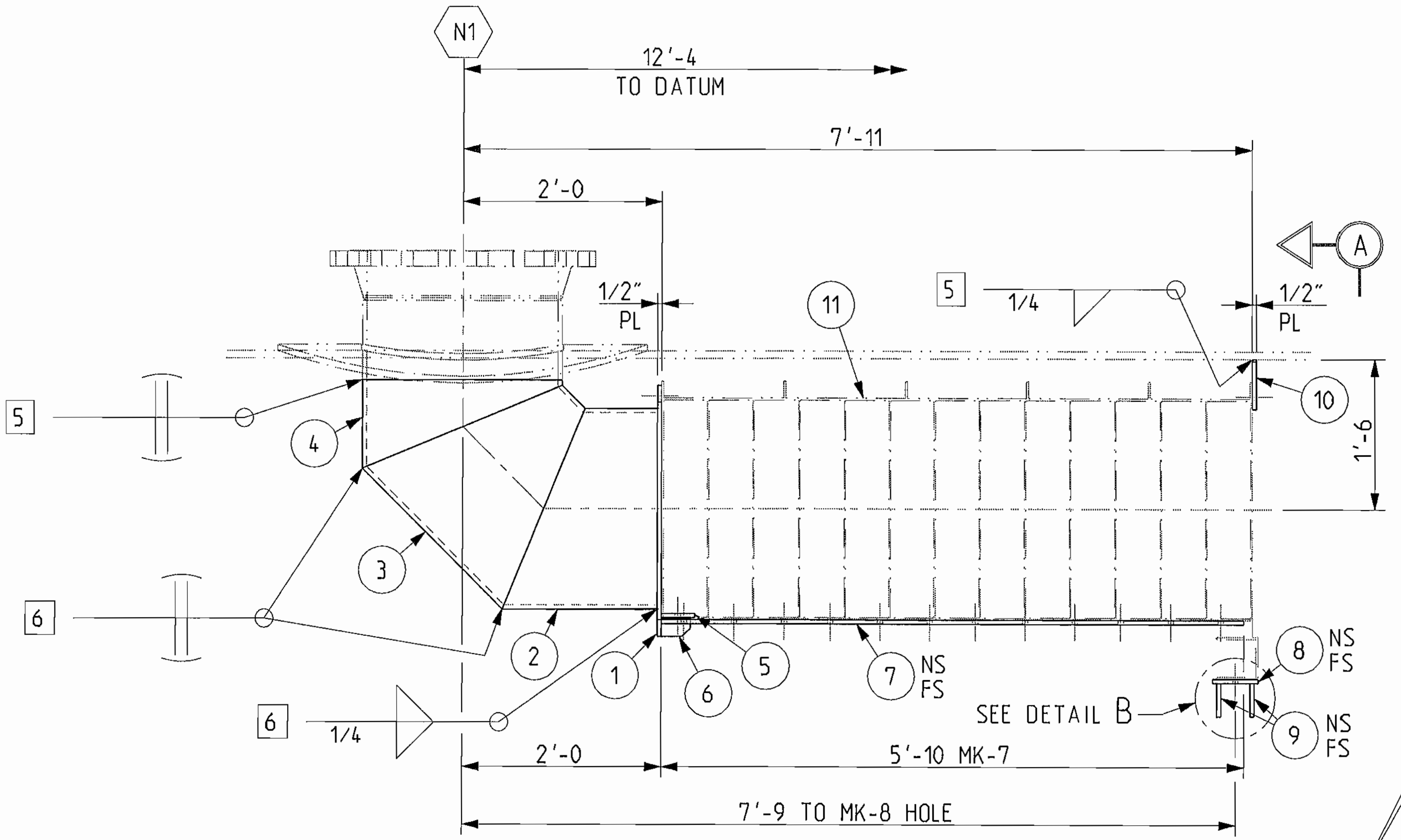
WELDING PROCEDURE KEY

5 P1-P8-FCAW-AL
P1-P8-GMAWP-A
P1-P8-GTAW-AL

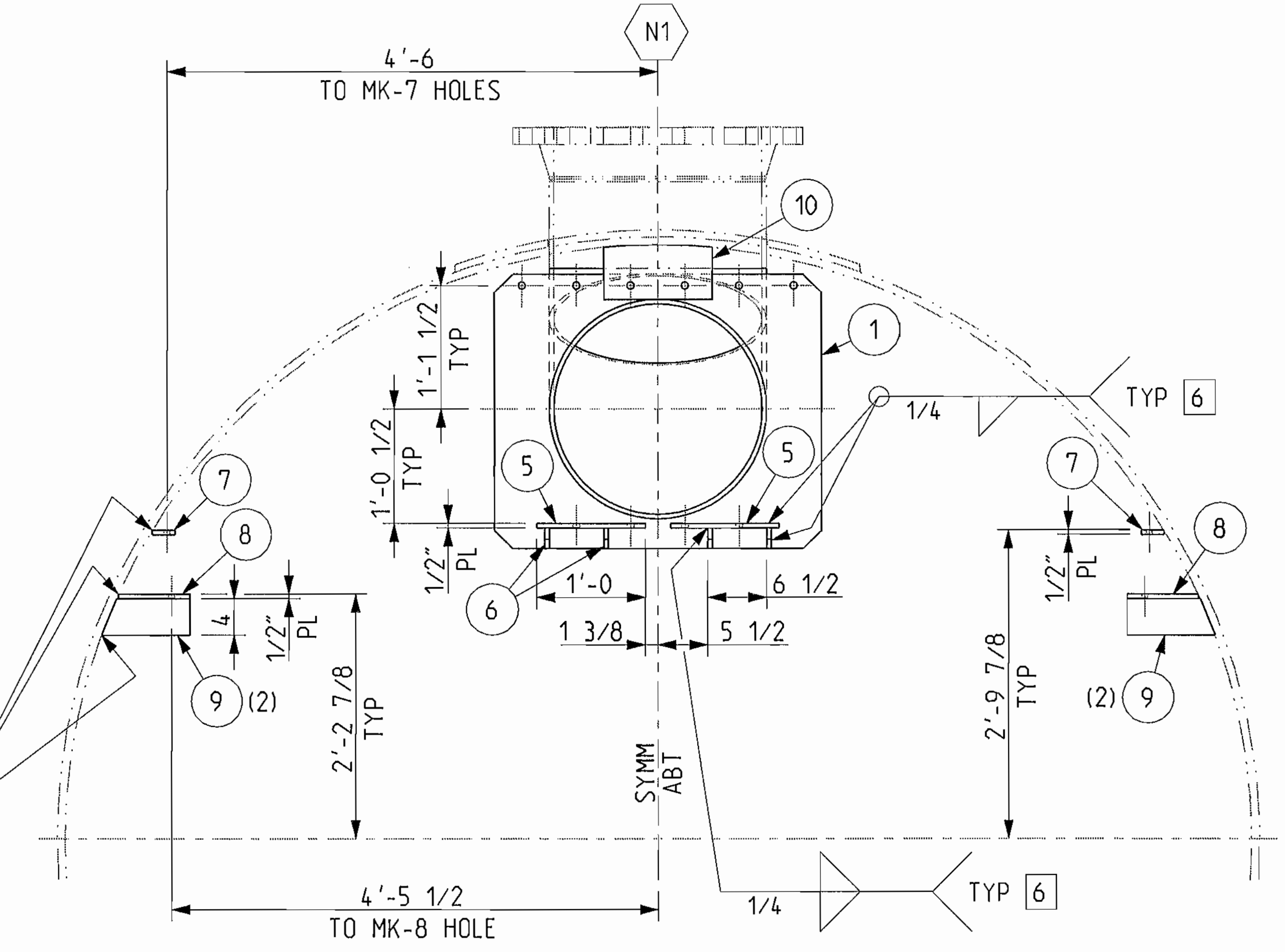
6 P8-P8-GMAWP-A
P8-P8-GTAW-AL
P8-P8-SMAW-A

BILL OF MATERIAL

Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
	5361-1G-1	1	PLATE	1/2" PLATE, SKETCH W/HOLES	0.500	30	36	SA-240-304			87
	5361-1G-2	1	PIPE	24" NOM XH, SKETCH	0.500		18.688	SA-312-TP304			144
	5361-1G-3	1	PIPE	24" NOM XH, SKETCH	0.500		23.75	SA-312-TP304			145
	5361-1G-4	1	PIPE	24" NOM XH, SKETCH	0.500		10.563	SA-312-TP304		X	59
	5361-1G-5	2	PLATE	1/2" PLATE W/HOLES	0.500	4	12	SA-240-304			13
	5361-1G-6	4	PLATE	1/2" PLATE, SKETCH	0.500	2.25	3.5	SA-240-304			4
	5361-1G-7	2	PLATE	1/2" PLATE W/HOLES	0.500	2.5	70	SA-240-304		X	49
	5361-1G-8	2	PLATE	1/2" PLATE W/HOLE	0.500	5.5	7.813	SA-240-304		X	12
	5361-1G-9	4	PLATE	1/2" PLATE, SKETCH	0.500	4	9.688	SA-240-304		X	20
	5361-1G-10	1	PLATE	1/2" PLATE, SKETCH W/HOLES	0.500	6	12	SA-240-304		X	10
	5361-1G-11	1	DIFFUSER	INLET DIFFUSER ASSY (BY AMACS)				304L SS			942

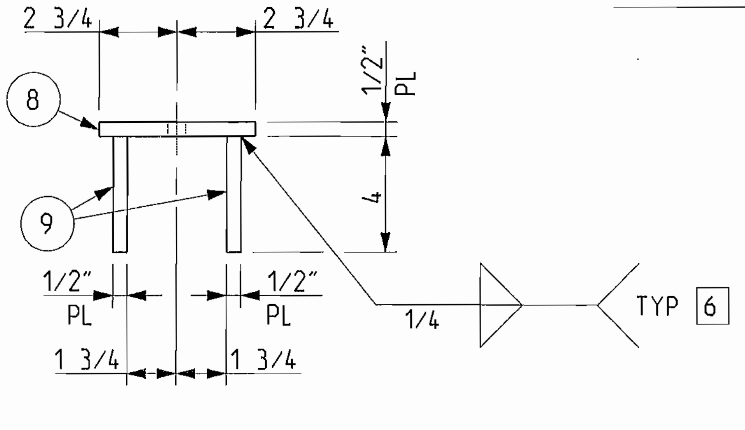


ELEVATION



SECT A

MK-11 HIDDEN
FOR CLARITY



DETAIL "B"

DIFFUSER BEAM SEAT
TYP (2) PLACES

SHOP NOTE: ALL INTERNAL WELDS MUST BE SUITABLY PREPPED FOR INTERNAL LINING. ALL SHARP EDGES & ROUGH WELD CONTOURS ARE TO BE ROUNDED/SMOOTHED OUT. POROSITY & WELD SPATTER SHALL BE REMOVED.

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

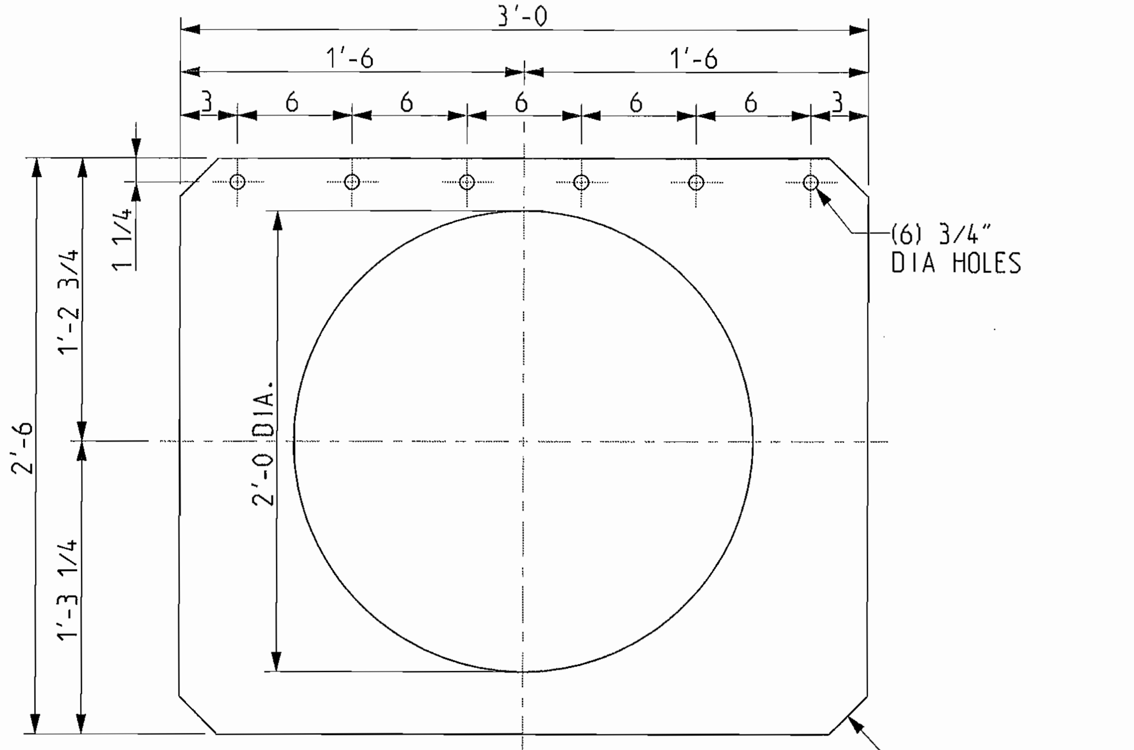
WORK THIS DWG WITH D-5361-1, -1A & -1GA

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

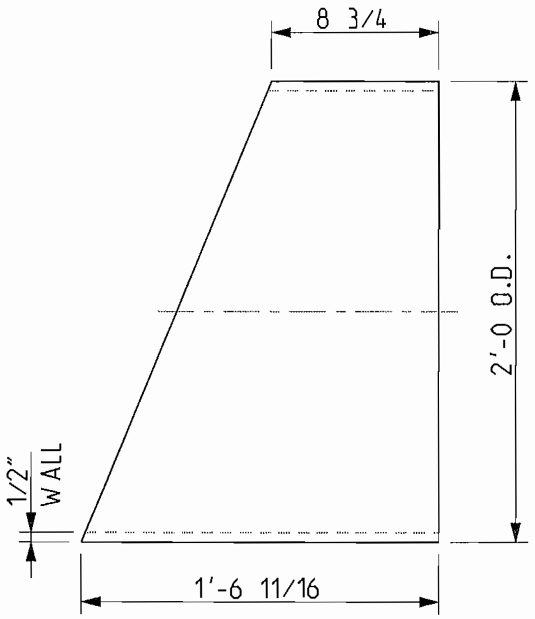
INLET DIFFUSER DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1G
REV

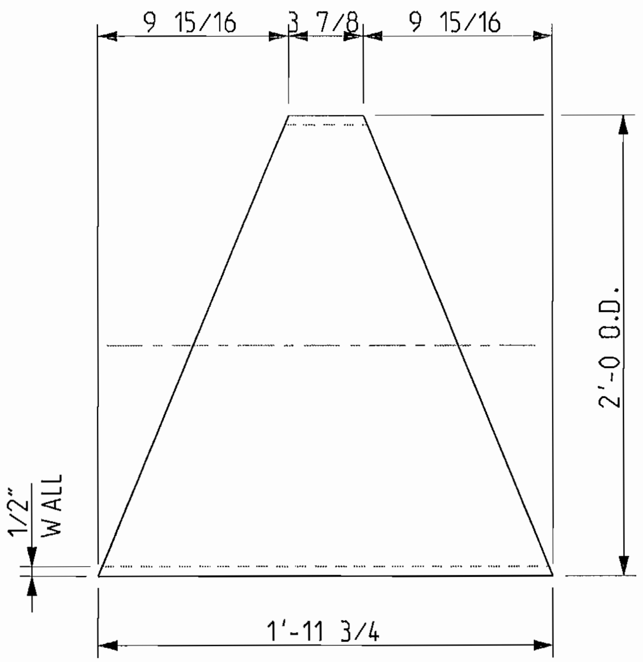


DETAIL ①

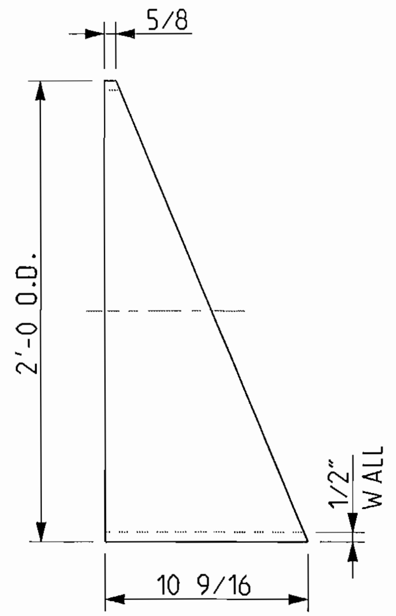
1/2" PL



DETAIL ②

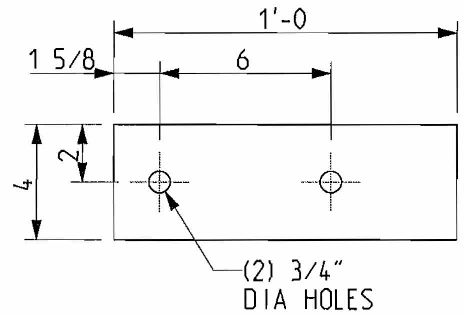


DETAIL ③



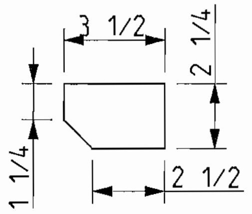
DETAIL ④

CLIP CORNERS
2" @ 45° (TYP)



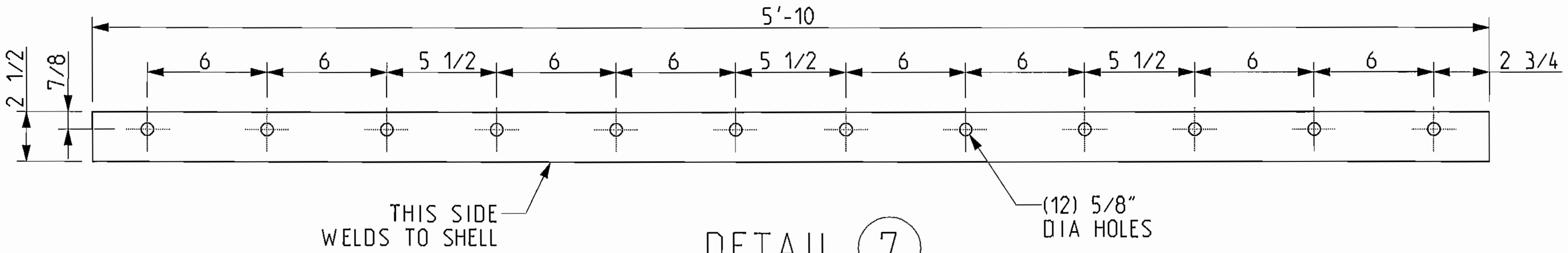
DETAIL ⑤

1/2" PL



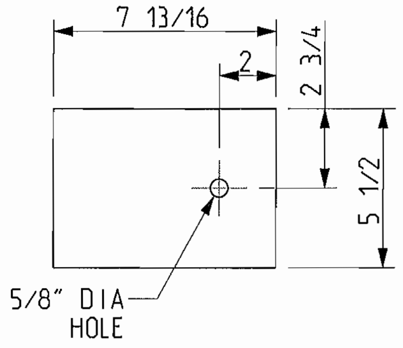
DETAIL ⑥

1/2" PL



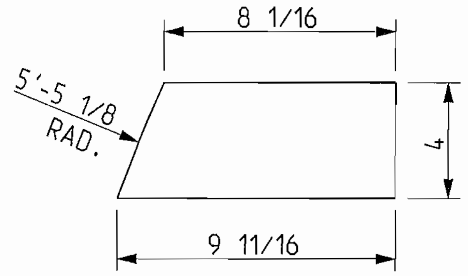
DETAIL ⑦

1/2" PL



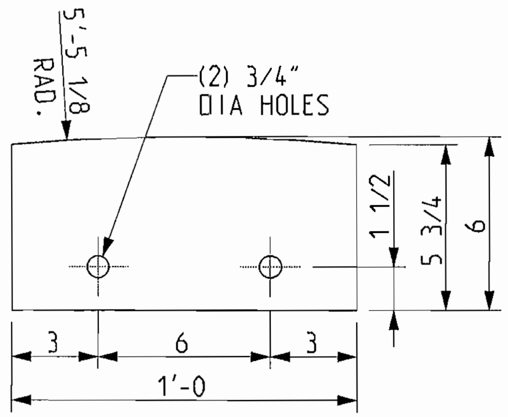
DETAIL ⑧

1/2" PL



DETAIL ⑨

1/2" PL



DETAIL ⑩

1/2" PL

WORK THIS DWG WITH D-5361-1G

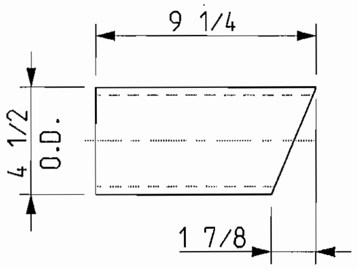
APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

No.	Date	By	Chk'd	Revision Description

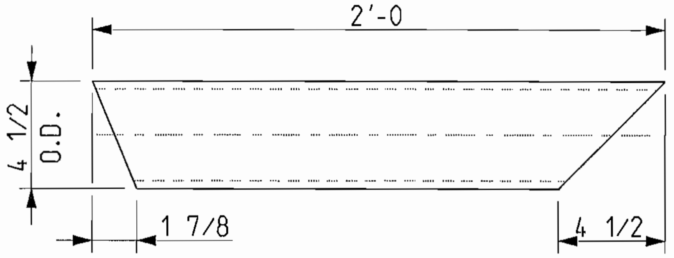
EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

INLET DIFFUSER DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1GA
REV



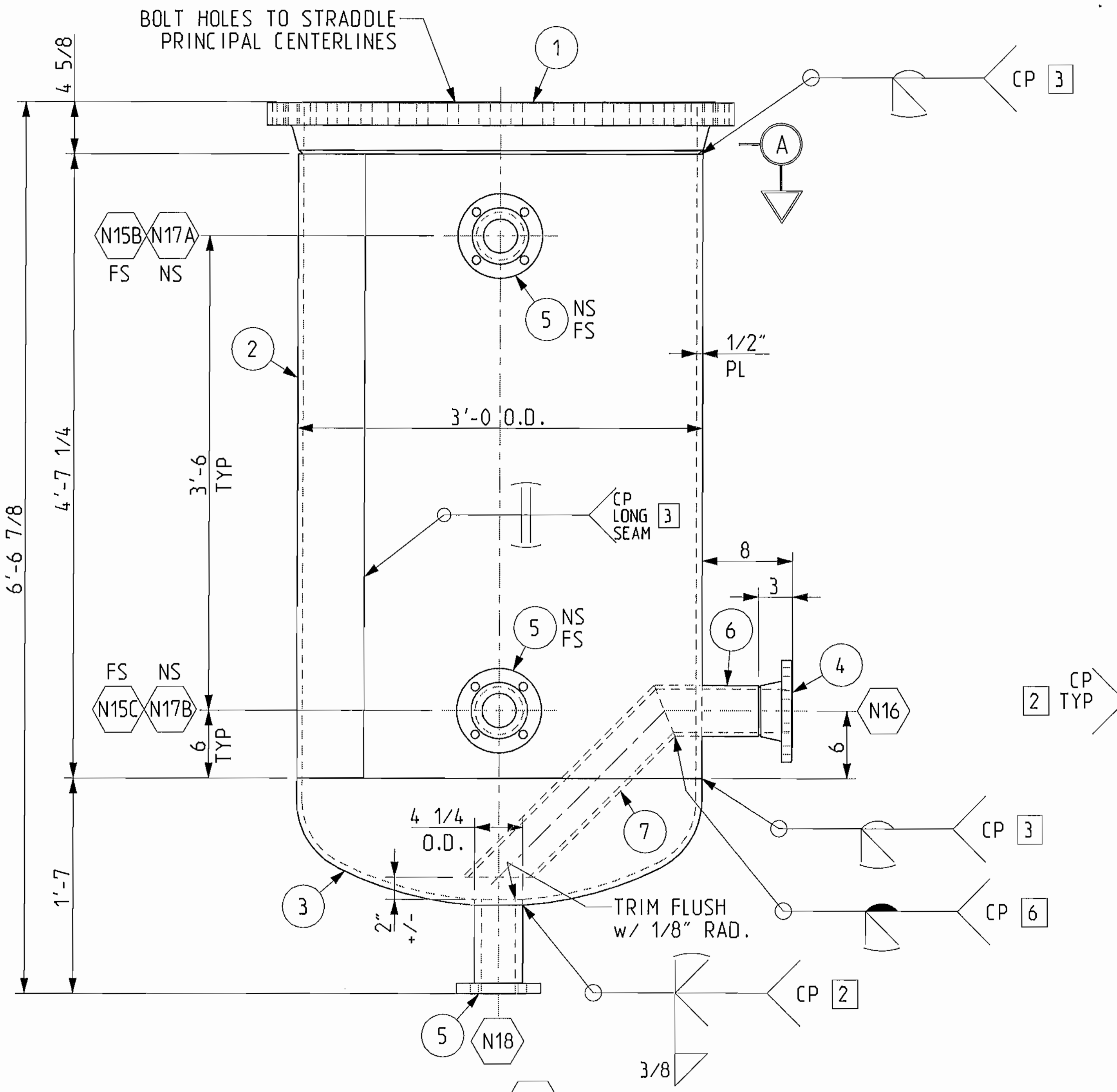
DETAIL ⑥



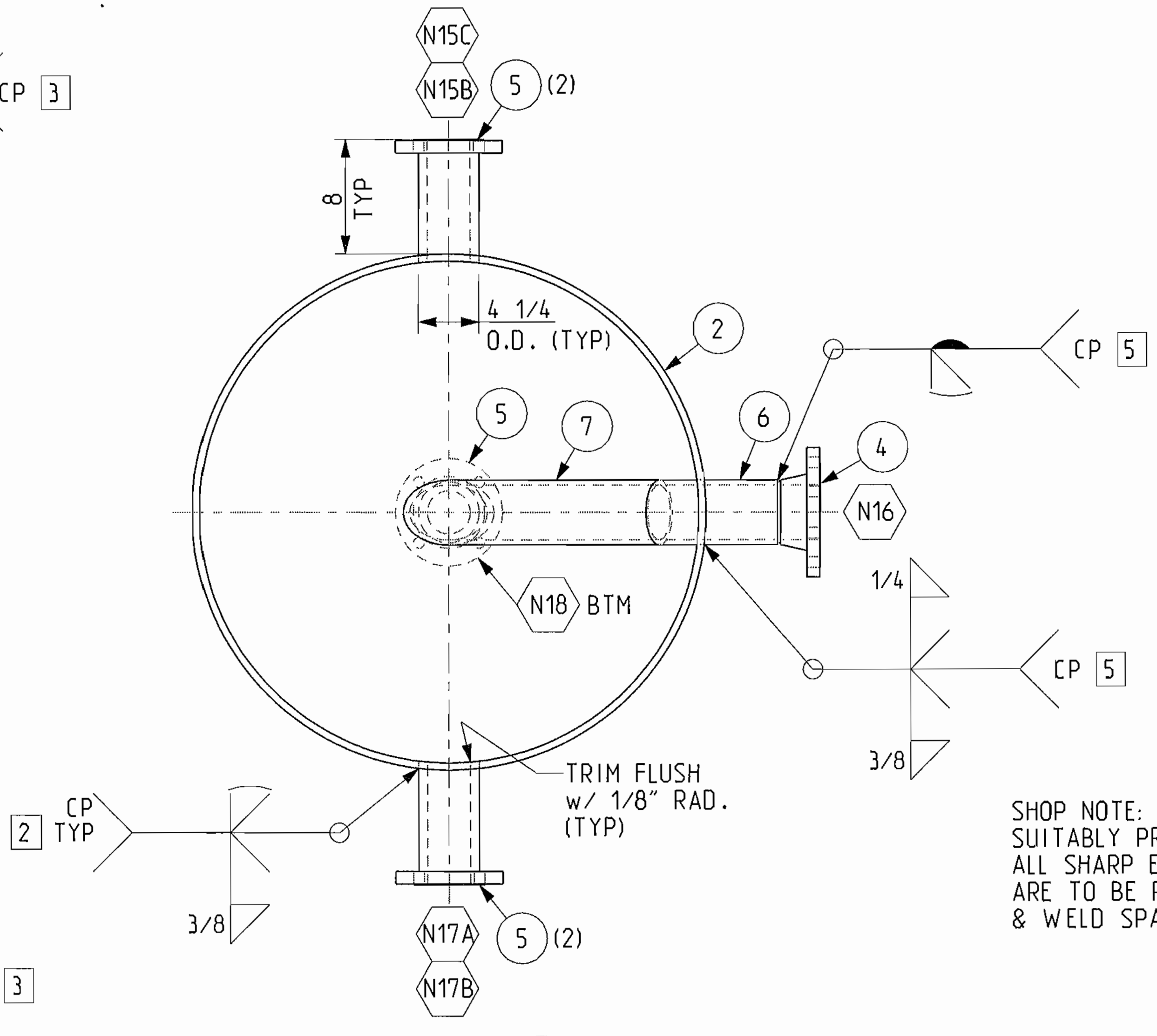
DETAIL ⑦

BILL OF MATERIAL

Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
1	5361-1H-A		BOOT	36" BOOT ASSEMBLY							1551#
	5361-1H-1	1	FLANGE	36" - 150# SERIES "B" RFWN XH BORE (35" I.D.)				SA-105		X	270
	5361-1H-2	1	PLATE	1/2" PLATE, ROLLED w/4" TANS	0.500	55.25	119.5	SA-516-70		X	874
	5361-1H-3	1	HEAD	0.375" MIN x 36" OD ASME 2:1 SF=2"				SA-516-70		X	228
	5361-1H-4	1	FLANGE	4" - 150# RFWN XH BORE				SA-105		X	16
	5361-1H-5	5	FLANGE	3" - 150# RF LWN			9	SA-105		X	127
	5361-1H-6	1	PIPE	4" NOM XH, SKETCH	0.337		9.25	SA-312-TP304		X	10
	5361-1H-7	1	PIPE	4" NOM XH, SKETCH	0.337		24	SA-312-TP304		X	26
1	5361-1H-B		GASKET	1/8" - 36" - 150# SERIES "B" RING TYPE C-4401				KLINGERSIL			1
44	5361-1H-C		STUD	7/8" DIA FULL THREAD			6.75	SA-193-B7			51
88	5361-1H-D		NUT	7/8" HEAVY HEX				SA-194-2H			26



BOOT ⟨N13⟩ 36"



SECT Ⓐ

WELDING PROCEDURE KEY

- 2 P1-P1-FCAW-AL
  P1-P1-GMAWP-AL
- 3 P1-P1-GMAWP-AL
  P1-P1-FCAW-AL
  P1-P1-EM14K1-A
- 5 P1-P8-FCAW-AL
  P1-P8-GMAWP-A
  P1-P8-GTAW-AL
- 6 P8-P8-GMAWP-A
  P8-P8-GTAW-AL
  P8-P8-SMAW-A

SHOP NOTE: ALL INTERNAL WELDS MUST BE SUITABLY PREPPED FOR INTERNAL LINING. ALL SHARP EDGES & ROUGH WELD CONTOURS ARE TO BE ROUNDED/SMOOTHED OUT. POROSITY & WELD SPATTER SHALL BE REMOVED.

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY

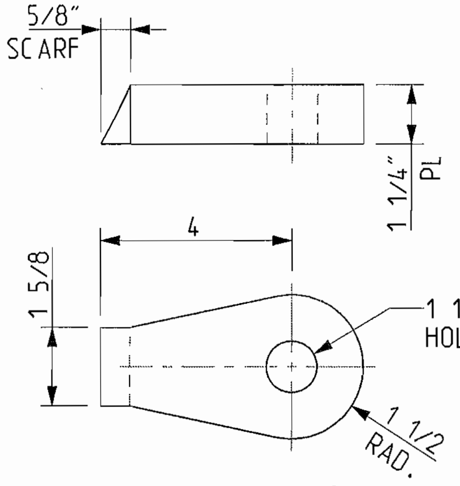
WORK THIS DWG WITH D-5361-1 & -1A

No.	Date	By	Chk'd	Revision Description

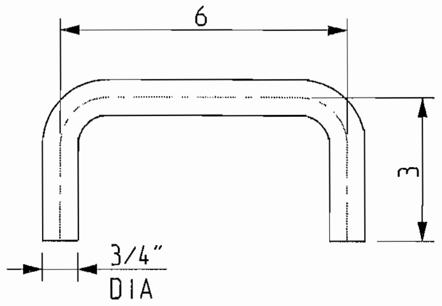
EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

BOOT DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1H
REV



DETAIL ④



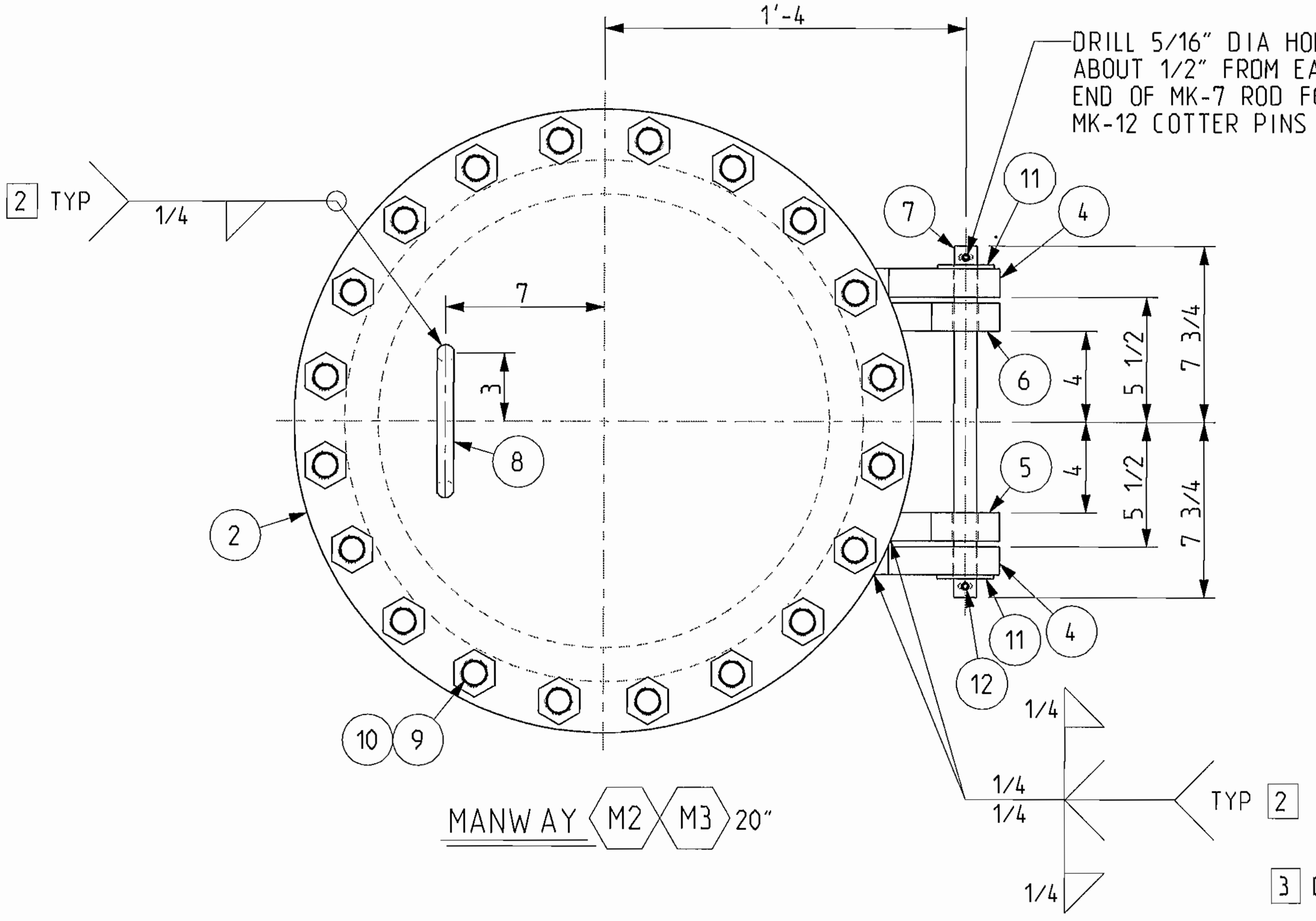
DETAIL ⑧

WELDING PROCEDURE KEY

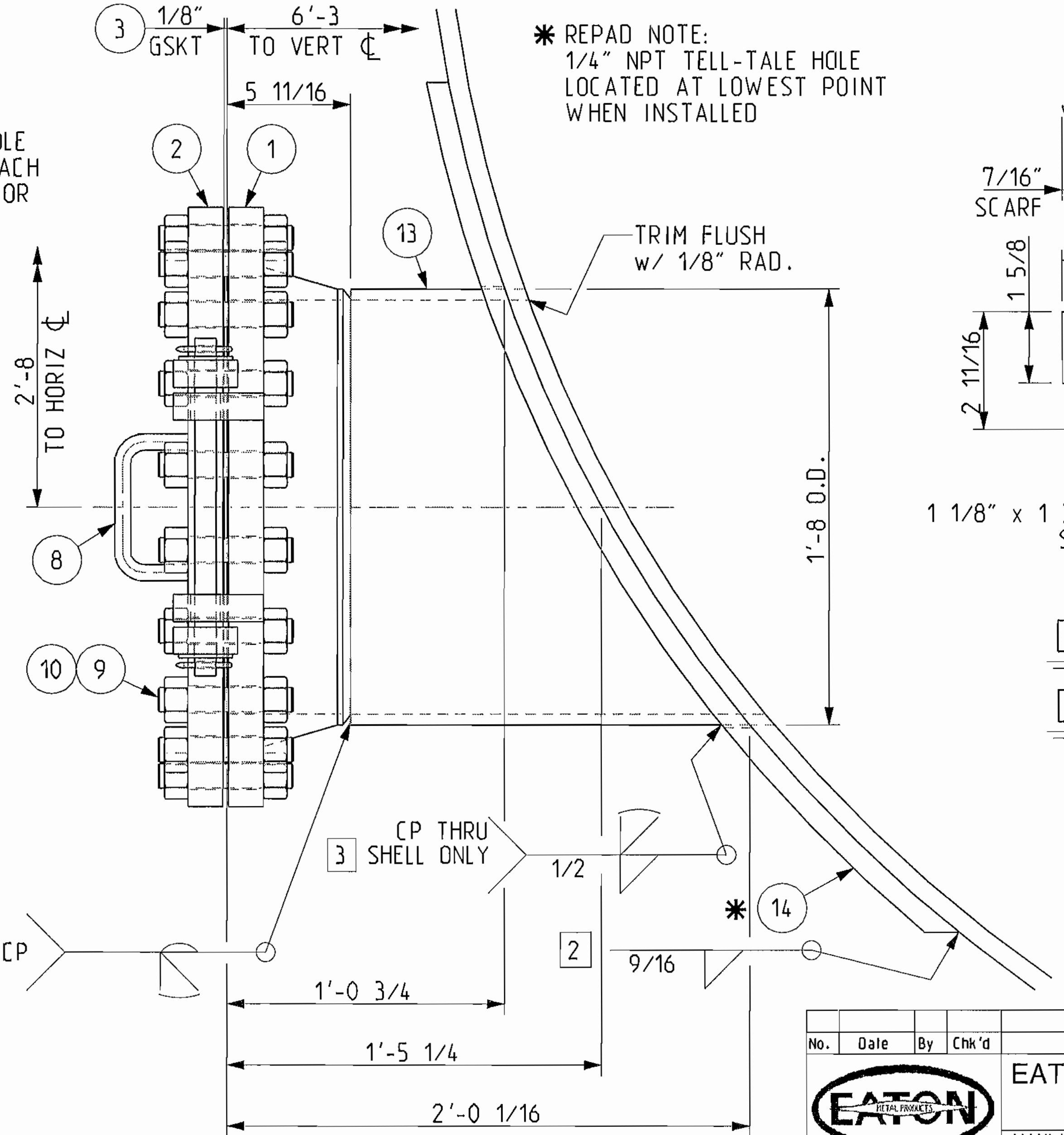
2	P1-P1-FCAW-AL P1-P1-GMAWP-AL
3	P1-P1-GMAWP-AL P1-P1-FCAW-AL P1-P1-EM14K1-A

BILL OF MATERIAL

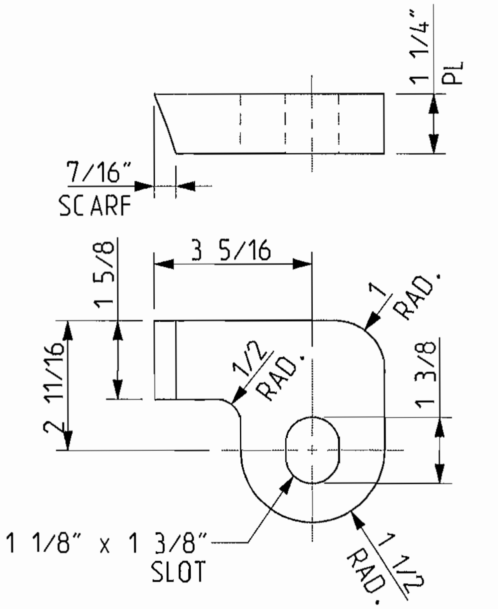
Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Spec	See Note	MTR	Weights
	5361-1J-1	2	FLANGE	20" - 150# RFWN XH BORE				SA-105		X	399
	5361-1J-2	2	FLANGE	20" - 150# RF BLIND				SA-105		X	541
	5361-1J-3	2	GASKET	1/8" - 20" - 150# RING TYPE KLINGERSIL	C-4401			KLINGERSIL			2
	5361-1J-4	4	PLATE	1-1/4" SKETCH PL W/ HOLE	1.250	3	5.5	A-36		X	16
	5361-1J-5	2	PLATE	1-1/4" SKETCH PL W/ SLOT	1.250	4.188	4.813	A-36		X	9
	5361-1J-6	2	PLATE	1-1/4" SKETCH PL W/ SLOT	1.250	4.188	4.813	A-36		X	9
	5361-1J-7	2	ROD	1" DIA ROD W/ HOLES			15.5	A-36			7
	5361-1J-8	2	ROD	3/4" DIA ROD, BEND			12	A-36		X	3
	5361-1J-9	40	STUD	1-1/8" DIA FULL THREAD			6.25	SA-193-B7			70
	5361-1J-10	80	NUT	1-1/8" HEAVY HEX				SA-194-2H			46
	5361-1J-11	4	WASHER	1" STANDARD ROUND				STEEL			-
	5361-1J-12	4	COTTER	1/4" DIA COTTER PIN			1.5	STEEL			-
	5361-1J-13	2	PIPE	20" NOM XH	0.500		20.563	SA-106-B		X	357
	5361-1J-14	2	PLATE	CIRC 20.25 ID x 39" OD ROLL	1.000			SA-516-70		X	586



MANWAY ⟨M2⟩⟨M3⟩ 20"



✱ REPAD NOTE:
1/4" NPT TELL-TALE HOLE
LOCATED AT LOWEST POINT
WHEN INSTALLED



DETAIL ⑤ (AS SHOWN)

DETAIL ⑥ (OPP HAND)

SHOP NOTE: ALL INTERNAL WELDS MUST BE
SUITABLY PREPPED FOR INTERNAL LINING.
ALL SHARP EDGES & ROUGH WELD CONTOURS
ARE TO BE ROUNDED/SMOOTHED OUT.
POROSITY & WELD SPATTER SHALL BE REMOVED.

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY DB

WORK THIS DWG WITH D-5361-1 & -1A

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

MANWAY M2 & M3 DETAILS
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 9/18/2018
Chk'd By: DB
Date: 10/5/18
EMP Job No. 5361-S01
Dwg. No. D-5361-1J
REV

EATON METAL PRODUCTS
Eaton Metal Products Company LLC
ENGINEERS DESIGNERS FABRICATORS
PETROLEUM EQUIPMENT
(303) 296-4800 FAX: (303) 296-5736

ASME Design Calculations

Eaton Metal Products

4800 York Street

Denver, Colorado 80216

(303) 296-4800 General

COMPRESS Pressure Vessel Design Calculations

Customer: Anadarko
Description: 132" OD x 82'-10" S/S Inlet Slug Catcher V-1000
P.O. # 4500100246
Job No.: 5361
By: RT
Date: 10/5/18

Check By: DB

Date: 10/5/18

Left Head

ASME Section VIII Division 1, 2017 Edition

Component	Ellipsoidal Head
Material	SA-516 70 (II-D p. 18, ln. 33)
Attached To	Shell

Impact Tested	Normalized	Fine Grain Practice	PWHT	Optimize MDMT/ Find MAWP
No	No	Yes	No	No

	Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)
Internal	250	125	-20

Static Liquid Head

Condition	P_s (psi)	H_s (in)	SG
Operating	4.7	130.275	1
Test horizontal	5.17	143.15	1

Dimensions

Outer Diameter		132"
Head Ratio		2
Minimum Thickness		0.85"
Corrosion	**Inner**	0"
	Outer	0"
Length L_{sf}		2"
Nominal Thickness t_{sf}		1"

Weight and Capacity

	Weight (lb)[1]	Capacity (US gal)[1]
New	5,004.26	1,368.52
Corroded	5,004.26	1,368.52

Radiography

Category A joints	Full UW-11(a) Type 1
Head to shell seam	Spot UW-11(a)(5)(b) Type 1

[1] includes straight flange

Results Summary

Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0" = 0.0625"
Design thickness due to internal pressure (t)	0.831"
Rated MDMT	-20°F

UCS-66 Material Toughness Requirements	
Governing thickness, t_g =	0.85"
MDMT =	-20°F
Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F.	

Factor K		
$K = (1/6)*[2 + (D / (2*h))^2]$		
Corroded	$K = (1/6)*[2 + (130.3 / (2*32.575))^2]$	1
New	$K = (1/6)*[2 + (130.3 / (2*32.575))^2]$	1

Design thickness for internal pressure, (Corroded at 125 °F) Appendix 1-4(c)

t = $P*D_0*K / (2*S*E + 2*P*(K - 0.1)) + \text{Corrosion}$
= 254.7*132*1 / (2*20,000*1 + 2*254.7*(1 - 0.1)) + 0
= 0.831"

% Extreme fiber elongation - UCS-79(d)

EFE = $(75*t / R_f)*(1 - R_f / R_0)$
= $(75*1 / 22.651)*(1 - 22.651 / \infty)$
= 3.3111%

The extreme fiber elongation does not exceed 5%.

Shell

ASME Section VIII Division I, 2017 Edition				
Component		Cylinder		
Material		SA-516 70 (II-D p. 18, ln. 33)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
No	No	Yes	No	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		250	125	-20
Static Liquid Head				
Condition		P_s (psi)	H_s (in)	**SG**
Operating		4.7	130.25	1
Test horizontal		5.17	143.125	1
Dimensions				
Outer Diameter		132"		
Length		994"		
Nominal Thickness		0.875"		
Corrosion	**Inner**	0"		
	Outer	0"		
Weight and Capacity				
		Weight (lb)		**Capacity (US gal)**
New		100,929.05		57,334.99
Corroded		100,929.05		57,334.99
Radiography				
Longitudinal seam		Full UW-11(a) Type 1		
Left Circumferential seam		Spot UW-11(a)(5)(b) Type 1		
Right Circumferential seam		Spot UW-11(a)(5)(b) Type 1		

Results Summary	
Governing condition	Internal pressure
Minimum thickness per UG-16	0.0625" + 0" = 0.0625"
Design thickness due to internal pressure (t)	0.8363"
Rated MDMT	-20 °F

UCS-66 Material Toughness Requirements	
Governing thickness, t_g =	0.875"
MDMT =	-20°F

Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F.

Design thickness, (at 125 °F) Appendix 1-1

t = P*R_o / (S*E + 0.40*P) + Corrosion
= 254.7*66 / (20,000*1.00 + 0.40*254.7) + 0
= 0.8363"

% Extreme fiber elongation - UCS-79(d)

EFE = (50*t / R_f)*(1 - R_f / R_o)
= (50*0.875 / 65.5625)*(1 - 65.5625 / ∞)
= 0.6673%

The extreme fiber elongation does not exceed 5%.

Allowable Compressive Stress, Hot and Corroded- S_{cHC}, (table CS-2)

A = 0.125 / (R_o / t)
= 0.125 / (66 / 0.875)
= 0.001657
B = 14,214 psi
S = 20,000 / 1.00 = 20,000 psi
S_{cHC} = min(B, S) = 14,214 psi

Allowable Compressive Stress, Hot and New- S_{cHN}

S_{cHN} = S_{cHC}
= 14,214 psi

Allowable Compressive Stress, Cold and New- S_{cCN}, (table CS-2)

A = 0.125 / (R_o / t)
= 0.125 / (66 / 0.875)
= 0.001657
B = 14,214 psi
S = 20,000 / 1.00 = 20,000 psi
S_{cCN} = min(B, S) = 14,214 psi

Allowable Compressive Stress, Cold and Corroded- S_{cCC}

S_{cCC} = S_{cCN}
= 14,214 psi

Allowable Compressive Stress, Vacuum and Corroded- S_{cVC}, (table CS-2)

A = 0.125 / (R_o / t)
= 0.125 / (66 / 0.875)
= 0.001657
B = 14,214 psi
S = 20,000 / 1.00 = 20,000 psi
S_{cVC} = min(B, S) = 14,214 psi

Right Head

ASME Section VIII Division 1, 2017 Edition	
Component	Ellipsoidal Head
Material	SA-516 70 (II-D p. 18, ln. 33)
Attached To	Shell

Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
No	No	Yes	No	No

	Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal	250	125	-20

Static Liquid Head			
Condition	**P_S (psi)**	**H_S (in)**	**SG**
Operating	4.7	130.275	1
Test horizontal	5.17	143.15	1

Dimensions		
Outer Diameter		132"
Head Ratio		2
Minimum Thickness		0.85"
Corrosion	**Inner**	0"
	Outer	0"
Length L_{sf}		2"
Nominal Thickness t_{sf}		1"

Weight and Capacity		
	Weight (lb)[1]	**Capacity (US gal)[1]**
New	4,939.01	1,368.52
Corroded	4,939.01	1,368.52

Radiography	
Category A joints	Full UW-11(a) Type 1
Head to shell seam	Spot UW-11(a)(5)(b) Type 1

[1] includes straight flange

Results Summary	
Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0" = 0.0625"
Design thickness due to internal pressure (t)	0.831"
Rated MDMT	-20°F

UCS-66 Material Toughness Requirements	
Governing thickness, t_g =	0.85"
MDMT =	-20°F
Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F.	

Factor K		
$K = (1/6)*[2 + (D / (2*h))^2]$		
Corroded	$K = (1/6)*[2 + (130.3 / (2*32.575))^2]$	1
New	$K = (1/6)*[2 + (130.3 / (2*32.575))^2]$	1

Design thickness for internal pressure, (Corroded at 125 °F) Appendix 1-4(c)

$$t = P*D_o*K / (2*S*E + 2*P*(K - 0.1)) + Corrosion$$
$$= 254.7*132*1 / (2*20{,}000*1 + 2*254.7*(1 - 0.1)) + 0$$
$$= \underline{0.831}"$$

% Extreme fiber elongation - UCS-79(d)

$$EFE = (75*t / R_f)*(1 - R_f / R_o)$$
$$= (75*1 / 22.651)*(1 - 22.651 / \infty)$$
$$= 3.3111\%$$

The extreme fiber elongation does not exceed 5%.

Liquid Level

ASME Section VIII Division 1, 2017 Edition	
Location from Center Line (in)	65.125
Operating Liquid Specific Gravity	1

Wind Code

Building Code: ASCE 7-10	
Elevation of base above grade	1.00 ft
Increase effective outer diameter by	1.00 ft
Wind Force Coefficient, Cf	0.6000
Risk Category (Table 1.5-1)	III
Basic Wind Speed, V	120.0000 mph
Exposure Category	C
Wind Directionality Factor, Kd	0.9500
Topographic Factor, Kzt	1.0000
Enforce minimum design load of 16 psf per ASCE 29.8:	Yes
Hazardous, toxic, or explosive contents	No

Wind Pressure (WP) Calculations

$Kz = 2.01 * (Z/z_g)^{2/\alpha}$

$= 2.01 * (15.00 / 900.00)^{0.2105}$

$= 0.8489$

$qz = 0.00256 * Kz * Kzt * Kd * V^2$

$= 0.00256 * 0.8489 * 1.0000 * 0.9500 * 120.0000^2$

$= 29.7286$ psf

$qz = 0.6 * \max[29.7286, 16.0000]$

$= 17.8372$ psf

Note: The 0.6 factor is the wind load combination factor from Section 2.4.1.

Table Lookup Values	
$\alpha = 9.5000$, $z_g = 900.00$ ft	[Table 26.9-1, page 256]

Shear calculations are reported in the saddle report.

Saddles

ASME Section VIII Division 1, 2017 Edition		
Saddle Material	SA-36	
Saddle Construction	Centered web	
Welded to Vessel	Yes	
Saddle Allowable Stress, S_s	21,600 psi	
Saddle Yield Stress, S_y	36,000 psi	
Foundation Allowable Stress	1,350 psi	
Design Pressure	**Left Saddle**	**Right Saddle**
Operating	254.7 psi	
Test	330.17 psi	
Dimensions		
Right saddle distance to datum	186"	
Tangent To Tangent Length, L	998"	
Saddle separation, L_s	598"	
Vessel Radius, R	66"	
Tangent Distance Left, A_l	200"	
Tangent Distance Right, A_r	200"	
Saddle Height, H_s	78"	
Saddle Contact Angle, θ	140°	
Web Plate Thickness, t_s	0.75"	
Base Plate Length, E	129"	
Base Plate Width, F	22"	
Base Plate Thickness, t_b	1.5"	
Number of Stiffening Ribs, n	7	
Largest Stiffening Rib Spacing, d_i	20.9583"	
Stiffening Rib Thickness, t_w	0.75"	
Saddle Width, b	18"	
Reinforcing Plate		
Thickness, t_p	0.375"	
Width, W_p	30"	
Contact Angle, θ_w	152°	
Bolting		
Material	A-307	
Bolt Allowable Shear	10,000 psi	

Description	2.75" series 8 threaded	
Corrosion on root	0"	
Anchor Bolts per Saddle	4	
Base coefficient of friction, μ	0.45	
Weight		
	Operating, Corroded	**Hydrotest**
Weight on Left Saddle	308,872 lb	308,926 lb
Weight on Right Saddle	310,287 lb	310,325 lb
Weight of Saddle Pair	6,290 lb	

Notes
(1) Saddle calculations are based on the method presented in "Stresses in Large Cylindrical Pressure Vessels on Two Saddle Supports" by L.P. Zick.

Stress Summary

Load	**Condition**	**Saddle**	**Bending + pressure between saddles (psi)**				**Bending + pressure at the saddle (psi)**			
			S_1 (+)	**allow (+)**	**S_1 (-)**	**allow (-)**	**S_2 (+)**	**allow (+)**	**S_2 (-)**	**allow (-)**
Seismic	Operating	Right Saddle	10,905	24,000	1,426	17,057	18,763	24,000	9,285	17,057
		Left Saddle					18,763	24,000	9,285	17,057
Wind	Operating	Right Saddle	10,560	24,000	1,082	17,057	17,899	24,000	8,420	17,057
		Left Saddle					17,899	24,000	8,420	17,057
	Test	Right Saddle	13,355	34,200	1,068	17,057	20,708	34,200	8,421	17,057
		Left Saddle					20,708	34,200	8,421	17,057
Weight	Operating	Right Saddle	10,539	20,000	1,061	14,214	17,899	20,000	8,420	14,214
		Left Saddle					17,899	20,000	8,420	14,214

Stress Summary

Load	**Condition**	**Saddle**	**Tangential shear (psi)**		**Circumferential stress (psi)**			**Stress over saddle (psi)**		**Splitting (psi)**	
			S_3	**allow**	**S_4 (horns)**	**S_4 (Wear plate)**	**allow (+/-)**	**S_5**	**allow**	**S_6**	**allow**
Seismic	Operating	Right Saddle	4,264	16,000	-28,971	-28,927	30,000	15,597	18,000	5,323	14,400
		Left Saddle	4,234	16,000	-28,839	-28,795	30,000	15,526	18,000	5,299	14,400
Wind	Operating	Right Saddle	2,893	16,000	-21,966	-21,933	30,000	11,826	18,000	4,036	14,400
		Left Saddle	2,871	16,000	-21,868	-21,835	30,000	11,773	18,000	4,018	14,400
	Test	Right Saddle	2,830	27,360	-21,685	-21,653	34,200	11,675	32,400	3,985	32,400
		Left Saddle	2,808	27,360	-21,588	-21,556	34,200	11,623	32,400	3,967	32,400
Weight	Operating	Right Saddle	2,798	16,000	-21,543	-21,511	30,000	11,598	18,000	3,959	14,400
		Left Saddle	2,776	16,000	-21,445	-21,413	30,000	11,545	18,000	3,940	14,400

Seismic base shear on vessel	
Vessel is assumed to be a rigid structure.	
Method of seismic analysis	ASCE 7-10 ground supported
Vertical seismic accelerations considered	Yes
Importance factor, I_e	1.25
Site Class	D
Short period spectral response acceleration as percent of g, S_s	100
1 second spectral response acceleration as percent of g, S_1	40
From Table 11.4-1, F_a	1.1
From Table 11.4-2, F_v	1.6
Risk Category (Table 1.5-1)	II
Hazardous, toxic, or explosive contents	No
Equations	
$S_{MS} = F_a*S_s$	
$S_{M1} = F_v*S_1$	
$S_{DS} = (2 / 3)*S_{MS}$	
$S_{D1} = (2 / 3)*S_{M1}$	
$F_p = 0.3*S_{DS}*W*I_e*0.7$	
Results	
$S_{MS} = 1.1*1$	1.1
$S_{M1} = 1.6*0.4$	0.64
$S_{DS} = (2 / 3)*1.1$	0.7333
$S_{D1} = (2 / 3)*0.64$	0.4267
Seismic Design Category (Section 11.6)	D
$F_p = 0.3*0.7333*619,159*1.25*0.7$	119,188.11 lb_f

Saddle reactions due to weight + seismic
V_v = vertical seismic force acting on the saddle
V = horizontal seismic shear acting on the saddle (worst case if not slotted)
Seismic longitudinal reaction, Q_l
Seismic transverse reaction, Q_t
Equations
$Q_l = V*H_s / L_s + V_v$
$Q_t = V*H_s / (R_o*Sin(\theta / 2)) + V_v$
$Q = W + max[Q_t , Q_l]$
Results

Operating	Right Saddle	$Q_l = 119,188.11*78 / 598 + 0.14*0.7333*310,287$	47,402.41 lb_f
		$Q_t = 59,730.25*78 / (66*Sin(140 / 2)) + 0.14*0.7333*310,287$	106,976.75 lb_f
		$Q = 310,287 + max[106,976.75 , 47,402.41]$	417,263.75 lb_f
	Left Saddle	$Q_l = 119,188.11*78 / 598 + 0.14*0.7333*308,872$	47,257.13 lb_f
		$Q_t = 59,457.86*78 / (66*Sin(140 / 2)) + 0.14*0.7333*308,872$	106,488.91 lb_f
		$Q = 308,872 + max[106,488.91 , 47,257.13]$	415,360.91 lb_f

Saddle reactions due to weight + wind			
Wind longitudinal reaction, Q_l			
Wind transverse reaction, Q_t			
Wind pressure, P_w			17.8372 psf
Equations			
$V_{wt} = P_w*G*(C_{f(shell)}*(\text{Projected shell area}) + C_{f(saddle)}*(\text{Projected saddle area}))$			
$V_{we} = P_w*G*(C_{f(shell)}*\pi*R_o^2 / 144 + C_{f(saddle)}*(\text{Projected saddle area}))$			
$Q_t = V_{wt}*H_s / (R_o*Sin(\theta / 2))$			
$Q_l = V_{we}*H_s / L_s$			
$Q = W + max[Q_t , Q_l]$			
Results			
Operating	Right Saddle	$V_{wt} = 17.84*0.85*(0.6*527.2743 + 2*1.5)$	4,842.07 lb_f
		$V_{we} = 17.84*0.85*(0.5*\pi*72^2 / 144 + 2*22.8069)$	1,548.95 lb_f
		$Q_t = 4,842.07*78 / (66*Sin(140 / 2))$	6,089.71 lb_f
		$Q_l = 1,548.95*78 / 598$	202.04 lb_f
		$Q = 310,287 + max[6,089.71 , 202.04]$	316,376.71 lb_f
	Left Saddle	$V_{wt} = 17.84*0.85*(0.6*527.2743 + 2*1.5)$	4,842.07 lb_f
		$V_{we} = 17.84*0.85*(0.5*\pi*72^2 / 144 + 2*22.8069)$	1,548.95 lb_f
		$Q_t = 4,842.07*78 / (66*Sin(140 / 2))$	6,089.71 lb_f
		$Q_l = 1,548.95*78 / 598$	202.04 lb_f
		$Q = 308,872 + max[6,089.71 , 202.04]$	314,961.71 lb_f
Test	Right Saddle	$V_{wt} = 5.89*0.85*(0.6*527.2743 + 2*1.5)$	1,597.88 lb_f
		$V_{we} = 5.89*0.85*(0.5*\pi*72^2 / 144 + 2*22.8069)$	511.15 lb_f
		$Q_t = 1,597.88*78 / (66*Sin(140 / 2))$	2,009.6 lb_f
		$Q_l = 511.15*78 / 598$	66.67 lb_f
		$Q = 310,325 + max[2,009.6 , 66.67]$	312,334.6 lb_f
		$V_{wt} = 5.89*0.85*(0.6*527.2743 + 2*1.5)$	1,597.88 lb_f

	Left Saddle	$V_{we} = 5.89*0.85*(0.5*\pi*72^2 / 144 + 2*22.8069)$	511.15 lb_f
		$Q_t = 1{,}597.88*78 / (66*Sin(140 / 2))$	2,009.6 lb_f
		$Q_l = 511.15*78 / 598$	66.67 lb_f
		Q = 308,926 + max[2,009.6 , 66.67]	310,935.6 lb_f

Load Case 1: Seismic, Operating

Longitudinal stress between saddles (Seismic, Operating, right saddle loading and geometry govern)

$S_1 = \pm\ 3*K_1*Q*(L / 12) / (\pi*R^2*t)$
$= 3*0.1619*417{,}263.75*(998 / 12) / (\pi*65.5625^2*0.875)$
= 1,426 psi

$S_p = P*R / (2*t)$
= 254.7*65.125 / (2*0.875)
= 9,479 psi

Maximum tensile stress $S_{1t} = S_1 + S_p$ = 10,905 psi
Maximum compressive stress (shut down) $S_{1c} = S_1$ = 1,426 psi

Tensile stress is acceptable (≤ 1.2*S*E = 24,000 psi)
Compressive stress is acceptable ($\leq 1.2*S_c$ = 17,057 psi)

Longitudinal stress at the right saddle (Seismic, Operating)

L_e = 2*(Left head depth) / 3 + L + 2*(Right head depth) / 3
= 2*33.425 / 3 + 998 + 2*33.425 / 3
= 1,042.5667 in

Seismic vertical acceleration coefficient m = 0.5333*0.1925 = 0.1027

$w = W_t*(1 + m) / L_e = 619{,}159*(1 + 0.1027) / 1{,}042.5667 = 654.85\ lb_f/in$

Bending moment at the right saddle:

$M_q = w*(2*H*A_r / 3 + A_r^2 / 2 - (R^2 - H^2) / 4)$
$= 654.85*(2*33.425*200 / 3 + 200^2 / 2 - (66^2 - 33.425^2) / 4)$
= 15,485,248.6 lb_f-in

$S_2 = \pm\ M_q*K_1' / (\pi*R^2*t)$
$= 15{,}485{,}248.6*7.0845 / (\pi*65.5625^2*0.875)$
= 9,285 psi

$S_p = P*R / (2*t)$
= 254.7*65.125 / (2*0.875)
= 9,479 psi

Maximum tensile stress $S_{2t} = S_2 + S_p$ = 18,763 psi
Maximum compressive stress (shut down) $S_{2c} = S_2$ = 9,285 psi

Tensile stress is acceptable (≤ 1.2*S = 24,000 psi)
Compressive stress is acceptable ($\leq 1.2*S_c$ = 17,057 psi)

Tangential shear stress in the shell (right saddle, Seismic, Operating)

$Q_{shear} = Q - w*(a + 2*H / 3)$
= 417,263.75 - 654.85*(200 + 2*33.425 / 3)
= 271,701.25 lb_f

$S_3 = K_{2.2}*Q_{shear} / (R*t)$
= 0.9003*271,701.25 / (65.5625*0.875)
= 4,264 psi

Tangential shear stress is acceptable ($\le 0.8*S = 16{,}000$ psi)

Circumferential stress at the right saddle horns (Seismic, Operating)

$S_4 = -Q / (4*(t+t_p)*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*(t^2+t_p^2))$
$= -417{,}263.75 / (4*(0.875+0.375)*(18+1.56*Sqr(66*0.875))) - 3*0.0379*417{,}263.75 / (2*(0.875^2+0.375^2))$
$= \underline{-28{,}971}$ psi

Circumferential stress at saddle horns is acceptable ($\le 1.5*S_a = 30{,}000$ psi)

Circumferential stress at the right saddle wear plate horns (Seismic, Operating)

$S_4 = -Q / (4*t*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*t^2)$
$= -417{,}263.75 / (4*0.875*(18+1.56*Sqr(66*0.875))) - 3*0.0305*417{,}263.75 / (2*0.875^2)$
$= \underline{-28{,}927}$ psi

Circumferential stress at wear plate horns is acceptable ($\le 1.5*S_a = 30{,}000$ psi)

Ring compression in shell over right saddle (Seismic, Operating)

$S_5 = K_5*Q / ((t + t_p)*(t_s + 1.56*Sqr(R_o*t_c)))$
$= 0.6971*417{,}263.75 / ((0.875 + 0.375)*(0.75 + 1.56*Sqr(66*1.25)))$
$= \underline{15{,}597}$ psi

Ring compression in shell is acceptable ($\le 0.5*S_y = 18{,}000$ psi)

Saddle splitting load (right, Seismic, Operating)

Area resisting splitting force = Web area + wear plate area

$A_e = H_{eff}*t_s + t_p*W_p$
$= 10.125*0.75 + 0.375*30$
$= 18.8438$ in^2

$S_6 = K_8*Q / A_e$
$= 0.2404*417{,}263.75 / 18.8438$
$= \underline{5{,}323}$ psi

Stress in saddle is acceptable ($\le (2 / 3)*S_s = 14{,}400$ psi)

Longitudinal stress at the left saddle (Seismic, Operating)

L_e = 2*(Left head depth) / 3 + L + 2*(Right head depth) / 3
$= 2*33.425 / 3 + 998 + 2*33.425 / 3$
$= 1{,}042.5667$ in

Seismic vertical acceleration coefficient $m = 0.5333*0.1925 = 0.1027$

$w = W_t*(1 + m) / L_e = 619{,}159*(1 + 0.1027) / 1{,}042.5667 = 654.85$ lb$_f$/in

Bending moment at the left saddle:

$M_q = w*(2*H*A_l / 3 + A_l^2 / 2 - (R^2 - H^2) / 4)$
$= 654.85*(2*33.425*200 / 3 + 200^2 / 2 - (66^2 - 33.425^2) / 4)$
$= 15{,}485{,}248.6$ lb$_f$-in

$S_2 = \pm M_q*K_1' / (\pi*R^2*t)$
$= 15{,}485{,}248.6*7.0845 / (\pi*65.5625^2*0.875)$
$= 9{,}285$ psi

$S_p = P*R / (2*t)$
$= 254.7*65.125 / (2*0.875)$
$= 9{,}479$ psi

Maximum tensile stress $S_{2t} = S_2 + S_p = \underline{18{,}763}$ psi
Maximum compressive stress (shut down) $S_{2c} = S_2 = \underline{9{,}285}$ psi

Tensile stress is acceptable ($\leq$ 1.2*S = 24,000 psi)
Compressive stress is acceptable ($\leq$ 1.2*S_c = 17,057 psi)

Tangential shear stress in the shell (left saddle, Seismic, Operating)

Q_{shear} = Q - w*(a + 2*H / 3)
= 415,360.91 - 654.85*(200 + 2*33.425 / 3)
= 269,798.41 lb_f

S_3 = $K_{2.2}$*Q_{shear} / (R*t)
= 0.9003*269,798.41 / (65.5625*0.875)
= 4,234 psi

Tangential shear stress is acceptable ($\leq$ 0.8*S = 16,000 psi)

Circumferential stress at the left saddle horns (Seismic, Operating)

S_4 = -Q / (4*(t+t_p)*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*(t^2+t_p^2))
= -415,360.91 / (4*(0.875+0.375)*(18+1.56*Sqr(66*0.875))) - 3*0.0379*415,360.91 / (2*(0.875^2+0.375^2))
= -28,839 psi

Circumferential stress at saddle horns is acceptable ($\leq$ 1.5*S_a = 30,000 psi)

Circumferential stress at the left saddle wear plate horns (Seismic, Operating)

S_4 = -Q / (4*t*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*t^2)
= -415,360.91 / (4*0.875*(18+1.56*Sqr(66*0.875))) - 3*0.0305*415,360.91 / (2*0.875^2)
= -28,795 psi

Circumferential stress at wear plate horns is acceptable ($\leq$ 1.5*S_a = 30,000 psi)

Ring compression in shell over left saddle (Seismic, Operating)

S_5 = K_5*Q / ((t + t_p)*(t_s + 1.56*Sqr(R_o*t_c)))
= 0.6971*415,360.91 / ((0.875 + 0.375)*(0.75 + 1.56*Sqr(66*1.25)))
= 15,526 psi

Ring compression in shell is acceptable ($\leq$ 0.5*S_y = 18,000 psi)

Saddle splitting load (left, Seismic, Operating)

Area resisting splitting force = Web area + wear plate area

A_e = H_{eff}*t_s + t_p*W_p
= 10.125*0.75 + 0.375*30
= 18.8438 in^2

S_6 = K_8*Q / A_e
= 0.2404*415,360.91 / 18.8438
= 5,299 psi

Stress in saddle is acceptable ($\leq$ (2 / 3)*S_s = 14,400 psi)

Load Case 2: Wind, Operating

Longitudinal stress between saddles (Wind, Operating, right saddle loading and geometry govern)

S_1 = ± 3*K_1*Q*(L / 12) / (π*R^2*t)
= 3*0.1619*316,376.71*(998 / 12) / (π*65.5625^2*0.875)
= 1,082 psi

S_p = P*R / (2*t)
= 254.7*65.125 / (2*0.875)
= 9,479 psi

Maximum tensile stress S_{1t} = S_1 + S_p = 10,560 psi

Maximum compressive stress (shut down) $S_{1c} = S_1 = 1{,}082$ psi

Tensile stress is acceptable ($\leq 1.2*S*E = 24{,}000$ psi)
Compressive stress is acceptable ($\leq 1.2*S_c = 17{,}057$ psi)

Longitudinal stress at the right saddle (Wind, Operating)

L_e = 2*(Left head depth) / 3 + L + 2*(Right head depth) / 3
= 2*33.425 / 3 + 998 + 2*33.425 / 3
= 1,042.5667 in

$w = W_t / L_e = 619{,}159 / 1{,}042.5667 = 593.88\ lb_f/in$

Bending moment at the right saddle:

$M_q = w*(2*H*A_r / 3 + A_r^2 / 2 - (R^2 - H^2) / 4)$
$= 593.88*(2*33.425*200 / 3 + 200^2 / 2 - (66^2 - 33.425^2) / 4)$
$= 14{,}043{,}454\ lb_f\text{-}in$

$S_2 = \pm M_q*K_1' / (\pi*R^2*t)$
$= 14{,}043{,}454*7.0845 / (\pi*65.5625^2*0.875)$
= 8,420 psi

$S_p = P*R / (2*t)$
= 254.7*65.125 / (2*0.875)
= 9,479 psi

Maximum tensile stress $S_{2t} = S_2 + S_p = 17{,}899$ psi
Maximum compressive stress (shut down) $S_{2c} = S_2 = 8{,}420$ psi

Tensile stress is acceptable ($\leq 1.2*S = 24{,}000$ psi)
Compressive stress is acceptable ($\leq 1.2*S_c = 17{,}057$ psi)

Tangential shear stress in the shell (right saddle, Wind, Operating)

$Q_{shear} = Q - w*(a + 2*H / 3)$
= 316,376.71 - 593.88*(200 + 2*33.425 / 3)
$= 184{,}367.18\ lb_f$

$S_3 = K_{2.2}*Q_{shear} / (R*t)$
= 0.9003*184,367.18 / (65.5625*0.875)
= 2,893 psi

Tangential shear stress is acceptable ($\leq 0.8*S = 16{,}000$ psi)

Circumferential stress at the right saddle horns (Wind, Operating)

$S_4 = -Q / (4*(t+t_p)*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*(t^2+t_p^2))$
$= -316{,}376.71 / (4*(0.875+0.375)*(18+1.56*Sqr(66*0.875))) - 3*0.0379*316{,}376.71 / (2*(0.875^2+0.375^2))$
= -21,966 psi

Circumferential stress at saddle horns is acceptable ($\leq 1.5*S_a = 30{,}000$ psi)

Circumferential stress at the right saddle wear plate horns (Wind, Operating)

$S_4 = -Q / (4*t*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*t^2)$
$= -316{,}376.71 / (4*0.875*(18+1.56*Sqr(66*0.875))) - 3*0.0305*316{,}376.71 / (2*0.875^2)$
= -21,933 psi

Circumferential stress at wear plate horns is acceptable ($\leq 1.5*S_a = 30{,}000$ psi)

Ring compression in shell over right saddle (Wind, Operating)

$S_5 = K_5*Q / ((t + t_p)*(t_s + 1.56*Sqr(R_o*t_c)))$
= 0.6971*316,376.71 / ((0.875 + 0.375)*(0.75 + 1.56*Sqr(66*1.25)))
= 11,826 psi

Ring compression in shell is acceptable ($\leq 0.5*S_y = 18{,}000$ psi)

Saddle splitting load (right, Wind, Operating)

Area resisting splitting force = Web area + wear plate area

$A_e = H_{eff}*t_s + t_p*W_p$
= 10.125*0.75 + 0.375*30
= 18.8438 in^2

$S_6 = K_8*Q / A_e$
= 0.2404*316,376.71 / 18.8438
= 4,036 psi

Stress in saddle is acceptable ($\leq (2 / 3)*S_s = 14{,}400$ psi)

Longitudinal stress at the left saddle (Wind, Operating)

L_e = 2*(Left head depth) / 3 + L + 2*(Right head depth) / 3
= 2*33.425 / 3 + 998 + 2*33.425 / 3
= 1,042.5667 in

$w = W_t / L_e = 619{,}159 / 1{,}042.5667 = 593.88\ lb_f/in$

Bending moment at the left saddle:

$M_q = w*(2*H*A_l / 3 + A_l^2 / 2 - (R^2 - H^2) / 4)$
$= 593.88*(2*33.425*200 / 3 + 200^2 / 2 - (66^2 - 33.425^2) / 4)$
$= 14{,}043{,}454\ lb_f\text{-}in$

$S_2 = \pm\ M_q*K_1' / (\pi*R^2*t)$
$= 14{,}043{,}454*7.0845 / (\pi*65.5625^2*0.875)$
= 8,420 psi

$S_p = P*R / (2*t)$
= 254.7*65.125 / (2*0.875)
= 9,479 psi

Maximum tensile stress $S_{2t} = S_2 + S_p = 17{,}899$ psi
Maximum compressive stress (shut down) $S_{2c} = S_2 = 8{,}420$ psi

Tensile stress is acceptable ($\leq 1.2*S = 24{,}000$ psi)
Compressive stress is acceptable ($\leq 1.2*S_c = 17{,}057$ psi)

Tangential shear stress in the shell (left saddle, Wind, Operating)

$Q_{shear} = Q - w*(a + 2*H / 3)$
= 314,961.71 - 593.88*(200 + 2*33.425 / 3)
$= 182{,}952.18\ lb_f$

$S_3 = K_{2.2}*Q_{shear} / (R*t)$
= 0.9003*182,952.18 / (65.5625*0.875)
= 2,871 psi

Tangential shear stress is acceptable ($\leq 0.8*S = 16{,}000$ psi)

Circumferential stress at the left saddle horns (Wind, Operating)

$S_4 = -Q / (4*(t+t_p)*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*(t^2+t_p^2))$
$= -314{,}961.71 / (4*(0.875+0.375)*(18+1.56*Sqr(66*0.875))) - 3*0.0379*314{,}961.71 / (2*(0.875^2+0.375^2))$
= -21,868 psi

Circumferential stress at saddle horns is acceptable ($\leq 1.5*S_a = 30{,}000$ psi)

Circumferential stress at the left saddle wear plate horns (Wind, Operating)

$S_4 = -Q / (4*t*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*t^2)$

$= -314{,}961.71 / (4*0.875*(18+1.56*Sqr(66*0.875))) - 3*0.0305*314{,}961.71 / (2*0.875^2)$
$= \underline{-21{,}835}$ psi

Circumferential stress at wear plate horns is acceptable ($\le 1.5*S_a = 30{,}000$ psi)

Ring compression in shell over left saddle (Wind, Operating)

$S_5 = K_5*Q / ((t + t_p)*(t_s + 1.56*Sqr(R_o*t_c)))$
$= 0.6971*314{,}961.71 / ((0.875 + 0.375)*(0.75 + 1.56*Sqr(66*1.25)))$
$= \underline{11{,}773}$ psi

Ring compression in shell is acceptable ($\le 0.5*S_y = 18{,}000$ psi)

Saddle splitting load (left, Wind, Operating)

Area resisting splitting force = Web area + wear plate area

$A_e = H_{eff}*t_s + t_p*W_p$
$= 10.125*0.75 + 0.375*30$
$= 18.8438$ in^2

$S_6 = K_8*Q / A_e$
$= 0.2404*314{,}961.71 / 18.8438$
$= \underline{4{,}018}$ psi

Stress in saddle is acceptable ($\le (2 / 3)*S_s = 14{,}400$ psi)

Load Case 3: Wind, Test

Longitudinal stress between saddles (Wind, Test, right saddle loading and geometry govern)

$S_1 = \pm 3*K_1*Q*(L / 12) / (\pi*R^2*t)$
$= 3*0.1619*312{,}334.6*(998 / 12) / (\pi*65.5625^2*0.875)$
$= 1{,}068$ psi

$S_p = P*R / (2*t)$
$= 330.17*65.125 / (2*0.875)$
$= 12{,}287$ psi

Maximum tensile stress $S_{1t} = S_1 + S_p = \underline{13{,}355}$ psi
Maximum compressive stress (shut down) $S_{1c} = S_1 = \underline{1{,}068}$ psi

Tensile stress is acceptable ($\le 0.9*S_y*E = 34{,}200$ psi)
Compressive stress is acceptable ($\le 1.2*S_c = 17{,}057$ psi)

Longitudinal stress at the right saddle (Wind, Test)

$L_e = 2*(\text{Left head depth}) / 3 + L + 2*(\text{Right head depth}) / 3$
$= 2*33.425 / 3 + 998 + 2*33.425 / 3$
$= 1{,}042.5667$ in

$w = W_t / L_e = 619{,}251 / 1{,}042.5667 = 593.97$ lb$_f$/in

Bending moment at the right saddle:

$M_q = w*(2*H*A_r / 3 + A_r^2 / 2 - (R^2 - H^2) / 4)$
$= 593.97*(2*33.425*200 / 3 + 200^2 / 2 - (66^2 - 33.425^2) / 4)$
$= 14{,}045{,}540.6$ lb$_f$-in

$S_2 = \pm M_q*K_1' / (\pi*R^2*t)$
$= 14{,}045{,}540.6*7.0845 / (\pi*65.5625^2*0.875)$
$= 8{,}421$ psi

$S_p = P*R / (2*t)$
$= 330.17*65.125 / (2*0.875)$
$= 12{,}287$ psi

Maximum tensile stress $S_{2t} = S_2 + S_p$ = 20,708 psi
Maximum compressive stress (shut down) $S_{2c} = S_2$ = 8,421 psi

Tensile stress is acceptable ($\leq 0.9*S_y$ = 34,200 psi)
Compressive stress is acceptable ($\leq 1.2*S_c$ = 17,057 psi)

Tangential shear stress in the shell (right saddle, Wind, Test)

Q_{shear} = Q - w*(a + 2*H / 3)
= 312,334.6 - 593.97*(200 + 2*33.425 / 3)
= 180,305.47 lb_f

$S_3 = K_{2.2}*Q_{shear}$ / (R*t)
= 0.9003*180,305.47 / (65.5625*0.875)
= 2,830 psi

Tangential shear stress is acceptable ($\leq 0.8*(0.9*S_y)$ = 27,360 psi)

Circumferential stress at the right saddle horns (Wind, Test)

S_4 = -Q / (4*(t+t_p)*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*(t^2+t_p^2))
= -312,334.6 / (4*(0.875+0.375)*(18+1.56*Sqr(66*0.875))) - 3*0.0379*312,334.6 / (2*(0.875^2+0.375^2))
= -21,685 psi

Circumferential stress at saddle horns is acceptable ($\leq 0.9*S_y$ = 34,200 psi)

Circumferential stress at the right saddle wear plate horns (Wind, Test)

S_4 = -Q / (4*t*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*t^2)
= -312,334.6 / (4*0.875*(18+1.56*Sqr(66*0.875))) - 3*0.0305*312,334.6 / (2*0.875^2)
= -21,653 psi

Circumferential stress at wear plate horns is acceptable ($\leq 0.9*S_y$ = 34,200 psi)

Ring compression in shell over right saddle (Wind, Test)

$S_5 = K_5$*Q / ((t + t_p)*(t_s + 1.56*Sqr(R_o*t_c)))
= 0.6971*312,334.6 / ((0.875 + 0.375)*(0.75 + 1.56*Sqr(66*1.25)))
= 11,675 psi

Ring compression in shell is acceptable ($\leq 0.9*S_y$ = 32,400 psi)

Saddle splitting load (right, Wind, Test)

Area resisting splitting force = Web area + wear plate area

$A_e = H_{eff}*t_s + t_p*W_p$
= 10.125*0.75 + 0.375*30
= 18.8438 in^2

$S_6 = K_8*Q / A_e$
= 0.2404*312,334.6 / 18.8438
= 3,985 psi

Stress in saddle is acceptable ($\leq 0.9*S_y$ = 32,400 psi)

Longitudinal stress at the left saddle (Wind, Test)

L_e = 2*(Left head depth) / 3 + L + 2*(Right head depth) / 3
= 2*33.425 / 3 + 998 + 2*33.425 / 3
= 1,042.5667 in

w = W_t / L_e = 619,251 / 1,042.5667 = 593.97 lb_f/in

Bending moment at the left saddle:

$M_q = w*(2*H*A_l / 3 + A_l^2 / 2 - (R^2 - H^2) / 4)$
$= 593.97*(2*33.425*200 / 3 + 200^2 / 2 - (66^2 - 33.425^2) / 4)$
$= 14{,}045{,}540.6$ lb_f-in

$S_2 = \pm M_q*K_1' / (\pi*R^2*t)$
$= 14{,}045{,}540.6*7.0845 / (\pi*65.5625^2*0.875)$
$= 8{,}421$ psi

$S_p = P*R / (2*t)$
$= 330.17*65.125 / (2*0.875)$
$= 12{,}287$ psi

Maximum tensile stress $S_{2t} = S_2 + S_p = 20{,}708$ psi
Maximum compressive stress (shut down) $S_{2c} = S_2 = 8{,}421$ psi

Tensile stress is acceptable ($\leq 0.9*S_y = 34{,}200$ psi)
Compressive stress is acceptable ($\leq 1.2*S_c = 17{,}057$ psi)

Tangential shear stress in the shell (left saddle, Wind, Test)

$Q_{shear} = Q - w*(a + 2*H / 3)$
$= 310{,}935.6 - 593.97*(200 + 2*33.425 / 3)$
$= 178{,}906.47$ lb_f

$S_3 = K_{2.2}*Q_{shear} / (R*t)$
$= 0.9003*178{,}906.47 / (65.5625*0.875)$
$= 2{,}808$ psi

Tangential shear stress is acceptable ($\leq 0.8*(0.9*S_y) = 27{,}360$ psi)

Circumferential stress at the left saddle horns (Wind, Test)

$S_4 = -Q / (4*(t+t_p)*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*(t^2+t_p^2))$
$= -310{,}935.6 / (4*(0.875+0.375)*(18+1.56*Sqr(66*0.875))) - 3*0.0379*310{,}935.6 / (2*(0.875^2+0.375^2))$
$= -21{,}588$ psi

Circumferential stress at saddle horns is acceptable ($\leq 0.9*S_y = 34{,}200$ psi)

Circumferential stress at the left saddle wear plate horns (Wind, Test)

$S_4 = -Q / (4*t*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*t^2)$
$= -310{,}935.6 / (4*0.875*(18+1.56*Sqr(66*0.875))) - 3*0.0305*310{,}935.6 / (2*0.875^2)$
$= -21{,}556$ psi

Circumferential stress at wear plate horns is acceptable ($\leq 0.9*S_y = 34{,}200$ psi)

Ring compression in shell over left saddle (Wind, Test)

$S_5 = K_5*Q / ((t + t_p)*(t_s + 1.56*Sqr(R_o*t_c)))$
$= 0.6971*310{,}935.6 / ((0.875 + 0.375)*(0.75 + 1.56*Sqr(66*1.25)))$
$= 11{,}623$ psi

Ring compression in shell is acceptable ($\leq 0.9*S_y = 32{,}400$ psi)

Saddle splitting load (left, Wind, Test)

Area resisting splitting force = Web area + wear plate area

$A_e = H_{eff}*t_s + t_p*W_p$
$= 10.125*0.75 + 0.375*30$
$= 18.8438$ in^2

$S_6 = K_8*Q / A_e$
$= 0.2404*310{,}935.6 / 18.8438$
$= 3{,}967$ psi

Stress in saddle is acceptable ($\leq 0.9*S_y = 32,400$ psi)

Load Case 4: Weight, Operating

Longitudinal stress between saddles (Weight, Operating, right saddle loading and geometry govern)

$S_1 = \pm\ 3*K_1*Q*(L / 12) / (\pi*R^2*t)$
$= 3*0.1619*310,287*(998 / 12) / (\pi*65.5625^2*0.875)$
$= 1,061$ psi

$S_p = P*R / (2*t)$
$= 254.7*65.125 / (2*0.875)$
$= 9,479$ psi

Maximum tensile stress $S_{1t} = S_1 + S_p = 10,539$ psi
Maximum compressive stress (shut down) $S_{1c} = S_1 = 1,061$ psi

Tensile stress is acceptable ($\leq S*E = 20,000$ psi)
Compressive stress is acceptable ($\leq S_c = 14,214$ psi)

Longitudinal stress at the right saddle (Weight, Operating)

$L_e = 2*(\text{Left head depth}) / 3 + L + 2*(\text{Right head depth}) / 3$
$= 2*33.425 / 3 + 998 + 2*33.425 / 3$
$= 1,042.5667$ in

$w = W_t / L_e = 619,159 / 1,042.5667 = 593.88\ lb_f/in$

Bending moment at the right saddle:

$M_q = w*(2*H*A_r / 3 + A_r^2 / 2 - (R^2 - H^2) / 4)$
$= 593.88*(2*33.425*200 / 3 + 200^2 / 2 - (66^2 - 33.425^2) / 4)$
$= 14,043,454\ lb_f\text{-}in$

$S_2 = \pm\ M_q*K_1' / (\pi*R^2*t)$
$= 14,043,454*7.0845 / (\pi*65.5625^2*0.875)$
$= 8,420$ psi

$S_p = P*R / (2*t)$
$= 254.7*65.125 / (2*0.875)$
$= 9,479$ psi

Maximum tensile stress $S_{2t} = S_2 + S_p = 17,899$ psi
Maximum compressive stress (shut down) $S_{2c} = S_2 = 8,420$ psi

Tensile stress is acceptable ($\leq S = 20,000$ psi)
Compressive stress is acceptable ($\leq S_c = 14,214$ psi)

Tangential shear stress in the shell (right saddle, Weight, Operating)

$Q_{shear} = Q - w*(a + 2*H / 3)$
$= 310,287 - 593.88*(200 + 2*33.425 / 3)$
$= 178,277.48\ lb_f$

$S_3 = K_{2.2}*Q_{shear} / (R*t)$
$= 0.9003*178,277.48 / (65.5625*0.875)$
$= 2,798$ psi

Tangential shear stress is acceptable ($\leq 0.8*S = 16,000$ psi)

Circumferential stress at the right saddle horns (Weight, Operating)

$S_4 = -Q / (4*(t+t_p)*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*(t^2+t_p^2))$
$= -310,287 / (4*(0.875+0.375)*(18+1.56*Sqr(66*0.875))) - 3*0.0379*310,287 / (2*(0.875^2+0.375^2))$
$= -21,543$ psi

Circumferential stress at saddle horns is acceptable ($\le 1.5*S_a = 30{,}000$ psi)

Circumferential stress at the right saddle wear plate horns (Weight, Operating)

$S_4 = -Q / (4*t*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*t^2)$
$= -310{,}287 / (4*0.875*(18+1.56*Sqr(66*0.875))) - 3*0.0305*310{,}287 / (2*0.875^2)$
$= -21{,}511$ psi

Circumferential stress at wear plate horns is acceptable ($\le 1.5*S_a = 30{,}000$ psi)

Ring compression in shell over right saddle (Weight, Operating)

$S_5 = K_5*Q / ((t + t_p)*(t_s + 1.56*Sqr(R_o*t_c)))$
$= 0.6971*310{,}287 / ((0.875 + 0.375)*(0.75 + 1.56*Sqr(66*1.25)))$
$= 11{,}598$ psi

Ring compression in shell is acceptable ($\le 0.5*S_y = 18{,}000$ psi)

Saddle splitting load (right, Weight, Operating)

Area resisting splitting force = Web area + wear plate area

$A_e = H_{eff}*t_s + t_p*W_p$
$= 10.125*0.75 + 0.375*30$
$= 18.8438$ in^2

$S_6 = K_8*Q / A_e$
$= 0.2404*310{,}287 / 18.8438$
$= 3{,}959$ psi

Stress in saddle is acceptable ($\le (2 / 3)*S_s = 14{,}400$ psi)

Longitudinal stress at the left saddle (Weight, Operating)

$L_e = 2*(\text{Left head depth}) / 3 + L + 2*(\text{Right head depth}) / 3$
$= 2*33.425 / 3 + 998 + 2*33.425 / 3$
$= 1{,}042.5667$ in

$w = W_t / L_e = 619{,}159 / 1{,}042.5667 = 593.88$ lb$_f$/in

Bending moment at the left saddle:

$M_q = w*(2*H*A_l / 3 + A_l^2 / 2 - (R^2 - H^2) / 4)$
$= 593.88*(2*33.425*200 / 3 + 200^2 / 2 - (66^2 - 33.425^2) / 4)$
$= 14{,}043{,}454$ lb$_f$-in

$S_2 = \pm M_q*K_1' / (\pi*R^2*t)$
$= 14{,}043{,}454*7.0845 / (\pi*65.5625^2*0.875)$
$= 8{,}420$ psi

$S_p = P*R / (2*t)$
$= 254.7*65.125 / (2*0.875)$
$= 9{,}479$ psi

Maximum tensile stress $S_{2t} = S_2 + S_p = 17{,}899$ psi
Maximum compressive stress (shut down) $S_{2c} = S_2 = 8{,}420$ psi

Tensile stress is acceptable ($\le S = 20{,}000$ psi)
Compressive stress is acceptable ($\le S_c = 14{,}214$ psi)

Tangential shear stress in the shell (left saddle, Weight, Operating)

$Q_{shear} = Q - w*(a + 2*H / 3)$
$= 308{,}872 - 593.88*(200 + 2*33.425 / 3)$
$= 176{,}862.48$ lb$_f$

$S_3 = K_{2.2}*Q_{shear} / (R*t)$

= 0.9003*176,862.48 / (65.5625*0.875)
= 2,776 psi

Tangential shear stress is acceptable ($\leq$ 0.8*S = 16,000 psi)

Circumferential stress at the left saddle horns (Weight, Operating)

S_4 = -Q / (4*(t+t_p)*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*(t^2+t_p^2))
= -308,872 / (4*(0.875+0.375)*(18+1.56*Sqr(66*0.875))) - 3*0.0379*308,872 / (2*(0.875^2+0.375^2))
= -21,445 psi

Circumferential stress at saddle horns is acceptable ($\leq$ 1.5*S_a = 30,000 psi)

Circumferential stress at the left saddle wear plate horns (Weight, Operating)

S_4 = -Q / (4*t*(b+1.56*Sqr(R_o*t))) - 3*K_3*Q / (2*t^2)
= -308,872 / (4*0.875*(18+1.56*Sqr(66*0.875))) - 3*0.0305*308,872 / (2*0.875^2)
= -21,413 psi

Circumferential stress at wear plate horns is acceptable ($\leq$ 1.5*S_a = 30,000 psi)

Ring compression in shell over left saddle (Weight, Operating)

S_5 = K_5*Q / ((t + t_p)*(t_s + 1.56*Sqr(R_o*t_c)))
= 0.6971*308,872 / ((0.875 + 0.375)*(0.75 + 1.56*Sqr(66*1.25)))
= 11,545 psi

Ring compression in shell is acceptable ($\leq$ 0.5*S_y = 18,000 psi)

Saddle splitting load (left, Weight, Operating)

Area resisting splitting force = Web area + wear plate area

A_e = H_{eff}*t_s + t_p*W_p
= 10.125*0.75 + 0.375*30
= 18.8438 in^2

S_6 = K_8*Q / A_e
= 0.2404*308,872 / 18.8438
= 3,940 psi

Stress in saddle is acceptable ($\leq$ (2 / 3)*S_s = 14,400 psi)

Shear stress in anchor bolting, one end slotted

Maximum seismic or wind base shear = 119,188.11 lb_f

Thermal expansion base shear = W*μ = 313,432*0.45 = 141,044.4 lb_f
Corroded root area for a 2.75" series 8 threaded bolt = 5.259 in^2 (4 per saddle)

Bolt shear stress = 141,044.4 / (5.259*1*4) = 6,705 psi

Anchor bolt stress is acceptable ($\leq$ 10,000 psi)

Shear stress in anchor bolting, transverse

Maximum seismic or wind base shear = 119,188.11 lb_f
Corroded root area for a 2.75" series 8 threaded bolt = 5.259 in^2 (4 per saddle)

Bolt shear stress = 119,188.11 / (5.259*2*4) = 2,833 psi

Anchor bolt stress is acceptable ($\leq$ 10,000 psi)

Web plate buckling check (Escoe pg 251)

Allowable compressive stress S_c is the lesser of 21,600 or 42,963 psi: (21,600)

S_c = K_i*π^2*E / (12*(1 - 0.3^2)*(d_i / t_s)^2)

$= 1.28*\pi^2*29E+06 / (12*(1 - 0.3^2)*(20.9583 / 0.75)^2)$
= 42,963 psi

Allowable compressive load on the saddle

$b_e = d_i*t_s / (d_i*t_s + 2*t_w*(b - 1))$
= 20.9583*0.75 / (20.9583*0.75 + 2*0.75*(18 - 1))
= 0.3814

$F_b = n*(A_s + 2*b_e*t_s)*S_c$
= 7*(12.9375 + 2*0.3814*0.75)*21,600
= 2,042,640.07 lb_f

Saddle loading of 420,408.75 lb_f is $\leq F_b$; satisfactory.

Primary bending + axial stress in the saddle due to end loads (assumes one saddle slotted)

$\sigma_b = V*(H_s - x_o)*y / I + Q / A$
= 119,188.11*(78 - 50.7638)*9 / 2,553.35 + 417,263.75 / 183.5921
= 13,715 psi

The primary bending + axial stress in the saddle $\leq S_s$ = 21,600 psi; satisfactory.

Secondary bending + axial stress in the saddle due to end loads (includes thermal expansion, assumes one saddle slotted)

$\sigma_b = V*(H_s - x_o)*y / I + Q / A$
= 260,232.51*(78 - 50.7638)*9 / 2,553.35 + 417,263.75 / 183.5921
= 27,256 psi

The secondary bending + axial stress in the saddle $\leq 2*S_y$ = 72,000 psi; satisfactory.

Saddle base plate thickness check (Roark sixth edition, Table 26, case 7a)

where a = 20.9583, b = 10.625 in

$t_b = (\beta_1*q*b^2 / (1.5*S_a))^{0.5}$
$= (1.7753*148*10.625^2 / (1.5*21,600))^{0.5}$
= 0.9572 in

The base plate thickness of 1.5 in is adequate.

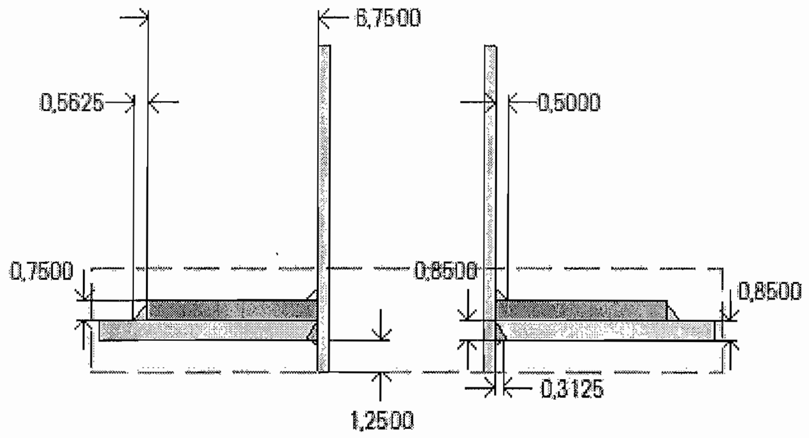
Foundation bearing check

$S_f = Q_{max} / (F*E)$
= 420,408.75 / (22*129)
= 148 psi

Concrete bearing stress ≤ 1,350 psi ; satisfactory.

Nozzle M1 - 20" 150# Manway (M1)

ASME Section VIII Division 1, 2017 Edition



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

Location and Orientation	
Located on	Right Head
Orientation	0°
End of nozzle to datum line	-57.5"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Description	NPS 20 Sch 30 (XS)
Access opening	Yes
Material specification	SA-106 B Smls pipe (II-D p. 14, ln. 10)
Inside diameter, new	19"
Pipe nominal wall thickness	0.5"
Pipe minimum wall thickness[1]	0.4375"
Corrosion allowance	0"
Projection available outside vessel, Lpr	4.7709"
Internal projection, h_{new}	1.25"
Projection available outside vessel to flange face, Lf	10.4609"
Local vessel minimum thickness	0.85"
Liquid static head included	2.35 psi
Longitudinal joint efficiency	0.85
Reinforcing Pad	
Material specification	SA-516 70 (II-D p. 18, ln. 33)

Diameter, D_p	33.5"
Thickness, t_e	0.75"
Is split	No
Welds	
Inner fillet, Leg_{41}	0.5"
Outer fillet, Leg_{42}	0.5625"
Lower fillet, Leg_{43}	0.3125"
Nozzle to vessel groove weld	0.85"
Pad groove weld	0"

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

ASME B16.5-2013 Flange	
Description	NPS 20 Class 150 WN A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	Yes
Rated MDMT	-31.5°F
Liquid static head	2.35 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Circumferential joint radiography	None UW-11(c) Type 1
Bore diameter, B (specified by purchaser)	19"
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -31.5°F (Coincident ratio = 0.8854) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle	
t_r = 252.35*9.5 / (17,100*0.85 - 0.6*252.35) =	0.1667"
Stress ratio = t_r*E* / (t_n - c) = 0.1667*0.85 / (0.4375 - 0) =	0.3238
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Pad	
Governing thickness, t_g =	0.75"

MDMT =	-20°F
Material is exempt from impact testing per UG-20(f) 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 = 252.35 psi @ 125 °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}
14.2768	15.0001	1.9662	1.2264	1.0688	10.125	0.6137	0.1667	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
247,995.38	237,632	473,400.7	66,384	609,090.02	275,212	767,549.99

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to pad fillet (Leg_{41})	0.35	0.35	weld size is adequate
Pad to shell fillet (Leg_{42})	0.375	0.3938	weld size is adequate

Calculations for internal pressure 252.35 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

$$
\begin{aligned}
L_R &= \text{MAX}(d, R_n + (t_n - C_n) + (t - C)) \\
&= \text{MAX}(19, 9.5 + (0.5 - 0) + (0.85 - 0)) \\
&= 19 \text{ in}
\end{aligned}
$$

Outer Normal Limit of reinforcement per UG-40

$$
\begin{aligned}
L_H &= \text{MIN}(2.5*(t - C), 2.5*(t_n - C_n) + t_e) \\
&= \text{MIN}(2.5*(0.85 - 0), 2.5*(0.5 - 0) + 0.75) \\
&= 2 \text{ in}
\end{aligned}
$$

Inner Normal Limit of reinforcement per UG-40

$$
\begin{aligned}
L_I &= \text{MIN}(h, 2.5*(t - C), 2.5*(t_i - C_n - C)) \\
&= \text{MIN}(1.25, 2.5*(0.85 - 0), 2.5*(0.5 - 0 - 0)) \\
&= 1.25 \text{ in}
\end{aligned}
$$

Nozzle required thickness per UG-27(c)(1)

$$
\begin{aligned}
t_{rn} &= P*R_n / (S_n*E - 0.6*P) \\
&= 252.3508*9.5 / (17{,}100*1 - 0.6*252.3508) \\
&= 0.1414 \text{ in}
\end{aligned}
$$

Required thickness t_r from UG-37(a)(c)

$$
\begin{aligned}
t_r &= P*K_1*D_o / (2*S*E + 0.8*P) \\
&= 252.3508*0.9*132 / (2*20{,}000*1 + 0.8*252.3508) \\
&= 0.7457 \text{ in}
\end{aligned}
$$

Required thickness t_r per Interpretation VIII-1-07-50

t_r = $P*D_o*K / (2*S*E + 2*P*(K - 0.1))$
= $252.35*132*1 / (2*20{,}000*1 + 2*252.35*(1 - 0.1))$
= $0.8234''$

Area required per UG-37(c)

Allowable stresses: $S_n = 17{,}100$, $S_v = 20{,}000$, $S_p = 20{,}000$ psi

f_{r1} = lesser of 1 or $S_n / S_v = 0.855$

f_{r2} = lesser of 1 or $S_n / S_v = 0.855$

f_{r3} = lesser of f_{r2} or $S_p / S_v = 0.855$

f_{r4} = lesser of 1 or $S_p / S_v = 1$

A = $d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1})$
= $19*0.7457*1 + 2*0.5*0.7457*1*(1 - 0.855)$
= $\underline{14.2768}$ in^2

Area available from FIG. UG-37.1

A_1 = larger of the following= $\underline{1.9662}$ in^2

= $d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= $19*(1*0.85 - 1*0.7457) - 2*0.5*(1*0.85 - 1*0.7457)*(1 - 0.855)$
= 1.9662 in^2

= $2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= $2*(0.85 + 0.5)*(1*0.85 - 1*0.7457) - 2*0.5*(1*0.85 - 1*0.7457)*(1 - 0.855)$
= 0.2664 in^2

A_2 = smaller of the following= $\underline{1.2264}$ in^2

= $5*(t_n - t_{rn})*f_{r2}*t$
= $5*(0.5 - 0.1414)*0.855*0.85$
= 1.3031 in^2

= $2*(t_n - t_{rn})*(2.5*t_n + t_e)*f_{r2}$
= $2*(0.5 - 0.1414)*(2.5*0.5 + 0.75)*0.855$
= 1.2264 in^2

A_3 = smaller of the following= $\underline{1.0688}$ in^2

= $5*t*t_i*f_{r2}$
= $5*0.85*0.5*0.855$
= $\underline{1.8169}$ in^2

= $5*t_i*t_i*f_{r2}$
= $5*0.5*0.5*0.855$
= $\underline{1.0688}$ in^2

= $2*h*t_i*f_{r2}$
= $2*1.25*0.5*0.855$
= $\underline{1.0688}$ in^2

A_{41} = Leg^2*f_{r3}
= $0.5^2*0.855$
= $\underline{0.2138}$ in^2

A_{42} = Leg^2*f_{r4}
= 0.5625^2*1
= 0.3164 in^2

A_{43} = Leg^2*f_{r2}
= $0.3125^2*0.855$
= 0.0835 in^2

A_5 = $(D_p - d - 2*t_n)*t_e*f_{r4}$
= $(33.5 - 19 - 2*0.5)*0.75*1$
= 10.125 in^2

Area = $A_1 + A_2 + A_3 + A_{41} + A_{42} + A_{43} + A_5$
= $1.9662 + 1.2264 + 1.0688 + 0.2138 + 0.3164 + 0.0835 + 10.125$
= 15.0001 in^2

As Area >= A the reinforcement is adequate.

UW-16(c)(2) Weld Check

Inner fillet: t_{min} = lesser of 0.75 or t_n or t_e = 0.5 in
$t_{w(min)}$ = $0.7*t_{min}$ = 0.35 in
$t_{w(actual)}$ = $0.7*Leg = 0.7*0.5 = 0.35$ in

Outer fillet: t_{min} = lesser of 0.75 or t_e or t = 0.75 in
$t_{w(min)}$ = $0.5*t_{min}$ = 0.375 in
$t_{w(actual)}$ = $0.7*Leg = 0.7*0.5625 = 0.3938$ in

UG-45 Nozzle Neck Thickness Check (Access Opening)

Interpretation VIII-1-83-66 has been applied.
$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P)$ + Corrosion
= $252.3508*9.5 / (17{,}100*0.85 - 0.6*252.3508) + 0$
= 0.1667 in

t_a = max[$t_{a\ UG\text{-}27}$, $t_{a\ UG\text{-}22}$]
= max[0.1667 , 0]
= 0.1667 in

Available nozzle wall thickness new, $t_n = 0.875*0.5 = 0.4375$ in

The nozzle neck thickness is adequate.

Allowable stresses in joints UG-45 and UW-15(c)

Groove weld in tension: 0.74*20,000 = 14,800 psi
Nozzle wall in shear: 0.7*17,100 = 11,970 psi
Inner fillet weld in shear: 0.49*17,100 = 8,379 psi
Outer fillet weld in shear: 0.49*20,000 = 9,800 psi
Lower fillet weld in shear: 0.49*17,100 = 8,379 psi

Strength of welded joints:

(1) Inner fillet weld in shear
$(\pi / 2)*\text{Nozzle OD}*Leg*S_i = (\pi / 2)*20*0.5*8{,}379 = 131{,}617.02\ lb_f$

(2) Outer fillet weld in shear

$(\pi / 2)$*Pad OD*Leg*S_o = $(\pi / 2)$*33.5*0.5625*9,800 = 290,076.99 lb_f

(3) Nozzle wall in shear
$(\pi / 2)$*Mean nozzle dia*t_n*S_n = $(\pi / 2)$*19.5*0.5*11,970 = 183,323.71 lb_f

(4) Groove weld in tension
$(\pi / 2)$*Nozzle OD*t_w*S_g = $(\pi / 2)$*20*0.85*14,800 = 395,212.35 lb_f

(5) Lower fillet weld in shear
$(\pi / 2)$*Nozzle OD*Leg*S_l = $(\pi / 2)$*20*0.3125*8,379 = 82,260.64 lb_f

Loading on welds per UG-41(b)(1)

$$\begin{aligned} W &= (A - A_1 + 2*t_n*f_{r1}*(E_1*t - F*t_r))*S_v \\ &= (14.2768 - 1.9662 + 2*0.5*0.855*(1*0.85 - 1*0.7457))*20{,}000 \\ &= \underline{247{,}995.38}\ lb_f \end{aligned}$$

$$\begin{aligned} W_{1\text{-}1} &= (A_2 + A_5 + A_{41} + A_{42})*S_v \\ &= (1.2264 + 10.125 + 0.2138 + 0.3164)*20{,}000 \\ &= \underline{237{,}632}\ lb_f \end{aligned}$$

$$\begin{aligned} W_{2\text{-}2} &= (A_2 + A_3 + A_{41} + A_{43} + 2*t_n*t*f_{r1})*S_v \\ &= (1.2264 + 1.0688 + 0.2138 + 0.0835 + 2*0.5*0.85*0.855)*20{,}000 \\ &= \underline{66{,}384}\ lb_f \end{aligned}$$

$$\begin{aligned} W_{3\text{-}3} &= (A_2 + A_3 + A_5 + A_{41} + A_{42} + A_{43} + 2*t_n*t*f_{r1})*S_v \\ &= (1.2264 + 1.0688 + 10.125 + 0.2138 + 0.3164 + 0.0835 + 2*0.5*0.85*0.855)*20{,}000 \\ &= \underline{275{,}212}\ lb_f \end{aligned}$$

Load for path 1-1 lesser of W or $W_{1\text{-}1}$ = 237,632 lb_f
Path 1-1 through (2) & (3) = 290,076.99 + 183,323.71 = $\underline{473{,}400.7}$ lb_f
Path 1-1 is stronger than $W_{1\text{-}1}$ so it is acceptable per UG-41(b)(1).

Load for path 2-2 lesser of W or $W_{2\text{-}2}$ = 66,384 lb_f
Path 2-2 through (1), (4), (5) = 131,617.02 + 395,212.35 + 82,260.64 = $\underline{609{,}090.02}$ lb_f
Path 2-2 is stronger than $W_{2\text{-}2}$ so it is acceptable per UG-41(b)(1).

Load for path 3-3 lesser of W or $W_{3\text{-}3}$ = 247,995.38 lb_f
Path 3-3 through (2), (4), (5) = 290,076.99 + 395,212.35 + 82,260.64 = $\underline{767{,}549.99}$ lb_f
Path 3-3 is stronger than W so it is acceptable per UG-41(b)(2).

Nozzle M2 - 20" 150# Manway (Nozzle M3 similar) (M2)

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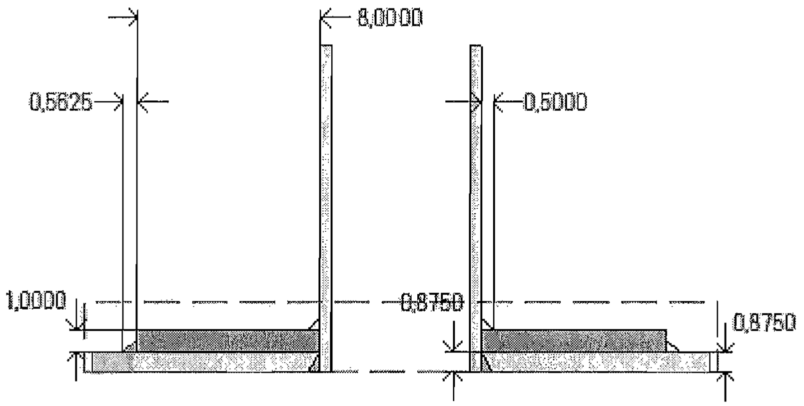

Note: round inside edges per UG-76(c)

Location and Orientation

Located on	Shell
Orientation	270°
Nozzle center line offset to datum line	84"
End of nozzle to shell center	75"
Offset from center, Lo	-32"
Passes through a Category A joint	No

Nozzle

Description	NPS 20 Sch 30 (XS)
Access opening	Yes
Material specification	SA-106 B Smls pipe (II-D p. 14, ln. 10)
Inside diameter, new	19"
Pipe nominal wall thickness	0.5"
Pipe minimum wall thickness[1]	0.4375"
Corrosion allowance	0"
Opening chord length	21.8695"
Projection available outside vessel, Lpr	7.0846"
Projection available outside vessel to flange face, Lf	12.7746"
Local vessel minimum thickness	0.875"
Liquid static head included	3.51 psi
Longitudinal joint efficiency	0.85

Reinforcing Pad

Material specification	SA-516 70 (II-D p. 18, ln. 33)

Diameter, D_p	38.9783"
Thickness, t_e	1"
Is split	No
Welds	
Inner fillet, Leg_{41}	0.5"
Outer fillet, Leg_{42}	0.5625"
Nozzle to vessel groove weld	0.875"
Pad groove weld	0"

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

ASME B16.5-2013 Flange	
Description	NPS 20 Class 150 WN A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	Yes
Rated MDMT	-31.1°F
Liquid static head	3.51 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Circumferential joint radiography	None UW-11(c) Type 1
Bore diameter, B (specified by purchaser)	19"
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -31.1°F (Coincident ratio = 0.8895) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle	
t_r = 253.51*9.5 / (17,100*0.85 - 0.6*253.51) =	0.1674"
Stress ratio = t_r*E^* / (t_n - c) = 0.1674*0.85 / (0.4375 - 0) =	0.3253
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Pad	
Governing thickness, t_g =	0.875"
MDMT =	-20°F

Material is exempt from impact testing per UG-20(f) 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 = 253.51 psi @ 125 °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}
18.3238	18.7955	0.9265	1.3388	--	16	0.5302	0.1674	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
348,674.7	357,380	520,837.38	46,014.5	538,453.27	372,342.5	744,349.92

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to pad fillet (Leg_{41})	0.35	0.35	weld size is adequate
Pad to shell fillet (Leg_{42})	0.375	0.3938	weld size is adequate

Calculations for internal pressure 253.51 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

$$
\begin{aligned}
L_R &= \text{MAX}(d, R_n + (t_n - C_n) + (t - C)) \\
&= \text{MAX}(21.8695, 10.9348 + (0.5 - 0) + (0.875 - 0)) \\
&= 21.8695 \text{ in}
\end{aligned}
$$

Outer Normal Limit of reinforcement per UG-40

$$
\begin{aligned}
L_H &= \text{MIN}(2.5*(t - C), 2.5*(t_n - C_n) + t_e) \\
&= \text{MIN}(2.5*(0.875 - 0), 2.5*(0.5 - 0) + 1) \\
&= 2.1875 \text{ in}
\end{aligned}
$$

Nozzle required thickness per UG-27(c)(1)

$$
\begin{aligned}
t_{rn} &= P*R_n / (S_n*E - 0.6*P) \\
&= 253.5059*9.5 / (17{,}100*1 - 0.6*253.5059) \\
&= 0.1421 \text{ in}
\end{aligned}
$$

Required thickness t_r from UG-37(a)

$$
\begin{aligned}
t_r &= P*R_o / (S*E + 0.4*P) \\
&= 253.5059*66 / (20{,}000*1 + 0.4*253.5059) \\
&= 0.8323 \text{ in}
\end{aligned}
$$

Area required per UG-37(c)

Allowable stresses: $S_n = 17{,}100$, $S_v = 20{,}000$, $S_p = 20{,}000$ psi

f_{r1} = lesser of 1 or $S_n / S_v = 0.855$

f_{r2} = lesser of 1 or $S_n / S_v = 0.855$

f_{r3} = lesser of f_{r2} or $S_p / S_v = 0.855$

f_{r4} = lesser of 1 or $S_p / S_v = 1$

A = $d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1})$
= $21.8695*0.8324*1 + 2*0.5*0.8324*1*(1 - 0.855)$
= 18.3238 in^2

Area available from FIG. UG-37.1

A_1 = larger of the following= 0.9265 in^2

= $d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= $21.8695*(1*0.875 - 1*0.8324) - 2*0.5*(1*0.875 - 1*0.8324)*(1 - 0.855)$
= 0.9265 in^2

= $2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= $2*(0.875 + 0.5)*(1*0.875 - 1*0.8324) - 2*0.5*(1*0.875 - 1*0.8324)*(1 - 0.855)$
= 0.1111 in^2

A_2 = smaller of the following= 1.3388 in^2

= $5*(t_n - t_{rn})*f_{r2}*t$
= $5*(0.5 - 0.1421)*0.855*0.875$
= 1.3388 in^2

= $2*(t_n - t_{rn})*(2.5*t_n + t_e)*f_{r2}$
= $2*(0.5 - 0.1421)*(2.5*0.5 + 1)*0.855$
= 1.377 in^2

A_{41} = Leg^2*f_{r3}
= $0.5^2*0.855$
= 0.2138 in^2

A_{42} = Leg^2*f_{r4}
= 0.5625^2*1
= 0.3164 in^2

A_5 = $(D_p - d - 2*t_n)*t_e*f_{r4}$
= $(38.9783 - 22.9783)*1*1$
= 16 in^2

Area = $A_1 + A_2 + A_{41} + A_{42} + A_5$
= $0.9265 + 1.3388 + 0.2138 + 0.3164 + 16$
= 18.7955 in^2

As Area >= A the reinforcement is adequate.

UW-16(c)(2) Weld Check

Inner fillet: t_{min} = lesser of 0.75 or t_n or t_e = 0.5 in
$t_{w(min)}$ = $0.7*t_{min}$ = 0.35 in
$t_{w(actual)}$ = $0.7*Leg = 0.7*0.5 = 0.35$ in

Outer fillet: t_{min} = lesser of 0.75 or t_e or t = 0.75 in
$t_{w(min)}$ = $0.5*t_{min}$ = 0.375 in
$t_{w(actual)}$ = $0.7*Leg = 0.7*0.5625 = 0.3938$ in

UG-45 Nozzle Neck Thickness Check (Access Opening)

$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P) + Corrosion$
= 253.5059*9.5 / (17,100*0.85 - 0.6*253.5059) + 0
= 0.1674 in

t_a = max[$t_{a\ UG\text{-}27}$, $t_{a\ UG\text{-}22}$]
= max[0.1674 , 0]
= 0.1674 in

Available nozzle wall thickness new, t_n = 0.875*0.5 = 0.4375 in

The nozzle neck thickness is adequate.

Allowable stresses in joints UG-45 and UW-15(c)

Groove weld in tension: 0.74*20,000 = 14,800 psi
Nozzle wall in shear: 0.7*17,100 = 11,970 psi
Inner fillet weld in shear: 0.49*17,100 = 8,379 psi
Outer fillet weld in shear: 0.49*20,000 = 9,800 psi

Strength of welded joints:

(1) Inner fillet weld in shear
$(\pi / 2)$*Nozzle OD*Leg*S_i = $(\pi / 2)$*20*0.5*8,379 = 131,617.02 lb_f

(2) Outer fillet weld in shear
$(\pi / 2)$*Pad OD*Leg*S_o = $(\pi / 2)$*38.9783*0.5625*9,800 = 337,513.67 lb_f

(3) Nozzle wall in shear
$(\pi / 2)$*Mean nozzle dia*t_n*S_n = $(\pi / 2)$*19.5*0.5*11,970 = 183,323.71 lb_f

(4) Groove weld in tension
$(\pi / 2)$*Nozzle OD*t_w*S_g = $(\pi / 2)$*20*0.875*14,800 = 406,836.25 lb_f

Loading on welds per UG-41(b)(1)

W = $(A - A_1 + 2*t_n*f_{r1}*(E_1*t - F*t_r))*S_v$
= (18.3238 - 0.9265 + 2*0.5*0.855*(1*0.875 - 1*0.8324))*20,000
= 348,674.7 lb_f

W_{1-1} = $(A_2 + A_5 + A_{41} + A_{42})*S_v$
= (1.3388 + 16 + 0.2138 + 0.3164)*20,000
= 357,380 lb_f

W_{2-2} = $(A_2 + A_3 + A_{41} + A_{43} + 2*t_n*t*f_{r1})*S_v$
= (1.3388 + 0 + 0.2138 + 0 + 2*0.5*0.875*0.855)*20,000
= 46,014.5 lb_f

W_{3-3} = $(A_2 + A_3 + A_5 + A_{41} + A_{42} + A_{43} + 2*t_n*t*f_{r1})*S_v$
= (1.3388 + 0 + 16 + 0.2138 + 0.3164 + 0 + 2*0.5*0.875*0.855)*20,000
= 372,342.5 lb_f

Load for path 1-1 lesser of W or W_{1-1} = 348,674.7 lb_f
Path 1-1 through (2) & (3) = 337,513.67 + 183,323.71 = 520,837.38 lb_f
Path 1-1 is stronger than W so it is acceptable per UG-41(b)(2).

Load for path 2-2 lesser of W or W_{2-2} = 46,014.5 lb_f

Path 2-2 through (1), (4) = 131,617.02 + 406,836.25 = 538,453.27 lb_f
Path 2-2 is stronger than W_{2-2} so it is acceptable per UG-41(b)(1).

Load for path 3-3 lesser of W or W_{3-3} = 348,674.7 lb_f
Path 3-3 through (2), (4) = 337,513.67 + 406,836.25 = 744,349.92 lb_f
Path 3-3 is stronger than W so it is acceptable per UG-41(b)(2).

Nozzle N1 - 24" 150# Inlet (Nozzle N2 similar) (N1)

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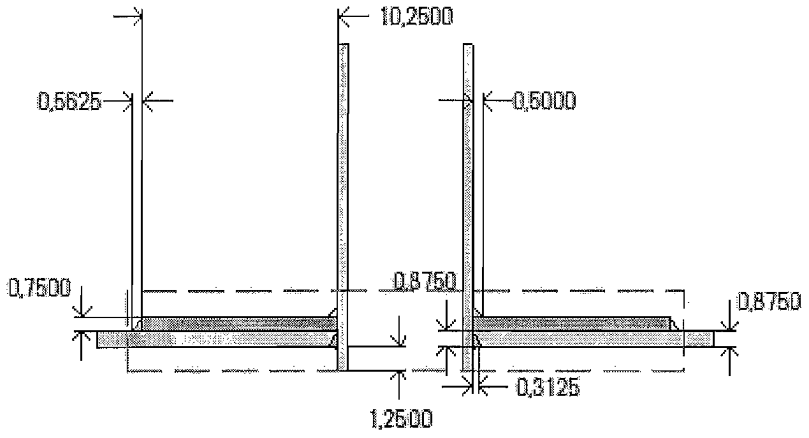

Note: round inside edges per UG-76(c)

Location and Orientation

Located on	Shell
Orientation	0°
Nozzle center line offset to datum line	148"
End of nozzle to shell center	78"
Passes through a Category A joint	No

Nozzle

Description	NPS 24 XS
Access opening	No
Material specification	SA-106 B Smls pipe (II-D p. 14, ln. 10)
Inside diameter, new	23"
Pipe nominal wall thickness	0.5"
Pipe minimum wall thickness[1]	0.4375"
Corrosion allowance	0"
Projection available outside vessel, Lpr	6"
Internal projection, h_{new}	1.25"
Projection available outside vessel to flange face, Lf	12"
Local vessel minimum thickness	0.875"
Liquid static head included	0 psi
Longitudinal joint efficiency	0.85

Reinforcing Pad

Material specification	SA-516 70 (II-D p. 18, ln. 33)
Diameter, D_p	44.5"

Thickness, t_e	0.75"
Is split	No
Welds	
Inner fillet, Leg$_{41}$	0.5"
Outer fillet, Leg$_{42}$	0.5625"
Lower fillet, Leg$_{43}$	0.3125"
Nozzle to vessel groove weld	0.875"
Pad groove weld	0"

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

ASME B16.5-2013 Flange	
Description	NPS 24 Class 150 WN A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	No
Rated MDMT	-32.3°F
Liquid static head	0 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Circumferential joint radiography	None UW-11(c) Type 1
Bore diameter, B (specified by purchaser)	23"
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772) 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 = 250*11.5 / (17,100*0.85 - 0.6*250) =	0.1999"
Stress ratio = t_r*E^* / (t_n - c) = 0.1999*0.85 / (0.4375 - 0) =	0.3883
Reduction in MDMT, T_R from Fig UCS-66.1 =	101.6°F
MDMT = max[MDMT - T_R, -55] = max[-13 - 101.6 , -55] =	-55°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Pad	
Governing thickness, t_g =	0.75"
MDMT =	-20°F
Material is exempt from impact testing per UG-20(f) 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 = 250 psi @ 125 °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}
18.9997	19.424	1.2365	1.13	1.0688	15.375	0.6137	0.3281	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
356,189.72	340,704	606,254.73	64,883.5	744,856.69	378,711.5	972,242.42

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to pad fillet (Leg_{41})	0.35	0.35	weld size is adequate
Pad to shell fillet (Leg_{42})	0.375	0.3938	weld size is adequate

Calculations for internal pressure 250 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

L_R = MAX(d, R_n + (t_n - C_n) + (t - C))
= MAX(23, 11.5 + (0.5 - 0) + (0.875 - 0))
= 23 in

Outer Normal Limit of reinforcement per UG-40

L_H = MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e)
= MIN(2.5*(0.875 - 0), 2.5*(0.5 - 0) + 0.75)
= 2 in

Inner Normal Limit of reinforcement per UG-40

L_I = MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C))
= MIN(1.25, 2.5*(0.875 - 0), 2.5*(0.5 - 0 - 0))
= 1.25 in

Nozzle required thickness per UG-27(c)(1)

t_{rn} = P*R_n / (S_n*E - 0.6*P)
= 250*11.5 / (17,100*1 - 0.6*250)
= 0.1696 in

Required thickness t_r from UG-37(a)

t_r = P*R_o / (S*E + 0.4*P)
= 250*66 / (20,000*1 + 0.4*250)
= 0.8209 in

Area required per UG-37(c)

Allowable stresses: $S_n = 17{,}100$, $S_v = 20{,}000$, $S_p = 20{,}000$ psi

f_{r1} = lesser of 1 or $S_n / S_v = 0.855$

f_{r2} = lesser of 1 or $S_n / S_v = 0.855$

f_{r3} = lesser of f_{r2} or $S_p / S_v = 0.855$

f_{r4} = lesser of 1 or $S_p / S_v = 1$

$$\begin{aligned} A &= d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1}) \\ &= 23*0.8209*1 + 2*0.5*0.8209*1*(1 - 0.855) \\ &= \underline{18.9997}\ \text{in}^2 \end{aligned}$$

Area available from FIG. UG-37.1

A_1 = larger of the following= $\underline{1.2365}$ in^2

$$\begin{aligned} &= d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1}) \\ &= 23*(1*0.875 - 1*0.8209) - 2*0.5*(1*0.875 - 1*0.8209)*(1 - 0.855) \\ &= 1.2365\ \text{in}^2 \end{aligned}$$

$$\begin{aligned} &= 2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1}) \\ &= 2*(0.875 + 0.5)*(1*0.875 - 1*0.8209) - 2*0.5*(1*0.875 - 1*0.8209)*(1 - 0.855) \\ &= 0.1409\ \text{in}^2 \end{aligned}$$

A_2 = smaller of the following= $\underline{1.13}$ in^2

$$\begin{aligned} &= 5*(t_n - t_{rn})*f_{r2}*t \\ &= 5*(0.5 - 0.1696)*0.855*0.875 \\ &= 1.2359\ \text{in}^2 \end{aligned}$$

$$\begin{aligned} &= 2*(t_n - t_{rn})*(2.5*t_n + t_e)*f_{r2} \\ &= 2*(0.5 - 0.1696)*(2.5*0.5 + 0.75)*0.855 \\ &= 1.13\ \text{in}^2 \end{aligned}$$

A_3 = smaller of the following= $\underline{1.0688}$ in^2

$$\begin{aligned} &= 5*t*t_i*f_{r2} \\ &= 5*0.875*0.5*0.855 \\ &= \underline{1.8703}\ \text{in}^2 \end{aligned}$$

$$\begin{aligned} &= 5*t_i*t_i*f_{r2} \\ &= 5*0.5*0.5*0.855 \\ &= \underline{1.0688}\ \text{in}^2 \end{aligned}$$

$$\begin{aligned} &= 2*h*t_i*f_{r2} \\ &= 2*1.25*0.5*0.855 \\ &= \underline{1.0688}\ \text{in}^2 \end{aligned}$$

$$\begin{aligned} A_{41} &= Leg^2*f_{r3} \\ &= 0.5^2*0.855 \\ &= \underline{0.2138}\ \text{in}^2 \end{aligned}$$

$$\begin{aligned} A_{42} &= Leg^2*f_{r4} \\ &= 0.5625^2*1 \\ &= \underline{0.3164}\ \text{in}^2 \end{aligned}$$

$$\begin{aligned} A_{43} &= Leg^2*f_{r2} \\ &= 0.3125^2*0.855 \end{aligned}$$

= 0.0835 in^2

A_5 = $(D_p - d - 2*t_n)*t_e*f_{r4}$
= (44.5 - 23 - 2*0.5)*0.75*1
= 15.375 in^2

Area = $A_1 + A_2 + A_3 + A_{41} + A_{42} + A_{43} + A_5$
= 1.2365 + 1.13 + 1.0688 + 0.2138 + 0.3164 + 0.0835 + 15.375
= 19.424 in^2

As Area >= A the reinforcement is adequate.

UW-16(c)(2) Weld Check

Inner fillet: t_{min} = lesser of 0.75 or t_n or t_e = 0.5 in
$t_{w(min)}$ = 0.7*t_{min} = 0.35 in
$t_{w(actual)}$ = 0.7*Leg = 0.7*0.5 = 0.35 in

Outer fillet: t_{min} = lesser of 0.75 or t_e or t = 0.75 in
$t_{w(min)}$ = 0.5*t_{min} = 0.375 in
$t_{w(actual)}$ = 0.7*Leg = 0.7*0.5625 = 0.3938 in

UG-45 Nozzle Neck Thickness Check

$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P)$ + Corrosion
= 250*11.5 / (17,100*0.85 - 0.6*250) + 0
= 0.1999 in

t_a = max[$t_{a\ UG\text{-}27}$, $t_{a\ UG\text{-}22}$]
= max[0.1999 , 0]
= 0.1999 in

t_{b1} = $P*R_o / (S*E + 0.4*P)$ + Corrosion
= 250*66 / (20,000*1 + 0.4*250) + 0
= 0.8209 in

t_{b1} = max[t_{b1} , $t_{b\ UG16}$]
= max[0.8209 , 0.0625]
= 0.8209 in

t_b = min[t_{b3} , t_{b1}]
= min[0.3281 , 0.8209]
= 0.3281 in

$t_{UG\text{-}45}$ = max[t_a , t_b]
= max[0.1999 , 0.3281]
= 0.3281 in

Available nozzle wall thickness new, t_n = 0.875*0.5 = 0.4375 in

The nozzle neck thickness is adequate.

Allowable stresses in joints UG-45 and UW-15(c)

Groove weld in tension:	0.74*20,000 = 14,800 psi
Nozzle wall in shear:	0.7*17,100 = 11,970 psi
Inner fillet weld in shear:	0.49*17,100 = 8,379 psi
Outer fillet weld in shear:	0.49*20,000 = 9,800 psi

Lower fillet weld in shear: 0.49*17,100 = 8,379 psi

Strength of welded joints:

(1) Inner fillet weld in shear
$(\pi / 2)$*Nozzle OD*Leg*S_i = $(\pi / 2)$*24*0.5*8,379 = 157,940.43 lb_f

(2) Outer fillet weld in shear
$(\pi / 2)$*Pad OD*Leg*S_o = $(\pi / 2)$*44.5*0.5625*9,800 = 385,326.15 lb_f

(3) Nozzle wall in shear
$(\pi / 2)$*Mean nozzle dia*t_n*S_n = $(\pi / 2)$*23.5*0.5*11,970 = 220,928.58 lb_f

(4) Groove weld in tension
$(\pi / 2)$*Nozzle OD*t_w*S_g = $(\pi / 2)$*24*0.875*14,800 = 488,203.5 lb_f

(5) Lower fillet weld in shear
$(\pi / 2)$*Nozzle OD*Leg*S_l = $(\pi / 2)$*24*0.3125*8,379 = 98,712.77 lb_f

Loading on welds per UG-41(b)(1)

W = $(A - A_1 + 2*t_n*f_{r1}*(E_1*t - F*t_r))*S_v$
= (18.9997 - 1.2365 + 2*0.5*0.855*(1*0.875 - 1*0.8209))*20,000
= 356,189.72 lb_f

W_{1-1} = $(A_2 + A_5 + A_{41} + A_{42})*S_v$
= (1.13 + 15.375 + 0.2138 + 0.3164)*20,000
= 340,704 lb_f

W_{2-2} = $(A_2 + A_3 + A_{41} + A_{43} + 2*t_n*t*f_{r1})*S_v$
= (1.13 + 1.0688 + 0.2138 + 0.0835 + 2*0.5*0.875*0.855)*20,000
= 64,883.5 lb_f

W_{3-3} = $(A_2 + A_3 + A_5 + A_{41} + A_{42} + A_{43} + 2*t_n*t*f_{r1})*S_v$
= (1.13 + 1.0688 + 15.375 + 0.2138 + 0.3164 + 0.0835 + 2*0.5*0.875*0.855)*20,000
= 378,711.5 lb_f

Load for path 1-1 lesser of W or W_{1-1} = 340,704 lb_f
Path 1-1 through (2) & (3) = 385,326.15 + 220,928.58 = 606,254.73 lb_f
Path 1-1 is stronger than W_{1-1} so it is acceptable per UG-41(b)(1).

Load for path 2-2 lesser of W or W_{2-2} = 64,883.5 lb_f
Path 2-2 through (1), (4), (5) = 157,940.43 + 488,203.5 + 98,712.77 = 744,856.69 lb_f
Path 2-2 is stronger than W_{2-2} so it is acceptable per UG-41(b)(1).

Load for path 3-3 lesser of W or W_{3-3} = 356,189.72 lb_f
Path 3-3 through (2), (4), (5) = 385,326.15 + 488,203.5 + 98,712.77 = 972,242.42 lb_f
Path 3-3 is stronger than W so it is acceptable per UG-41(b)(2).

Nozzle N3 - 2" 150# LP Drain Inlet (Nozzle N4 similar) (N3)

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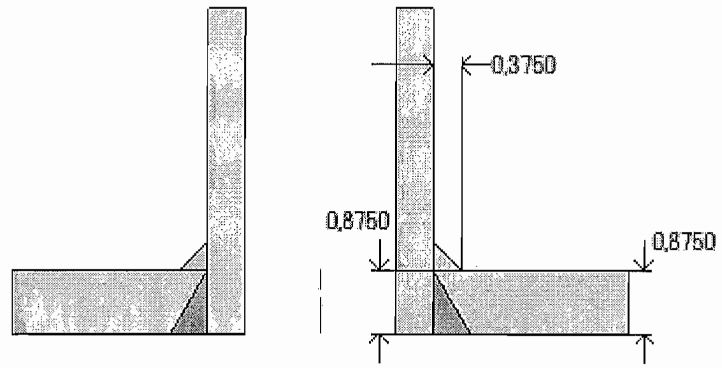	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	0°
Nozzle center line offset to datum line	24"
End of nozzle to shell center	74"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 19)
Inside diameter, new	2"
Nominal wall thickness	0.53"
Corrosion allowance	0"
Projection available outside vessel, Lpr	7.25"
Projection available outside vessel to flange face, Lf	8"
Local vessel minimum thickness	0.875"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.875"

ASME B16.5-2013 Flange	
Description	NPS 2 Class 150 LWN A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)

Blind included	No
Rated MDMT	-32.3°F
Liquid static head	0 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements	
LWN rated MDMT per UCS-66(c)(4) =	-32.3°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 = 250 psi @ 125 °F							The nozzle passes UG-45	
A required	**A available**	A_1	A_2	A_3	A_5	**A welds**	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.189	0.53

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

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

Calculations for internal pressure 250 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

$$
\begin{aligned}
L_R &= \text{MAX}(d, R_n + (t_n - C_n) + (t - C)) \\
&= \text{MAX}(2, 1 + (0.53 - 0) + (0.875 - 0)) \\
&= 2.405 \text{ in}
\end{aligned}
$$

Outer Normal Limit of reinforcement per UG-40

$$
\begin{aligned}
L_H &= \text{MIN}(2.5*(t - C), 2.5*(t_n - C_n) + t_e) \\
&= \text{MIN}(2.5*(0.875 - 0), 2.5*(0.53 - 0) + 0) \\
&= 1.325 \text{ in}
\end{aligned}
$$

Nozzle required thickness per UG-27(c)(1)

$$
\begin{aligned}
t_{rn} &= P*R_n / (S_n*E - 0.6*P) \\
&= 250*1 / (20{,}000*1 - 0.6*250) \\
&= 0.0126 \text{ in}
\end{aligned}
$$

Required thickness t_r from UG-37(a)

$$
\begin{aligned}
t_r &= P*R_o / (S*E + 0.4*P) \\
&= 250*66 / (20{,}000*1 + 0.4*250) \\
&= 0.8209 \text{ in}
\end{aligned}
$$

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

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.53 in
$t_{c(min)}$ = lesser of 0.25 or 0.7*t_{min} = 0.25 in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

$$\begin{aligned} t_{a\ UG\text{-}27} &= P*R_n / (S_n*E - 0.6*P) + \text{Corrosion} \\ &= 250*1 / (20{,}000*1 - 0.6*250) + 0 \\ &= 0.0126 \text{ in} \end{aligned}$$

$$\begin{aligned} t_a &= \max[\ t_{a\ UG\text{-}27} , t_{a\ UG\text{-}22}\ ] \\ &= \max[\ 0.0126 , 0\ ] \\ &= 0.0126 \text{ in} \end{aligned}$$

$$\begin{aligned} t_{b1} &= P*R_o / (S*E + 0.4*P) + \text{Corrosion} \\ &= 250*66 / (20{,}000*1 + 0.4*250) + 0 \\ &= 0.8209 \text{ in} \end{aligned}$$

$$\begin{aligned} t_{b1} &= \max[\ t_{b1} , t_{b\ UG16}\ ] \\ &= \max[\ 0.8209 , 0.0625\ ] \\ &= 0.8209 \text{ in} \end{aligned}$$

$$\begin{aligned} t_b &= \min[\ t_{b3} , t_{b1}\ ] \\ &= \min[\ 0.189 , 0.8209\ ] \\ &= 0.189 \text{ in} \end{aligned}$$

$$\begin{aligned} t_{UG\text{-}45} &= \max[\ t_a , t_b\ ] \\ &= \max[\ 0.0126 , 0.189\ ] \\ &= \underline{0.189} \text{ in} \end{aligned}$$

Available nozzle wall thickness new, $t_n = 0.53$ in

The nozzle neck thickness is adequate.

Nozzle N6 - 3" 150# Drain (Nozzles N9A & N9B similar) (N6)

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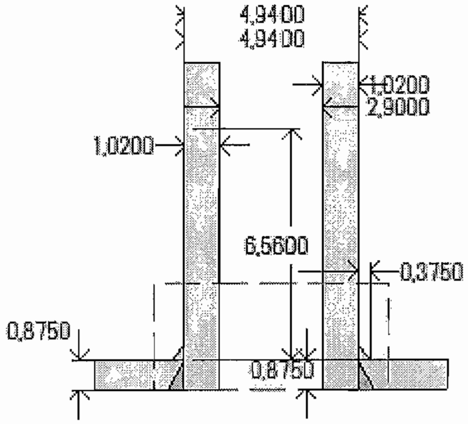

Note: Per UW-16(b) minimum inside corner radius r_1 = min [1 / 4*t , 0.125 in] = 0.125 in

Location and Orientation	
Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	24"
End of nozzle to shell center	74"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 19)
Inside diameter, new	2.9"
Wall thickness, t_n	1.02"
Minimum wall thickness	0.8325"
Corrosion allowance	0"
Projection available outside vessel, Lpr	7.06"
Heavy barrel length, L_{hb}	6.56"
Projection available outside vessel to flange face, Lf	8"
Local vessel minimum thickness	0.875"
Liquid static head included	4.73 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.875"

ASME B16.5-2013 Flange	
Description	NPS 3 Class 150 FVC HB A105 (Nut Stop)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	No
Rated MDMT	-30.5°F
Liquid static head	5.02 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -30.5°F (Coincident ratio = 0.8948) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
t_r = 254.73*1.45 / (20,000*1 - 0.6*254.73) =	0.0186"
Stress ratio = t_r*E^* / (t_n - c) = 0.0186*1 / (1.02 - 0) =	0.0183
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Nozzle	
t_r = 254.73*1.45 / (20,000*1 - 0.6*254.73) =	0.0186"
Stress ratio = t_r*E^* / (t_n - c) = 0.0186*1 / (0.8325 - 0) =	0.0224
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 254.73 psi @ 125 °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}
2.4254	4.6681	0.1464	4.3811	--	--	0.1406	0.2258	0.8325

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

Calculations for internal pressure 254.73 psi @ 125 °F

Parallel Limit of reinforcement per UG-40 and Fig. UG-40 sketch (e-2)

L_R = MAX(d, R_n + (t_n - C_n) + (t - C))
= MAX(2.9, 1.45 + (1.02 - 0) + (0.875 - 0))
= 3.345 in

Outer Normal Limit of reinforcement per UG-40 and Fig. UG-40 sketch (e-2)

L_H = MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e)
= MIN(2.5*(0.875 - 0), 2.5*(1.02 - 0) + 0)
= 2.1875 in

Nozzle required thickness per UG-27(c)(1)

t_{rn} = P*R_n / (S_n*E - 0.6*P)
= 254.7332*1.45 / (20,000*1 - 0.6*254.7332)
= 0.0186 in

Required thickness t_r from UG-37(a)

t_r = P*R_o / (S*E + 0.4*P)
= 254.7332*66 / (20,000*1 + 0.4*254.7332)
= 0.8364 in

Area required per UG-37(c)

Allowable stresses: S_n = 20,000, S_v = 20,000 psi

f_{r1} = lesser of 1 or S_n / S_v = 1

f_{r2} = lesser of 1 or S_n / S_v = 1

A = d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1})
= 2.9*0.8364*1 + 2*1.02*0.8364*1*(1 - 1)
= 2.4254 in^2

Area available from FIG. UG-37.1

A_1 = larger of the following= 0.1464 in^2

= $d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= $2.9*(1*0.875 - 1*0.8364) - 2*1.02*(1*0.875 - 1*0.8364)*(1 - 1)$
= 0.1121 in^2

= $2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= $2*(0.875 + 1.02)*(1*0.875 - 1*0.8364) - 2*1.02*(1*0.875 - 1*0.8364)*(1 - 1)$
= 0.1464 in^2

A_2 = smaller of the following= 4.3811 in^2

= $5*(t_n - t_{rn})*f_{r2}*t$
= $5*(1.02 - 0.0186)*1*0.875$
= 4.3811 in^2

= $5*(t_n - t_{rn})*f_{r2}*t_n$
= $5*(1.02 - 0.0186)*1*1.02$
= 5.1071 in^2

A_{41} = Leg^2*f_{r2}
= 0.375^2*1
= 0.1406 in^2

Area = $A_1 + A_2 + A_{41}$
= 0.1464 + 4.3811 + 0.1406
= 4.6681 in^2

As Area >= A the reinforcement is adequate.

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.75 in
$t_{c(min)}$ = lesser of 0.25 or $0.7*t_{min}$ = 0.25 in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P)$ + Corrosion
= 255.022*1.45 / (20,000*1 - 0.6*255.022) + 0
= 0.0186 in

t_a = max[$t_{a\ UG\text{-}27}$, $t_{a\ UG\text{-}22}$]
= max[0.0186 , 0]
= 0.0186 in

t_{b1} = $P*R_o / (S*E + 0.4*P)$ + Corrosion
= 254.7332*66 / (20,000*1 + 0.4*254.7332) + 0
= 0.8364 in

t_{b1} = max[t_{b1} , $t_{b\ UG16}$]
= max[0.8364 , 0.0625]
= 0.8364 in

t_b = min[t_{b3} , t_{b1}]
= min[0.2258 , 0.8364]
= 0.2258 in

t_{UG-45} = $\max[\ t_a\ ,\ t_b\ ]$
= $\max[\ 0.0186\ ,\ 0.2258\ ]$
= 0.2258 in

Available nozzle wall thickness new, $t_n = 0.8325$ in

The nozzle neck thickness is adequate.

Nozzle N7 - 6" 150# Drain (Nozzles N8 & N10 similar) (N7)

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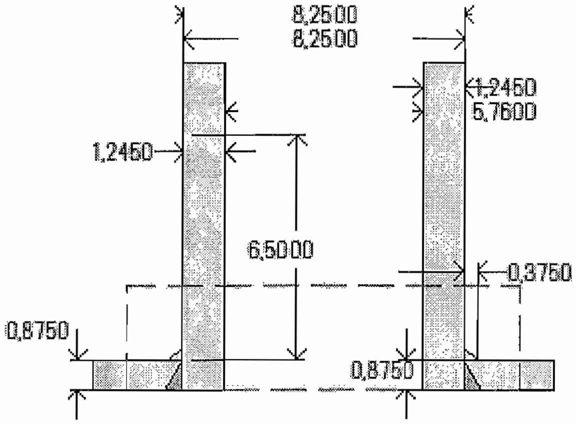

Note: Per UW-16(b) minimum inside corner radius r_1 = min [1 / 4*t , 0.125 in] = 0.125 in

Location and Orientation

Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	72"
End of nozzle to shell center	74"
Passes through a Category A joint	No

Nozzle

Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 19)
Inside diameter, new	5.76"
Wall thickness, t_n	1.245"
Minimum wall thickness	1.0575"
Corrosion allowance	0"
Projection available outside vessel, Lpr	7"
Heavy barrel length, L_{hb}	6.5"
Projection available outside vessel to flange face, Lf	8"
Local vessel minimum thickness	0.875"
Liquid static head included	4.73 psi
Longitudinal joint efficiency	1

Welds

Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.875"

ASME B16.5-2013 Flange	
Description	NPS 6 Class 150 FVC HB A105 (Nut Stop)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	No
Rated MDMT	-30.5°F
Liquid static head	5.02 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -30.5°F (Coincident ratio = 0.8948) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
t_r = 254.73*2.88 / (20,000*1 - 0.6*254.73) =	0.037"
Stress ratio = t_r*E^* / (t_n - c) = 0.037*1 / (1.245 - 0) =	0.0297
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Nozzle	
t_r = 254.73*2.88 / (20,000*1 - 0.6*254.73) =	0.037"
Stress ratio = t_r*E^* / (t_n - c) = 0.037*1 / (1.0575 - 0) =	0.035
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 254.73 psi @ 125 °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}
4.8174	5.6482	0.2226	5.285	--	--	0.1406	0.2818	1.0575

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

Calculations for internal pressure 254.73 psi @ 125 °F

Parallel Limit of reinforcement per UG-40 and Fig. UG-40 sketch (e-2)

$L_R = \text{MAX}(d, R_n + (t_n - C_n) + (t - C))$
$= \text{MAX}(5.76, 2.88 + (1.245 - 0) + (0.875 - 0))$
$= 5.76$ in

Outer Normal Limit of reinforcement per UG-40 and Fig. UG-40 sketch (e-2)

$L_H = \text{MIN}(2.5*(t - C), 2.5*(t_n - C_n) + t_e)$
$= \text{MIN}(2.5*(0.875 - 0), 2.5*(1.245 - 0) + 0)$
$= 2.1875$ in

Nozzle required thickness per UG-27(c)(1)

$t_{rn} = P*R_n / (S_n*E - 0.6*P)$
$= 254.7332*2.88 / (20{,}000*1 - 0.6*254.7332)$
$= 0.037$ in

Required thickness t_r from UG-37(a)

$t_r = P*R_o / (S*E + 0.4*P)$
$= 254.7332*66 / (20{,}000*1 + 0.4*254.7332)$
$= 0.8364$ in

Area required per UG-37(c)

Allowable stresses: $S_n = 20{,}000$, $S_v = 20{,}000$ psi

f_{r1} = lesser of 1 or $S_n / S_v = 1$

f_{r2} = lesser of 1 or $S_n / S_v = 1$

$A = d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1})$
$= 5.76*0.8364*1 + 2*1.245*0.8364*1*(1 - 1)$
$= 4.8174$ in^2

Area available from FIG. UG-37.1

A_1 = larger of the following= $\underline{0.2226}$ in^2

= $d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= 5.76*(1*0.875 - 1*0.8364) - 2*1.245*(1*0.875 - 1*0.8364)*(1 - 1)
= 0.2226 in^2

= $2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= 2*(0.875 + 1.245)*(1*0.875 - 1*0.8364) - 2*1.245*(1*0.875 - 1*0.8364)*(1 - 1)
= 0.1638 in^2

A_2 = smaller of the following= $\underline{5.285}$ in^2

= $5*(t_n - t_{rn})*f_{r2}*t$
= 5*(1.245 - 0.037)*1*0.875
= 5.285 in^2

= $5*(t_n - t_{rn})*f_{r2}*t_n$
= 5*(1.245 - 0.037)*1*1.245
= 7.5198 in^2

A_{41} = Leg^2*f_{r2}
= 0.375^2*1
= $\underline{0.1406}$ in^2

Area = $A_1 + A_2 + A_{41}$
= 0.2226 + 5.285 + 0.1406
= $\underline{5.6482}$ in^2

As Area >= A the reinforcement is adequate.

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.75 in
$t_{c(min)}$ = lesser of 0.25 or 0.7*t_{min} = $\underline{0.25}$ in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P)$ + Corrosion
= 255.022*2.88 / (20,000*1 - 0.6*255.022) + 0
= 0.037 in

t_a = max[$t_{a\ UG\text{-}27}$, $t_{a\ UG\text{-}22}$]
= max[0.037 , 0]
= 0.037 in

t_{b1} = $P*R_o / (S*E + 0.4*P)$ + Corrosion
= 254.7332*66 / (20,000*1 + 0.4*254.7332) + 0
= 0.8364 in

t_{b1} = max[t_{b1} , $t_{b\ UG16}$]
= max[0.8364 , 0.0625]
= 0.8364 in

t_b = min[t_{b3} , t_{b1}]
= min[0.2818 , 0.8364]
= 0.2818 in

t_{UG-45} = $\max[\ t_a\ ,\ t_b\ ]$
= $\max[\ 0.037\ ,\ 0.2818\ ]$
= $\underline{0.2818}$ in

Available nozzle wall thickness new, $t_n = 1.0575$ in

The nozzle neck thickness is adequate.

Nozzle N11 - 2" 6000# Head End Level Gauge (N11)

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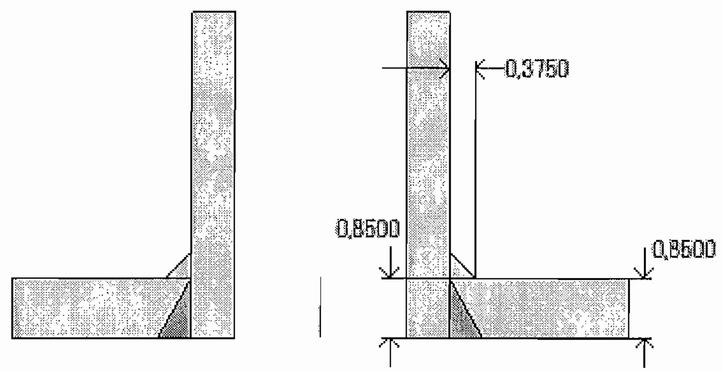

Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	Left Head
Orientation	0°
End of nozzle to datum line	1,020.0374"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Description	NPS 2 Class 6000 - threaded
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 19)
Inside diameter, new	2.375"
Nominal wall thickness	0.625"
Corrosion allowance	0"
Projection available outside vessel, Lpr	2.625"
Local vessel minimum thickness	0.85"
Liquid static head included	2.35 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.85"

UCS-66 Material Toughness Requirements Nozzle

t_r = 252.35*1.1875 / (20,000*1 - 0.6*252.35) =	0.0151"
Stress ratio = t_r*E^* / (t_n - c) = 0.0151*1 / (0.625 - 0) =	0.0242
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in²)							UG-44 Summary (in)	
For P = 252.35 psi @ 125 °F							The nozzle passes UG-44	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.0625	0.625

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

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

Calculations for internal pressure 252.35 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

L_R = MAX(d, $R_n + (t_n - C_n) + (t - C)$)
= MAX(2.375, 1.1875 + (0.625 - 0) + (0.85 - 0))
= 2.6625 in

Outer Normal Limit of reinforcement per UG-40

L_H = MIN(2.5*(t - C), 2.5*($t_n - C_n$) + t_e)
= MIN(2.5*(0.85 - 0), 2.5*(0.625 - 0) + 0)
= 1.5625 in

Nozzle required thickness per UG-27(c)(1)

t_{rn} = P*R_n / (S_n*E - 0.6*P)
= 252.3508*1.1875 / (20,000*1 - 0.6*252.3508)
= 0.0151 in

Required thickness t_r from UG-37(a)(c)

t_r = P*K_1*D_o / (2*S*E + 0.8*P)
= 252.3508*0.9*132 / (2*20,000*1 + 0.8*252.3508)
= 0.7457 in

Required thickness t_r per Interpretation VIII-1-07-50

t_r = P*D_o*K / (2*S*E + 2*P*(K - 0.1))
= 252.35*132*1 / (2*20,000*1 + 2*252.35*(1 - 0.1))
= 0.8234"

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

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.625 in
$t_{c(min)}$ = lesser of 0.25 or 0.7*t_{min} = 0.25 in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-44 Thickness Check - ASME B16.11 Coupling

Interpretation VIII-1-83-66 has been applied.

$t_{a\ App\ 1\text{-}1}$ = $P*R_o / (S_n*E + 0.4*P)$ + Corrosion
= 252.3508*1.8125 / (20,000*1 + 0.4*252.3508) + 0
= 0.0228 in

$t_{a\ UG\text{-}44}$ = max[$t_{a\ App\ 1\text{-}1}$, $t_{b\ UG16}$]
= max[0.0228 , 0.0625]
= 0.0625 in

Available nozzle wall thickness new, t_n = 0.625 in

The nozzle neck thickness is adequate.

Nozzle N12 - 4" 150# LAHH (N12)

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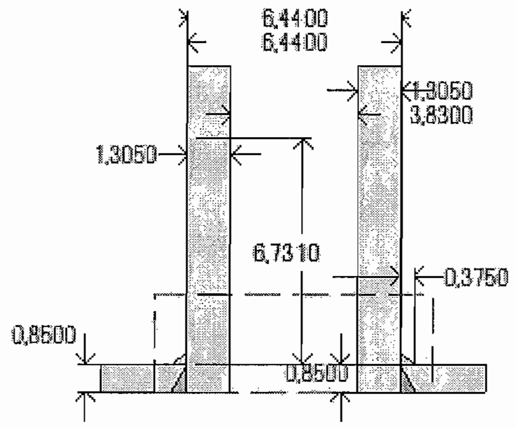	
Note: Per UW-16(b) minimum inside corner radius r_1 = min [1 / 4*t , 0.125 in] = 0.125 in	
Location and Orientation	
Located on	Left Head
Orientation	0°
End of nozzle to datum line	1,022"
Calculated as hillside	Yes
Distance to head center, R	33"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 19)
Inside diameter, new	3.83"
Wall thickness, t_n	1.305"
Minimum wall thickness	1.1175"
Corrosion allowance	0"
Opening chord length	3.9924"
Projection available outside vessel, Lpr	7.231"
Heavy barrel length, L_{hb}	6.731"
Projection available outside vessel to flange face, Lf	8.171"
Local vessel minimum thickness	0.85"
Liquid static head included	1.16 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"

Nozzle to vessel groove weld	0.85"

ASME B16.5-2013 Flange	
Description	NPS 4 Class 150 FVC HB A105 (Nut Stop)
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	No
Rated MDMT	-31.9°F
Liquid static head	1.16 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -31.9°F (Coincident ratio = 0.8813) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle At Intersection	
$t_r = 251.16*1.915 / (20,000*1 - 0.6*251.16) =$	0.0242"
Stress ratio = $t_r*E^* / (t_n - c) = 0.0242*1 / (1.305 - 0) =$	0.0186
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Nozzle	
$t_r = 251.16*1.915 / (20,000*1 - 0.6*251.16) =$	0.0242"
Stress ratio = $t_r*E^* / (t_n - c) = 0.0242*1 / (1.1175 - 0) =$	0.0217
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 251.16 psi @ 125 °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}
2.9632	6.0485	0.4645	5.4434	--	--	0.1406	0.245	1.1175

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

Calculations for internal pressure 251.16 psi @ 125 °F

Parallel Limit of reinforcement per UG-40 and Fig. UG-40 sketch (e-2)

L_R = MAX(d, R_n + (t_n - C_n) + (t - C))
= MAX(3.9924, 1.9962 + (1.305 - 0) + (0.85 - 0))
= 4.1512 in

Outer Normal Limit of reinforcement per UG-40 and Fig. UG-40 sketch (e-2)

L_H = MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e)
= MIN(2.5*(0.85 - 0), 2.5*(1.305 - 0) + 0)
= 2.125 in

Nozzle required thickness per UG-27(c)(1)

t_{rn} = P*R_n / (S_n*E - 0.6*P)
= 251.1596*1.915 / (20,000*1 - 0.6*251.1596)
= 0.0242 in

Required thickness t_r from UG-37(a)(c)

t_r = P*K_1*D_o / (2*S*E + 0.8*P)
= 251.1596*0.9*132 / (2*20,000*1 + 0.8*251.1596)
= 0.7422 in

Required thickness t_r per Interpretation VIII-1-07-50

t_r = P*D_o*K / (2*S*E + 2*P*(K - 0.1))
= 251.16*132*1 / (2*20,000*1 + 2*251.16*(1 - 0.1))
= 0.8196"

Area required per UG-37(c)

Allowable stresses: S_n = 20,000, S_v = 20,000 psi

f_{r1} = lesser of 1 or S_n / S_v = 1

f_{r2} = lesser of 1 or S_n / S_v = 1

A = $d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1})$
= 3.9924*0.7422*1 + 2*1.305*0.7422*1*(1 - 1)
= 2.9632 in^2

Area available from FIG. UG-37.1

A_1 = larger of the following= 0.4645 in^2

= $d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= 3.9924*(1*0.85 - 1*0.7422) - 2*1.305*(1*0.85 - 1*0.7422)*(1 - 1)
= 0.4303 in^2

= $2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= 2*(0.85 + 1.305)*(1*0.85 - 1*0.7422) - 2*1.305*(1*0.85 - 1*0.7422)*(1 - 1)
= 0.4645 in^2

A_2 = smaller of the following= 5.4434 in^2

= $5*(t_n - t_{rn})*f_{r2}*t$
= 5*(1.305 - 0.0242)*1*0.85
= 5.4434 in^2

= $5*(t_n - t_{rn})*f_{r2}*t_n$
= 5*(1.305 - 0.0242)*1*1.305
= 8.3572 in^2

A_{41} = Leg^2*f_{r2}
= 0.375^2*1
= 0.1406 in^2

Area = $A_1 + A_2 + A_{41}$
= 0.4645 + 5.4434 + 0.1406
= 6.0485 in^2

As Area >= A the reinforcement is adequate.

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.75 in
$t_{c(min)}$ = lesser of 0.25 or 0.7*t_{min} = 0.25 in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

Interpretation VIII-1-83-66 has been applied.
$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P)$ + Corrosion
= 251.1596*1.915 / (20,000*1 - 0.6*251.1596) + 0
= 0.0242 in

t_a = max[$t_{a\ UG\text{-}27}$, $t_{a\ UG\text{-}22}$]
= max[0.0242 , 0]
= 0.0242 in

t_{b1} = 0.8196 in

$t_{b1} = \max[\ t_{b1}\ ,\ t_{b\ UG16}\ ]$
$= \max[\ 0.8196\ ,\ 0.0625\ ]$
$= 0.8196$ in

$t_b = \min[\ t_{b3}\ ,\ t_{b1}\ ]$
$= \min[\ 0.245\ ,\ 0.8196\ ]$
$= 0.245$ in

$t_{UG\text{-}45} = \max[\ t_a\ ,\ t_b\ ]$
$= \max[\ 0.0242\ ,\ 0.245\ ]$
$= \underline{0.245}$ in

Available nozzle wall thickness new, $t_n = 1.1175$ in

The nozzle neck thickness is adequate.

Nozzle N13 - 36" 150# Boot (N13)

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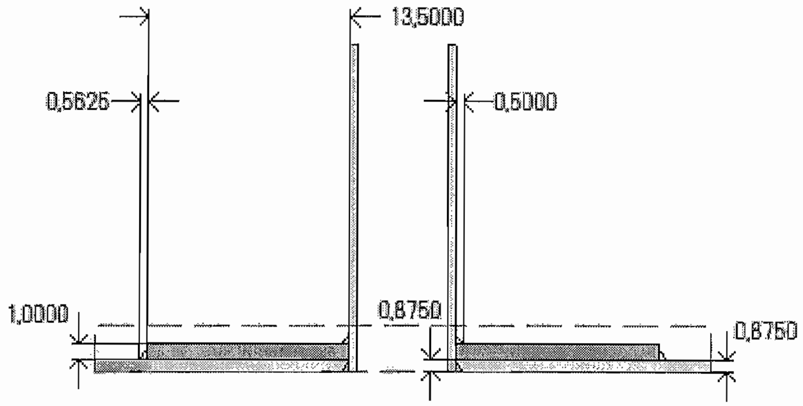


Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	Shell
Orientation	180°
Nozzle center line offset to datum line	720"
End of nozzle to shell center	138"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-516 70 (II-D p. 18, ln. 33)
Inside diameter, new	35"
Nominal wall thickness	0.5"
Corrosion allowance	0"
Projection available outside vessel, Lpr	72"
Local vessel minimum thickness	0.875"
Liquid static head included	4.73 psi
Longitudinal joint efficiency	0.7
Reinforcing Pad	
Material specification	SA-516 70 (II-D p. 18, ln. 33)
Diameter, D_p	63"
Thickness, t_e	1"
Is split	No
Welds	
Inner fillet, Leg_{41}	0.5"

Outer fillet, Leg_{42}	0.5625"
Nozzle to vessel groove weld	0.875"
Pad groove weld	0"

UCS-66 Material Toughness Requirements Nozzle	
Governing thickness, t_g =	0.5"
Exemption temperature from Fig UCS-66 Curve B =	-7°F
t_r = 254.73*17.5 / (20,000*0.7 - 0.6*254.73) =	0.3219"
Stress ratio = t_r*E^* / (t_n - c) = 0.3219*0.8 / (0.5 - 0) =	0.5151
Reduction in MDMT, T_R from Fig UCS-66.1 =	55°F
MDMT = max[MDMT - T_R, -55] = max[-7 - 55 , -55] =	-55°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

UCS-66 Material Toughness Requirements Pad	
Governing thickness, t_g =	0.875"
MDMT =	-20°F
Material is exempt from impact testing per UG-20(f) 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 = 254.73 psi @ 125 °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}
29.2726	30.1237	1.3524	1.2049	--	27	0.5664	0.3281	0.5

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
559,176.8	575,426	935,860.81	46,598	1,009,393.72	592,926	1,277,823.17

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status
Nozzle to pad fillet (Leg_{41})	0.35	0.35	weld size is adequate
Pad to shell fillet (Leg_{42})	0.375	0.3938	weld size is adequate

Calculations for internal pressure 254.73 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

L_R = MAX(d, R_n + (t_n - C_n) + (t - C))
= MAX(35, 17.5 + (0.5 - 0) + (0.875 - 0))
= 35 in

Outer Normal Limit of reinforcement per UG-40

L_H = MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e)
= MIN(2.5*(0.875 - 0), 2.5*(0.5 - 0) + 1)
= 2.1875 in

Nozzle required thickness per UG-27(c)(1)

t_{rn} = P*R_n / (S_n*E - 0.6*P)
= 254.7332*17.5 / (20,000*1 - 0.6*254.7332)
= 0.2246 in

Required thickness t_r from UG-37(a)

t_r = P*R_o / (S*E + 0.4*P)
= 254.7332*66 / (20,000*1 + 0.4*254.7332)
= 0.8364 in

Area required per UG-37(c)

Allowable stresses: S_n = 20,000, S_v = 20,000, S_p = 20,000 psi

f_{r1} = lesser of 1 or S_n / S_v = 1

f_{r2} = lesser of 1 or S_n / S_v = 1

f_{r3} = lesser of f_{r2} or $S_p / S_v = 1$

f_{r4} = lesser of 1 or $S_p / S_v = 1$

$$\begin{aligned}
A &= d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1}) \\
&= 35*0.8364*1 + 2*0.5*0.8364*1*(1 - 1) \\
&= \underline{29.2726}\ in^2
\end{aligned}$$

Area available from FIG. UG-37.1

A_1 = larger of the following= $\underline{1.3524}$ in^2

$$\begin{aligned}
&= d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1}) \\
&= 35*(1*0.875 - 1*0.8364) - 2*0.5*(1*0.875 - 1*0.8364)*(1 - 1) \\
&= 1.3524\ in^2
\end{aligned}$$

$$\begin{aligned}
&= 2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1}) \\
&= 2*(0.875 + 0.5)*(1*0.875 - 1*0.8364) - 2*0.5*(1*0.875 - 1*0.8364)*(1 - 1) \\
&= 0.1063\ in^2
\end{aligned}$$

A_2 = smaller of the following= $\underline{1.2049}$ in^2

$$\begin{aligned}
&= 5*(t_n - t_{rn})*f_{r2}*t \\
&= 5*(0.5 - 0.2246)*1*0.875 \\
&= 1.2049\ in^2
\end{aligned}$$

$$\begin{aligned}
&= 2*(t_n - t_{rn})*(2.5*t_n + t_e)*f_{r2} \\
&= 2*(0.5 - 0.2246)*(2.5*0.5 + 1)*1 \\
&= 1.2393\ in^2
\end{aligned}$$

$$\begin{aligned}
A_{41} &= Leg^2*f_{r3} \\
&= 0.5^2*1 \\
&= \underline{0.25}\ in^2
\end{aligned}$$

$$\begin{aligned}
A_{42} &= Leg^2*f_{r4} \\
&= 0.5625^2*1 \\
&= \underline{0.3164}\ in^2
\end{aligned}$$

$$\begin{aligned}
A_5 &= (D_p - d - 2*t_n)*t_e*f_{r4} \\
&= (63 - 35 - 2*0.5)*1*1 \\
&= \underline{27}\ in^2
\end{aligned}$$

$$\begin{aligned}
Area &= A_1 + A_2 + A_{41} + A_{42} + A_5 \\
&= 1.3524 + 1.2049 + 0.25 + 0.3164 + 27 \\
&= \underline{30.1237}\ in^2
\end{aligned}$$

As Area >= A the reinforcement is adequate.

UW-16(c)(2) Weld Check

Inner fillet: t_{min} = lesser of 0.75 or t_n or t_e = 0.5 in

$t_{w(min)}$ = $0.7*t_{min}$ = $\underline{0.35}$ in

$t_{w(actual)}$ = 0.7*Leg = 0.7*0.5 = 0.35 in

Outer fillet: t_{min} = lesser of 0.75 or t_e or t = 0.75 in

$t_{w(min)}$ = $0.5*t_{min}$ = $\underline{0.375}$ in

$t_{w(actual)}$ = 0.7*Leg = 0.7*0.5625 = 0.3938 in

UG-45 Nozzle Neck Thickness Check

$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P)$ + Corrosion
= 257.3322*17.5 / (20,000*0.7 - 0.6*257.3322) + 0
= 0.3253 in

t_a = max[$t_{a\ UG\text{-}27}$, $t_{a\ UG\text{-}22}$]
= max[0.3253 , 0]
= 0.3253 in

t_{b1} = $P*R_o / (S*E + 0.4*P)$ + Corrosion
= 254.7332*66 / (20,000*1 + 0.4*254.7332) + 0
= 0.8364 in

t_{b1} = max[t_{b1} , $t_{b\ UG16}$]
= max[0.8364 , 0.0625]
= 0.8364 in

t_b = min[t_{b3} , t_{b1}]
= min[0.3281 , 0.8364]
= 0.3281 in

$t_{UG\text{-}45}$ = max[t_a , t_b]
= max[0.3253 , 0.3281]
= 0.3281 in

Available nozzle wall thickness new, t_n = 0.5 in

The nozzle neck thickness is adequate.

Allowable stresses in joints UG-45 and UW-15(c)

Groove weld in tension: 0.74*20,000 = 14,800 psi
Nozzle wall in shear: 0.7*20,000 = 14,000 psi
Inner fillet weld in shear: 0.49*20,000 = 9,800 psi
Outer fillet weld in shear: 0.49*20,000 = 9,800 psi

Strength of welded joints:

(1) Inner fillet weld in shear
$(\pi / 2)$*Nozzle OD*Leg*S_i = $(\pi / 2)$*36*0.5*9,800 = 277,088.47 lb_f

(2) Outer fillet weld in shear
$(\pi / 2)$*Pad OD*Leg*S_o = $(\pi / 2)$*63*0.5625*9,800 = 545,517.93 lb_f

(3) Nozzle wall in shear
$(\pi / 2)$*Mean nozzle dia*t_n*S_n = $(\pi / 2)$*35.5*0.5*14,000 = 390,342.89 lb_f

(4) Groove weld in tension
$(\pi / 2)$*Nozzle OD*t_w*S_g = $(\pi / 2)$*36*0.875*14,800 = 732,305.24 lb_f

Loading on welds per UG-41(b)(1)

W = $(A - A_1 + 2*t_n*f_{r1}*(E_1*t - F*t_r))*S_v$
= (29.2726 - 1.3524 + 2*0.5*1*(1*0.875 - 1*0.8364))*20,000
= 559,176.8 lb_f

$W_{1\text{-}1}$ = $(A_2 + A_5 + A_{41} + A_{42})*S_v$
= (1.2049 + 27 + 0.25 + 0.3164)*20,000

= $\underline{575,426}$ lb_f

$W_{2\text{-}2}$ = $(A_2 + A_3 + A_{41} + A_{43} + 2{*}t_n{*}t{*}f_{r1}){*}S_v$
= $(1.2049 + 0 + 0.25 + 0 + 2{*}0.5{*}0.875{*}1){*}20{,}000$
= $\underline{46,598}$ lb_f

$W_{3\text{-}3}$ = $(A_2 + A_3 + A_5 + A_{41} + A_{42} + A_{43} + 2{*}t_n{*}t{*}f_{r1}){*}S_v$
= $(1.2049 + 0 + 27 + 0.25 + 0.3164 + 0 + 2{*}0.5{*}0.875{*}1){*}20{,}000$
= $\underline{592,926}$ lb_f

Load for path 1-1 lesser of W or $W_{1\text{-}1}$ = 559,176.8 lb_f
Path 1-1 through (2) & (3) = 545,517.93 + 390,342.89 = $\underline{935,860.81}$ lb_f
Path 1-1 is stronger than W so it is acceptable per UG-41(b)(2).

Load for path 2-2 lesser of W or $W_{2\text{-}2}$ = 46,598 lb_f
Path 2-2 through (1), (4) = 277,088.47 + 732,305.24 = $\underline{1,009,393.72}$ lb_f
Path 2-2 is stronger than $W_{2\text{-}2}$ so it is acceptable per UG-41(b)(1).

Load for path 3-3 lesser of W or $W_{3\text{-}3}$ = 559,176.8 lb_f
Path 3-3 through (2), (4) = 545,517.93 + 732,305.24 = $\underline{1,277,823.17}$ lb_f
Path 3-3 is stronger than W so it is acceptable per UG-41(b)(2).

% Extreme fiber elongation - UCS-79(d)

EFE = $(50{*}t / R_f){*}(1 - R_f / R_o)$
= $(50{*}0.5 / 17.75){*}(1 - 17.75 / \infty)$
= 1.4085%

The extreme fiber elongation does not exceed 5%.

Boot Head

ASME Section VIII Division 1, 2017 Edition				
Component		Ellipsoidal Head		
Material		SA-516 70 (II-D p. 18, ln. 33)		
Attached To		Nozzle N13 - 36" 150# Boot (N13)		
Impact Tested	**Normalized**	**Fine Grain Practice**	**PWHT**	**Optimize MDMT/ Find MAWP**
No	No	Yes	No	No
		Design Pressure (psi)	**Design Temperature (°F)**	**Design MDMT (°F)**
Internal		250	125	-20
Static Liquid Head				
Condition		**P_s (psi)**	**H_s (in)**	**SG**
Operating		7.72	213.9375	1
Test horizontal		8.19	226.8125	1
Dimensions				
Outer Diameter		36"		
Head Ratio		2		
Minimum Thickness		0.375"		
Corrosion	**Inner**	0"		
	Outer	0"		
Length L_{sf}		2"		
Nominal Thickness t_{sf}		0.5"		
Weight and Capacity				
		Weight (lb)[1]		**Capacity (US gal)[1]**
New		186.03		33.15
Corroded		186.03		33.15
Radiography				
Category A joints		Seamless No RT		
Head to shell seam		None UW-11(c) Type 1		

[1] includes straight flange

Results Summary	
Governing condition	internal pressure
Minimum thickness per UG-16	0.0625" + 0" = 0.0625"
Design thickness due to internal pressure (t)	0.2693"
Straight Flange governs MDMT	-55°F

Factor K

$K = (1/6)*[2 + (D / (2*h))^2]$		
Corroded	$K = (1/6)*[2 + (35.25 / (2*8.8125))^2]$	1
New	$K = (1/6)*[2 + (35.25 / (2*8.8125))^2]$	1

Design thickness for internal pressure, (Corroded at 125 °F) Appendix 1-4(c)

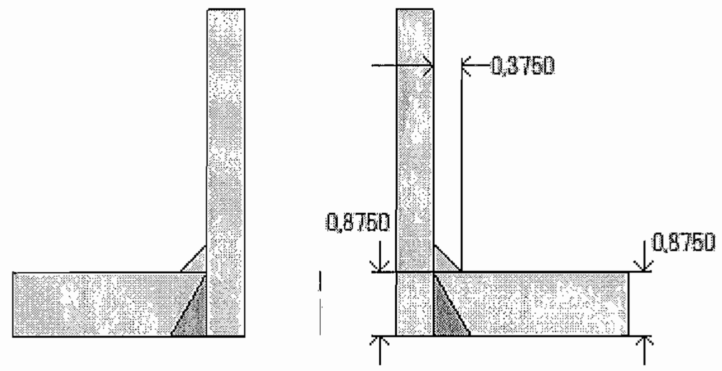
$$t = P*D_o*K / (2*S*E + 2*P*(K - 0.1)) + Corrosion$$
$$= 257.72*36*1 / (2*20,000*0.85 + 2*257.72*(1 - 0.1)) + 0$$
$$= 0.2692''$$

% Extreme fiber elongation - UCS-79(d)

$$EFE = (75*t / R_f)*(1 - R_f / R_o)$$
$$= (75*0.5 / 6.2425)*(1 - 6.2425 / \infty)$$
$$= 6.0072\%$$

The extreme fiber elongation exceeds 5 percent. Heat treatment per UCS-56 may be required. See UCS-79(d)(4) or (5).

Nozzle N14 - 2" 150# HP Drain Recycle (N14)

ASME Section VIII Division 1, 2017 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Shell
Orientation	0°
Nozzle center line offset to datum line	177"
End of nozzle to shell center	74"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 19)
Inside diameter, new	2"
Nominal wall thickness	0.53"
Corrosion allowance	0"
Projection available outside vessel, Lpr	7.25"
Projection available outside vessel to flange face, Lf	8"
Local vessel minimum thickness	0.875"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.875"

ASME B16.5-2013 Flange	
Description	NPS 2 Class 150 LWN A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)

Blind included	No
Rated MDMT	-32.3°F
Liquid static head	0 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements	
LWN rated MDMT per UCS-66(c)(4) =	-32.3°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

<table>
<tr><th colspan="7">UG-37 Area Calculation Summary (in^2)</th><th colspan="2">UG-45 Summary (in)</th></tr>
<tr><td colspan="7">For P = 250 psi @ 125 °F</td><td colspan="2">The nozzle passes UG-45</td></tr>
<tr><td>A required</td><td>A available</td><td>A_1</td><td>A_2</td><td>A_3</td><td>A_5</td><td>A welds</td><td>t_{req}</td><td>t_{min}</td></tr>
<tr><td colspan="7">This nozzle is exempt from area calculations per UG-36(c)(3)(a)</td><td>0.189</td><td>0.53</td></tr>
</table>

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

<table>
<tr><th colspan="4">UW-16 Weld Sizing Summary</th></tr>
<tr><td>Weld description</td><td>Required weld throat size (in)</td><td>Actual weld throat size (in)</td><td>Status</td></tr>
<tr><td>Nozzle to shell fillet (Leg_{41})</td><td>0.25</td><td>0.2625</td><td>weld size is adequate</td></tr>
</table>

Calculations for internal pressure 250 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

$$\begin{aligned} L_R &= MAX(d, R_n + (t_n - C_n) + (t - C)) \\ &= MAX(2, 1 + (0.53 - 0) + (0.875 - 0)) \\ &= 2.405 \text{ in} \end{aligned}$$

Outer Normal Limit of reinforcement per UG-40

$$\begin{aligned} L_H &= MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e) \\ &= MIN(2.5*(0.875 - 0), 2.5*(0.53 - 0) + 0) \\ &= 1.325 \text{ in} \end{aligned}$$

Nozzle required thickness per UG-27(c)(1)

$$\begin{aligned} t_{rn} &= P*R_n / (S_n*E - 0.6*P) \\ &= 250*1 / (20{,}000*1 - 0.6*250) \\ &= 0.0126 \text{ in} \end{aligned}$$

Required thickness t_r from UG-37(a)

$$\begin{aligned} t_r &= P*R_o / (S*E + 0.4*P) \\ &= 250*66 / (20{,}000*1 + 0.4*250) \\ &= 0.8209 \text{ in} \end{aligned}$$

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

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.53 in
$t_{c(min)}$ = lesser of 0.25 or 0.7*t_{min} = 0.25 in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P)$ + Corrosion
= $250*1 / (20{,}000*1 - 0.6*250) + 0$
= 0.0126 in

t_a = $\max[\ t_{a\ UG\text{-}27} ,\ t_{a\ UG\text{-}22}\ ]$
= max[0.0126 , 0]
= 0.0126 in

t_{b1} = $P*R_o / (S*E + 0.4*P)$ + Corrosion
= $250*66 / (20{,}000*1 + 0.4*250) + 0$
= 0.8209 in

t_{b1} = $\max[\ t_{b1} ,\ t_{b\ UG16}\ ]$
= max[0.8209 , 0.0625]
= 0.8209 in

t_b = $\min[\ t_{b3} ,\ t_{b1}\ ]$
= min[0.189 , 0.8209]
= 0.189 in

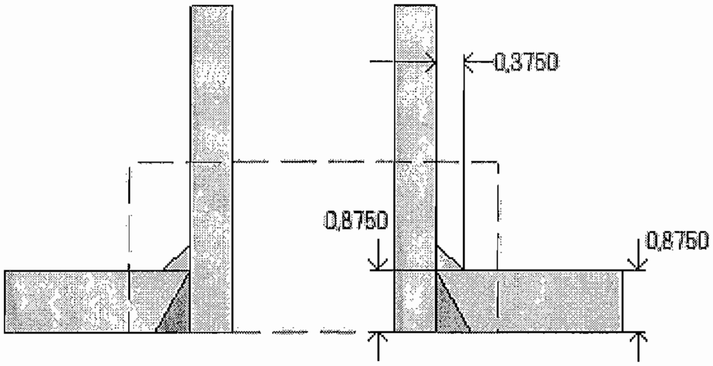
$t_{UG\text{-}45}$ = $\max[\ t_a ,\ t_b\ ]$
= max[0.0126 , 0.189]
= $\underline{0.189}$ in

Available nozzle wall thickness new, t_n = 0.53 in

The nozzle neck thickness is adequate.

Nozzle N15A - 3" 150# Level (Boot Interface) (N15A)

ASME Section VIII Division 1, 2017 Edition



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

Location and Orientation

Located on	Shell
Orientation	270°
Nozzle center line offset to datum line	720"
End of nozzle to shell center	65"
Offset from center, Lo	-36"
Passes through a Category A joint	No

Nozzle

Description	NPS 3 XXS
Access opening	No
Material specification	SA-106 B Smls pipe (II-D p. 14, ln. 10)
Inside diameter, new	2.3"
Pipe nominal wall thickness	0.6"
Pipe minimum wall thickness[1]	0.525"
Corrosion allowance	0"
Opening chord length	2.7526"
Projection available outside vessel, Lpr	5.8325"
Projection available outside vessel to flange face, Lf	8.5825"
Local vessel minimum thickness	0.875"
Liquid static head included	3.65 psi
Longitudinal joint efficiency	1

Welds

Inner fillet, Leg_{41}	0.375"

Nozzle to vessel groove weld	0.875"

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

ASME B16.5-2013 Flange	
Description	NPS 3 Class 150 WN A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	No
Rated MDMT	-31°F
Liquid static head	3.65 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Circumferential joint radiography	Full UW-11(a) Type 1
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -31°F (Coincident ratio = 0.89) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements Nozzle	
t_r = 253.65*1.15 / (17,100*1 - 0.6*253.65) =	0.0172"
Stress ratio = t_r*E^* / (t_n - c) = 0.0172*1 / (0.525 - 0) =	0.0328
Stress ratio ≤ 0.35, MDMT per UCS-66(b)(3) =	-155°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 253.65 psi @ 125 °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}
1.2187	2.8881	1.273	1.4949	--	--	0.1202	0.189	0.525

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

Calculations for internal pressure 253.65 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

$$
\begin{aligned}
L_R &= \text{MAX}(d,\ R_n + (t_n - C_n) + (t - C)) \\
&= \text{MAX}(2.7526,\ 1.3763 + (0.6 - 0) + (0.875 - 0)) \\
&= 2.8513 \text{ in}
\end{aligned}
$$

Outer Normal Limit of reinforcement per UG-40

$$
\begin{aligned}
L_H &= \text{MIN}(2.5*(t - C),\ 2.5*(t_n - C_n) + t_e) \\
&= \text{MIN}(2.5*(0.875 - 0),\ 2.5*(0.6 - 0) + 0) \\
&= 1.5 \text{ in}
\end{aligned}
$$

Nozzle required thickness per UG-27(c)(1)

$$
\begin{aligned}
t_{rn} &= P*R_n / (S_n*E - 0.6*P) \\
&= 253.6503*1.15 / (17{,}100*1 - 0.6*253.6503) \\
&= 0.0172 \text{ in}
\end{aligned}
$$

Required thickness t_r from UG-37(a)

$$
\begin{aligned}
t_r &= P*R_o / (S*E + 0.4*P) \\
&= 253.6503*66 / (20{,}000*1 + 0.4*253.6503) \\
&= 0.8328 \text{ in}
\end{aligned}
$$

Area required per UG-37(c)

Allowable stresses: S_n = 17,100, S_v = 20,000 psi

f_{r1} = lesser of 1 or S_n / S_v = 0.855

f_{r2} = lesser of 1 or S_n / S_v = 0.855

$$
\begin{aligned}
A &= d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1}) \\
&= 2.7526*0.8328*0.5 + 2*0.6*0.8328*0.5*(1 - 0.855) \\
&= 1.2187 \text{ in}^2
\end{aligned}
$$

Area available from FIG. UG-37.1

A_1 = larger of the following= 1.273 in^2

$$
\begin{aligned}
&= d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})\\
&= 2.7526*(1*0.875 - 0.5*0.8328) - 2*0.6*(1*0.875 - 0.5*0.8328)*(1 - 0.855)\\
&= 1.1825\ in^2
\end{aligned}
$$

$$
\begin{aligned}
&= 2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})\\
&= 2*(0.875 + 0.6)*(1*0.875 - 0.5*0.8328) - 2*0.6*(1*0.875 - 0.5*0.8328)*(1 - 0.855)\\
&= 1.273\ in^2
\end{aligned}
$$

A_2 = smaller of the following= 1.4949 in^2

$$
\begin{aligned}
&= 5*(t_n - t_{rn})*f_{r2}*t\\
&= 5*(0.6 - 0.0172)*0.855*0.875\\
&= 2.18\ in^2
\end{aligned}
$$

$$
\begin{aligned}
&= 5*(t_n - t_{rn})*f_{r2}*t_n\\
&= 5*(0.6 - 0.0172)*0.855*0.6\\
&= 1.4949\ in^2
\end{aligned}
$$

$$
\begin{aligned}
A_{41} &= Leg^2*f_{r2}\\
&= 0.375^2*0.855\\
&= 0.1202\ in^2
\end{aligned}
$$

$$
\begin{aligned}
Area &= A_1 + A_2 + A_{41}\\
&= 1.273 + 1.4949 + 0.1202\\
&= 2.8881\ in^2
\end{aligned}
$$

As Area >= A the reinforcement is adequate.

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.6 in
$t_{c(min)}$ = lesser of 0.25 or 0.7*t_{min} = 0.25 in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

$$
\begin{aligned}
t_{a\ UG\text{-}27} &= P*R_n / (S_n*E - 0.6*P) + Corrosion\\
&= 253.6503*1.15 / (17{,}100*1 - 0.6*253.6503) + 0\\
&= 0.0172\ in
\end{aligned}
$$

$$
\begin{aligned}
t_a &= max[\ t_{a\ UG\text{-}27}\ ,\ t_{a\ UG\text{-}22}\ ]\\
&= max[\ 0.0172\ ,\ 0\ ]\\
&= 0.0172\ in
\end{aligned}
$$

$$
\begin{aligned}
t_{b1} &= P*R_o / (S*E + 0.4*P) + Corrosion\\
&= 253.6503*66 / (20{,}000*1 + 0.4*253.6503) + 0\\
&= 0.8328\ in
\end{aligned}
$$

$$
\begin{aligned}
t_{b1} &= max[\ t_{b1}\ ,\ t_{b\ UG16}\ ]\\
&= max[\ 0.8328\ ,\ 0.0625\ ]\\
&= 0.8328\ in
\end{aligned}
$$

$$
\begin{aligned}
t_b &= min[\ t_{b3}\ ,\ t_{b1}\ ]\\
&= min[\ 0.189\ ,\ 0.8328\ ]\\
&= 0.189\ in
\end{aligned}
$$

$t_{UG\text{-}45}$ = max[t_a , t_b]
= max[0.0172 , 0.189]
= 0.189 in

Available nozzle wall thickness new, t_n = 0.875*0.6 = 0.525 in

The nozzle neck thickness is adequate.

Reinforcement check in the plane parallel to the longitudinal axis

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 253.65 psi @ 125 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.189	0.525

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

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

Parallel Limit of reinforcement per UG-40

L_R = MAX(d, R_n + (t_n - C_n) + (t - C))
= MAX(2.3, 1.15 + (0.6 - 0) + (0.875 - 0))
= 2.625 in

Outer Normal Limit of reinforcement per UG-40

L_H = MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e)
= MIN(2.5*(0.875 - 0), 2.5*(0.6 - 0) + 0)
= 1.5 in

Nozzle required thickness per UG-27(c)(1)

t_{rn} = P*R_n / (S_n*E - 0.6*P)
= 253.6503*1.15 / (17,100*1 - 0.6*253.6503)
= 0.0172 in

Required thickness t_r from UG-37(a)

t_r = P*R_o / (S*E + 0.4*P)
= 253.6503*66 / (20,000*1 + 0.4*253.6503)
= 0.8328 in

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

UG-45 Nozzle Neck Thickness Check

$t_{a\,UG\text{-}27}$ = P*R_n / (S_n*E - 0.6*P) + Corrosion
= 253.6503*1.15 / (17,100*1 - 0.6*253.6503) + 0
= 0.0172 in

t_a = max[$t_{a\,UG\text{-}27}$, $t_{a\,UG\text{-}22}$]
= max[0.0172 , 0]
= 0.0172 in

t_{b1} = P*R_o / (S*E + 0.4*P) + Corrosion

= $253.6503*66 / (20{,}000*1 + 0.4*253.6503) + 0$
= 0.8328 in

t_{b1} = max[t_{b1} , $t_{b\ UG16}$]
= max[0.8328 , 0.0625]
= 0.8328 in

t_b = min[t_{b3} , t_{b1}]
= min[0.189 , 0.8328]
= 0.189 in

$t_{UG\text{-}45}$ = max[t_a , t_b]
= max[0.0172 , 0.189]
= 0.189 in

Available nozzle wall thickness new, $t_n = 0.875*0.6 = 0.525$ in

The nozzle neck thickness is adequate.

Nozzle N15C - 3" 150# Water Level Gauge [In Boot] (Nozzle N15B, N17A, & N17B similar) (N15C)

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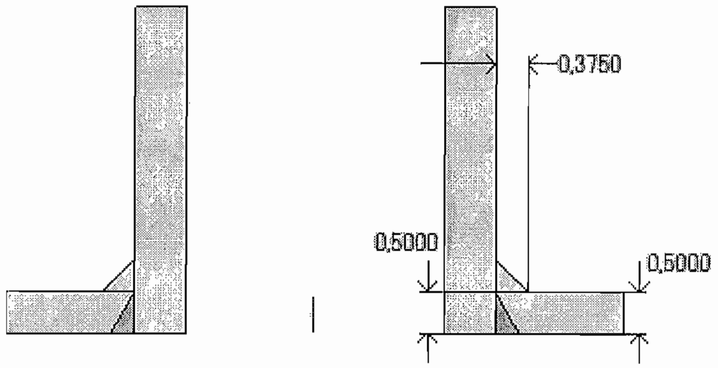

Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	Nozzle N13 - 36" 150# Boot (N13)
Orientation	270°
Nozzle center line offset to face of parent nozzle	6"
End of nozzle to shell center	26"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 19)
Inside diameter, new	3"
Nominal wall thickness	0.625"
Corrosion allowance	0"
Projection available outside vessel, Lpr	7.06"
Projection available outside vessel to flange face, Lf	8"
Local vessel minimum thickness	0.5"
Liquid static head included	7.12 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.5"

ASME B16.5-2013 Flange	
Description	NPS 3 Class 150 LWN A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)

Blind included	No
Rated MDMT	-29.8°F
Liquid static head	7.12 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -29.8°F (Coincident ratio = 0.9022) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements	
LWN rated MDMT per UCS-66(c)(4) =	-29.8°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (in^2)							UG-45 Summary (in)	
For P = 257.12 psi @ 125 °F							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.2074	0.625

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

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

Calculations for internal pressure 257.12 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

L_R = MAX(d, $R_n + (t_n - C_n) + (t - C)$)
= MAX(3, 1.5 + (0.625 - 0) + (0.5 - 0))
= 3 in

Outer Normal Limit of reinforcement per UG-40

L_H = MIN($2.5*(t - C)$, $2.5*(t_n - C_n) + t_e$)
= MIN(2.5*(0.5 - 0), 2.5*(0.625 - 0) + 0)
= 1.25 in

Nozzle required thickness per UG-27(c)(1)

t_{rn} = $P*R_n / (S_n*E - 0.6*P)$
= 257.1156*1.5 / (20,000*1 - 0.6*257.1156)
= 0.0194 in

Required thickness t_r from UG-37(a)

t_r = P*R / (S*E - 0.6*P)
= 257.1156*17.5 / (20,000*1 - 0.6*257.1156)
= 0.2267 in

Required thickness t_r per Interpretation VIII-1-07-50

t_r = P*R / (S*E - 0.6*P)
= 257.1156*17.5 / (20,000*0.7 - 0.6*257.1156)
= 0.325 in

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

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.5 in
$t_{c(min)}$ = lesser of 0.25 or $0.7*t_{min}$ = 0.25 in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P) + Corrosion$
= $257.1156*1.5 / (20{,}000*1 - 0.6*257.1156) + 0$
= 0.0194 in

t_a = $max[\ t_{a\ UG\text{-}27} , t_{a\ UG\text{-}22}\ ]$
= max[0.0194 , 0]
= 0.0194 in

t_{b1} = $P*R / (S*E - 0.6*P) + Corrosion$
= $257.1156*17.5 / (20{,}000*1 - 0.6*257.1156) + 0$
= 0.2267 in

t_{b1} = $max[\ t_{b1} , t_{b\ UG16}\ ]$
= max[0.2267 , 0.0625]
= 0.2267 in

t_b = $min[\ t_{b3} , t_{b1}\ ]$
= min[0.2074 , 0.2267]
= 0.2074 in

$t_{UG\text{-}45}$ = $max[\ t_a , t_b\ ]$
= max[0.0194 , 0.2074]
= 0.2074 in

Available nozzle wall thickness new, t_n = 0.625 in

The nozzle neck thickness is adequate.

Nozzle N16 - 4" 150# Water Outlet [In Boot] (N16)

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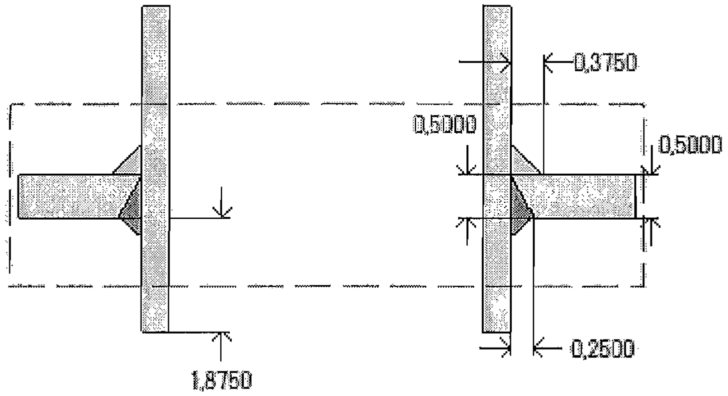


Note: round inside edges per UG-76(c)

Location and Orientation	
Located on	Nozzle N13 - 36" 150# Boot (N13)
Orientation	0°
Nozzle center line offset to face of parent nozzle	6"
End of nozzle to shell center	26"
Passes through a Category A joint	No
Nozzle	
Description	NPS 4 Sch 80S (XS)
Access opening	No
Material specification	SA-312 TP304 Wld & smls pipe (II-D p. 86, ln. 42)
Inside diameter, new	3.826"
Pipe nominal wall thickness	0.337"
Pipe minimum wall thickness[1]	0.2949"
Corrosion allowance	0"
Projection available outside vessel, Lpr	5"
Internal projection, h_{new}	1.875"
Projection available outside vessel to flange face, Lf	8"
Local vessel minimum thickness	0.5"
Liquid static head included	7.12 psi
Longitudinal joint efficiency	0.85
Welds	
Inner fillet, Leg_{41}	0.375"
Lower fillet, Leg_{43}	0.25"

Nozzle to vessel groove weld	0.5"

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

ASME B16.5-2013 Flange	
Description	NPS 4 Class 150 WN A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	No
Rated MDMT	-29.8°F
Liquid static head	7.12 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Circumferential joint radiography	Full UW-11(a) Type 1
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -29.8°F (Coincident ratio = 0.9022) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UHA-51 Material Toughness Requirements Nozzle	
t_r = 257.12*1.913 / (20,000*0.85 - 0.6*257.12) =	0.0292"
Stress ratio = t_r*E^* / (t_n - c) = 0.0292*0.85 / (0.2949 - 0) =	0.0842
Impact test exempt per UHA-51(g) (coincident ratio = 0.0842)	
Rated MDMT =	-320°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 = 257.12 psi @ 125 °F The opening is adequately reinforced							The nozzle passes UG-45	
A required	A available	A_1	A_2	A_3	A_5	A welds	t_{req}	t_{min}
0.8674	2.3426	1.0456	0.5261	0.5678	--	0.2031	0.2074	0.2949

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})	0.2359	0.2625	weld size is adequate

Calculations for internal pressure 257.12 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

$$
\begin{aligned}
L_R &= MAX(d, R_n + (t_n - C_n) + (t - C)) \\
&= MAX(3.826, 1.913 + (0.337 - 0) + (0.5 - 0)) \\
&= 3.826 \text{ in}
\end{aligned}
$$

Outer Normal Limit of reinforcement per UG-40

$$
\begin{aligned}
L_H &= MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e) \\
&= MIN(2.5*(0.5 - 0), 2.5*(0.337 - 0) + 0) \\
&= 0.8425 \text{ in}
\end{aligned}
$$

Inner Normal Limit of reinforcement per UG-40

$$
\begin{aligned}
L_I &= MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C)) \\
&= MIN(1.875, 2.5*(0.5 - 0), 2.5*(0.337 - 0 - 0)) \\
&= 0.8425 \text{ in}
\end{aligned}
$$

Nozzle required thickness per UG-27(c)(1)

$$
\begin{aligned}
t_{rn} &= P*R_n / (S_n*E - 0.6*P) \\
&= 257.1156*1.913 / (20{,}000*1 - 0.6*257.1156) \\
&= 0.0248 \text{ in}
\end{aligned}
$$

Required thickness t_r from UG-37(a)

$$
\begin{aligned}
t_r &= P*R / (S*E - 0.6*P) \\
&= 257.1156*17.5 / (20{,}000*1 - 0.6*257.1156) \\
&= 0.2267 \text{ in}
\end{aligned}
$$

Required thickness t_r per Interpretation VIII-1-07-50

$$
\begin{aligned}
t_r &= P*R / (S*E - 0.6*P) \\
&= 257.1156*17.5 / (20{,}000*0.7 - 0.6*257.1156) \\
&= 0.325 \text{ in}
\end{aligned}
$$

Area required per UG-37(c)

Allowable stresses: $S_n = 20{,}000$, $S_v = 20{,}000$ psi

f_{r1} = lesser of 1 or $S_n / S_v = 1$

f_{r2} = lesser of 1 or $S_n / S_v = 1$

A = $d*t_r*F + 2*t_n*t_r*F*(1 - f_{r1})$
= $3.826*0.2267*1 + 2*0.337*0.2267*1*(1 - 1)$
= $\underline{0.8674}$ in^2

Area available from FIG. UG-37.1

A_1 = larger of the following= $\underline{1.0456}$ in^2

= $d*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= $3.826*(1*0.5 - 1*0.2267) - 2*0.337*(1*0.5 - 1*0.2267)*(1 - 1)$
= 1.0456 in^2

= $2*(t + t_n)*(E_1*t - F*t_r) - 2*t_n*(E_1*t - F*t_r)*(1 - f_{r1})$
= $2*(0.5 + 0.337)*(1*0.5 - 1*0.2267) - 2*0.337*(1*0.5 - 1*0.2267)*(1 - 1)$
= 0.4575 in^2

A_2 = smaller of the following= $\underline{0.5261}$ in^2

= $5*(t_n - t_{rn})*f_{r2}*t$
= $5*(0.337 - 0.0248)*1*0.5$
= 0.7805 in^2

= $5*(t_n - t_{rn})*f_{r2}*t_n$
= $5*(0.337 - 0.0248)*1*0.337$
= 0.5261 in^2

A_3 = smaller of the following= $\underline{0.5678}$ in^2

= $5*t*t_i*f_{r2}$
= $5*0.5*0.337*1$
= $\underline{0.8425}$ in^2

= $5*t_i*t_i*f_{r2}$
= $5*0.337*0.337*1$
= $\underline{0.5678}$ in^2

= $2*h*t_i*f_{r2}$
= $2*1.875*0.337*1$
= $\underline{1.2638}$ in^2

A_{41} = Leg^2*f_{r2}
= 0.375^2*1
= $\underline{0.1406}$ in^2

A_{43} = Leg^2*f_{r2}
= 0.25^2*1
= $\underline{0.0625}$ in^2

Area = $A_1 + A_2 + A_3 + A_{41} + A_{43}$
= $1.0456 + 0.5261 + 0.5678 + 0.1406 + 0.0625$
= $\underline{2.3426}$ in^2

As Area >= A the reinforcement is adequate.

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.337 in
$t_{c(min)}$ = lesser of 0.25 or 0.7*t_{min} = $\underline{0.2359}$ in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

$$\begin{aligned} t_{a\ UG\text{-}27} &= P*R_n / (S_n*E - 0.6*P) + \text{Corrosion} \\ &= 257.1156*1.913 / (20{,}000*0.85 - 0.6*257.1156) + 0 \\ &= 0.0292 \text{ in} \end{aligned}$$

$$\begin{aligned} t_a &= \max[\ t_{a\ UG\text{-}27} \text{ , } t_{a\ UG\text{-}22}\ ] \\ &= \max[\ 0.0292 \text{ , } 0\ ] \\ &= 0.0292 \text{ in} \end{aligned}$$

$$\begin{aligned} t_{b1} &= P*R / (S*E - 0.6*P) + \text{Corrosion} \\ &= 257.1156*17.5 / (20{,}000*1 - 0.6*257.1156) + 0 \\ &= 0.2267 \text{ in} \end{aligned}$$

$$\begin{aligned} t_{b1} &= \max[\ t_{b1} \text{ , } t_{b\ UG16}\ ] \\ &= \max[\ 0.2267 \text{ , } 0.0625\ ] \\ &= 0.2267 \text{ in} \end{aligned}$$

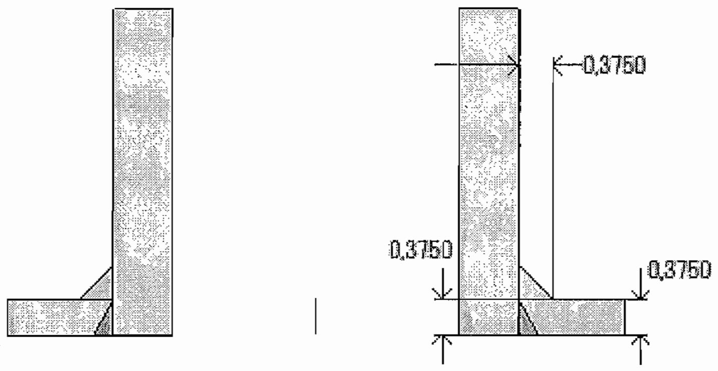
$$\begin{aligned} t_b &= \min[\ t_{b3} \text{ , } t_{b1}\ ] \\ &= \min[\ 0.2074 \text{ , } 0.2267\ ] \\ &= 0.2074 \text{ in} \end{aligned}$$

$$\begin{aligned} t_{UG\text{-}45} &= \max[\ t_a \text{ , } t_b\ ] \\ &= \max[\ 0.0292 \text{ , } 0.2074\ ] \\ &= \underline{0.2074} \text{ in} \end{aligned}$$

Available nozzle wall thickness new, t_n = 0.875*0.337 = 0.2949 in

The nozzle neck thickness is adequate.

Nozzle N18 - 3" 150# Drain [In Boot] (N18)

ASME Section VIII Division 1, 2017 Edition	
	
Note: round inside edges per UG-76(c)	
Location and Orientation	
Located on	Boot Head
Orientation	0°
End of nozzle to datum line	0"
Calculated as hillside	No
Distance to head center, R	0"
Passes through a Category A joint	No
Nozzle	
Access opening	No
Material specification	SA-105 (II-D p. 18, ln. 19)
Inside diameter, new	3"
Nominal wall thickness	0.625"
Corrosion allowance	0"
Projection available outside vessel, Lpr	6.9367"
Projection available outside vessel to flange face, Lf	7.8767"
Local vessel minimum thickness	0.375"
Liquid static head included	7.74 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg_{41}	0.375"
Nozzle to vessel groove weld	0.375"

ASME B16.5-2013 Flange	
Description	NPS 3 Class 150 LWN A105

Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, ln. 32)
Blind included	No
Rated MDMT	-29.5°F
Liquid static head	8.02 psi
MAWP rating	278.75 psi @ 125°F
MAP rating	285 psi @ 40°F
Hydrotest rating	450 psi @ 40°F
PWHT performed	No
Impact Tested	No
Gasket	
Description	Klingersil C-4401 Synthetic Fiber
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -29.5°F (Coincident ratio = 0.9053) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	

UCS-66 Material Toughness Requirements	
LWN rated MDMT per UCS-66(c)(4) =	-29.5°F
Material is exempt from impact testing at the Design MDMT of -20°F.	

Reinforcement Calculations for Internal Pressure

<table>
<tr><th colspan="7">UG-37 Area Calculation Summary (in^2)</th><th colspan="2">UG-45 Summary (in)</th></tr>
<tr><th colspan="7">For P = 257.74 psi @ 125 °F</th><th colspan="2">The nozzle passes UG-45</th></tr>
<tr><th>A required</th><th>A available</th><th>A_1</th><th>A_2</th><th>A_3</th><th>A_5</th><th>A welds</th><th>t_{req}</th><th>t_{min}</th></tr>
<tr><td colspan="7">This nozzle is exempt from area calculations per UG-36(c)(3)(a)</td><td>0.2074</td><td>0.625</td></tr>
</table>

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

<table>
<tr><th colspan="4">UW-16 Weld Sizing Summary</th></tr>
<tr><th>Weld description</th><th>Required weld throat size (in)</th><th>Actual weld throat size (in)</th><th>Status</th></tr>
<tr><td>Nozzle to shell fillet (Leg_{41})</td><td>0.25</td><td>0.2625</td><td>weld size is adequate</td></tr>
</table>

Calculations for internal pressure 257.74 psi @ 125 °F

Parallel Limit of reinforcement per UG-40

L_R = MAX(d, R_n + (t_n - C_n) + (t - C))
= MAX(3, 1.5 + (0.625 - 0) + (0.375 - 0))
= 3 in

Outer Normal Limit of reinforcement per UG-40

L_H = MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e)
= MIN(2.5*(0.375 - 0), 2.5*(0.625 - 0) + 0)
= 0.9375 in

Nozzle required thickness per UG-27(c)(1)

t_{rn} = P*R_n / (S_n*E - 0.6*P)
= 257.7361*1.5 / (20,000*1 - 0.6*257.7361)
= 0.0195 in

Required thickness t_r from UG-37(a)(c)

t_r = P*K_1*D_o / (2*S*E + 0.8*P)
= 257.7361*0.9*36 / (2*20,000*1 + 0.8*257.7361)
= 0.2077 in

Required thickness t_r per Interpretation VIII-1-07-50

t_r = P*D_o*K / (2*S*E + 2*P*(K - 0.1))
= 257.74*36*1 / (2*20,000*0.85 + 2*257.74*(1 - 0.1))
= 0.2692"

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

UW-16(c) Weld Check

Fillet weld: t_{min} = lesser of 0.75 or t_n or t = 0.375 in
$t_{c(min)}$ = lesser of 0.25 or 0.7*t_{min} = 0.25 in
$t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-45 Nozzle Neck Thickness Check

Interpretation VIII-1-83-66 has been applied.

$t_{a\ UG\text{-}27}$ = $P*R_n / (S_n*E - 0.6*P) + \text{Corrosion}$
= $258.0181*1.5 / (20{,}000*1 - 0.6*258.0181) + 0$
= 0.0195 in

t_a = max[$t_{a\ UG\text{-}27}$, $t_{a\ UG\text{-}22}$]
= max[0.0195 , 0]
= 0.0195 in

t_{b1} = 0.2293 in

t_{b1} = max[t_{b1} , $t_{b\ UG16}$]
= max[0.2293 , 0.0625]
= 0.2293 in

t_b = min[t_{b3} , t_{b1}]
= min[0.2074 , 0.2293]
= 0.2074 in

$t_{UG\text{-}45}$ = max[t_a , t_b]
= max[0.0195 , 0.2074]
= 0.2074 in

Available nozzle wall thickness new, t_n = 0.625 in

The nozzle neck thickness is adequate.

Material Test Reports

Final Bill of Material

ASME CODE VESSEL

MILL TEST REPORTS
REQUIRED AS INDICATED

BY
DATE
REV

BY RT
DATE 10/23/2018
JOB NO. **5361-S01**
CHK'D DB
DATE 11/26/2018
CUSTOMER **Anadarko**

REQUIRED DATE: **12/21/18**
STOCK CHECK: **11/29/18**
TO PURCHASING: **11/26/18**

Rev	Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Specification	See Note	MTR	Weight	Ship To:	PO No. / Vendor	Manufacturer	Heat & Slab Number	Plate ID
		5361-1-1	2	HEAD	0.85" MIN x 132" OD ASME 2:1 SF=2"				SA-516-70		X	11263	SLC	44986 CMF	Hyundai	FA38079	
		5361-1-2	4	PLATE	0.875" SHELL, ROLLED	0.875	124.25	411.938	SA-516-70		X	50805	SLC	44980 Evraz	Evraz	N19015, N19840, N19841	35U, 36U, 37U, 38U
		5361-1-3	4	PLATE	0.875" SHELL, ROLLED	0.875	124.25	411.938	SA-516-70		X	50808	SLC	44980 Evraz	Evraz	N19008, N19833, N19841, N20370	31U, 32U, 33U, 34U
		5361-1-4	1	PLATE	1/4" PLATE SK	0.250	3.188	9	A-36		X	2	SLC	**Stock**	Arcelormittal	D0872	38R
		5361-1-5	1	PLATE	1/4" PLATE	0.250	6	9	A-36			4	SLC	**Stock**			
		5361-1-6	1	NAMEPL	ASME NAMEPLATE (EMP STD)				STN STL			-	SLC	Purchase by QC			
		5361-1B-1	1	PLATE	1-1/2" BASEPLATE W/ HOLES	1.500	22	129	A-36			1194	SLC	**Stock**			
		5361-1B-2	1	PLATE	1-1/2" BASEPLATE W/ SLOTS	1.500	22	129	A-36			1187	SLC	**Stock**			
		5361-1B-3	2	PLATE	3/4" WEB PLATE SKETCH	0.750	53.813	124.75	A-36			1168	SLC	**45336 Reliance**			
		5361-1B-4	4	PLATE	3/4" END PLATE	0.750	18	53.813	A-36			824	SLC	**45336 Reliance**			
		5361-1B-5	8	PLATE	3/4" RIB PLATE	0.750	8.625	25.375	A-36			368	SLC	**45336 Reliance**			
		5361-1B-6	8	PLATE	3/4" RIB PLATE	0.750	8.625	13.688	A-36			199	SLC	**45336 Reliance**			
		5361-1B-7	4	PLATE	3/4" RIB PLATE	0.750	8.625	10.125	A-36			74	SLC	**45336 Reliance**			
		5361-1B-8	2	PLATE	3/8" WEAR PLATE, ROLL	0.375	30	175.688	SA-516-70		X	1121	SLC	**45335 Ryerson**	SSAB	A810J2	40U
		5361-1B-9	2	PLATE	1/4" PLATE W/HOLE	0.250	2	3	A-36			-	SLC	**Stock**			
		5361-1C-1	1	FLANGE	20" - 150# RFWN XH BORE				SA-105		X	199	SLC	45009 IPP	Norma	1231	
		5361-1C-2	1	FLANGE	20" - 150# RF BLIND				SA-105		X	271	SLC	45009 IPP	ST&H	805820E	
		5361-1C-3	1	GASKET	1/8" - 20" - 150# RING TYPE KLINGERSIL C-4401				KLINGERSIL			1	SLC	45281 KLINGER			
		5361-1C-4	2	PLATE	1-1/4" SKETCH PL W/ HOLE	1.250	3	5.5	A-36		X	8	SLC	**45335 Ryerson**	Nucor	8505747	27U
		5361-1C-5	1	PLATE	1-1/4" SKETCH PL W/ SLOT	1.250	4.188	4.813	A-36		X	5	SLC	**45335 Ryerson**	Nucor	8505747	27U
		5361-1C-6	1	PLATE	1-1/4" SKETCH PL W/ SLOT	1.250	4.188	4.813	A-36		X	5	SLC	**45335 Ryerson**	Nucor	8505747	27U
		5361-1C-7	1	ROD	1" DIA ROD W/ HOLES			15.5	A-36			3	SLC	**45335 Ryerson**			
		5361-1C-8	1	ROD	3/4" DIA ROD, BEND			12	A-36		X	1	SLC	**Stock**	Nucor	PL16105676	
		5361-1C-9	20	STUD	1-1/8" DIA FULL THREAD			6.25	SA-193-B7			35	SLC	45302 UINTAH			
		5361-1C-10	40	NUT	1-1/8" HEAVY HEX				SA-194-2H			23	SLC	45302 UINTAH			
		5361-1C-11	2	WASHER	1" STANDARD ROUND				STEEL			-	SLC	45302 UINTAH			
		5361-1C-12	2	COTTER	1/4" DIA COTTER PIN			1.5	STEEL			-	SLC	45302 UINTAH			
		5361-1C-13	1	PIPE	20" NOM XH	0.500		8	SA-106-B		X	69	SLC	45009 IPP	USS	MA6721	
		5361-1C-14	1	PLATE	3/4" CIRC PL 20.25" ID x 33.5" OD	0.750	**Shop to Form**		SA-516-70		X	119	SLC	**45335 Ryerson**	SSAB	A81210	39U
		5361-1D-1	1	FLANGE	36" - 150# SERIES "B" RFWN XH BORE (35" I.D.)				SA-105		X	270	SLC	45009 IPP	Coastal	ACDXJ	
		5361-1D-2	2	FLANGE	24" - 150# RFWN XH BORE				SA-105		X	542	SLC	45009 IPP	ST&H	N13378	
		5361-1D-3	3	FLANGE	6" - 150# RF HB LWN NS			9	SA-105		X	239	SLC	45008 Ameriforge	FVC	DVB	
		5361-1D-4	1	FLANGE	4" - 150# RF HB LWN NS			12.25	SA-105		X	80	SLC	45008 Ameriforge	FVC	EKR	
		5361-1D-5	3	FLANGE	3" - 150# RF HB LWN NS			9	SA-105		X	114	SLC	45008 Ameriforge	FVC	BWL, DXN	
		5361-1D-6	1	FLANGE	3" - 150# RFWN XXH BORE				SA-105		X	13	SLC	45009 IPP	ST&H	012898F	
		5361-1D-7	3	FLANGE	2" - 150# RF LWN			9	SA-105		X	44	SLC	45008 Ameriforge	FVC	DGT	
		5361-1D-8	1	COUPLING	2" - 6000# FULL SCRD			3.375	SA-105		X	8	SLC	45009 IPP	Bonney Forge	1133	

Final Bill of Material

ASME CODE VESSEL	BY	BY RT	DATE 10/23/2018	JOB NO. **5361-S01**	REQUIRED DATE: **12/21/18**
MILL TEST REPORTS REQUIRED AS INDICATED	DATE	CHK'D DB	DATE 11/26/2018	CUSTOMER **Anadarko**	STOCK CHECK: **11/29/18**
	REV				TO PURCHASING: **11/26/18**

Rev	Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Specification	See Note	MTR	Weight	Ship To:	PO No. / Vendor	Manufacturer	Heat & Slab Number	Plate ID
		5361-1D-9	2	PIPE	24" NOM XH	0.500		9.5	SA-106-B		X	199	SLC	45009 IPP	USS	MA2116	
		5361-1D-10	1	PIPE	3" NOM XXH	0.600		10	SA-106-B		X	16	SLC	45009 IPP	TMK	478063	
		5361-1D-11	1	PIPE	3" NOM XH, SKETCH	0.300		2	SA-106-B		X	2	SLC	45009 IPP	Arcelormittal	1609658	
		5361-1D-12	1	PLATE	1/2" PLATE, ROLLED w/4" TANS	0.500	10.938	119.5	SA-516-70		X	173	SLC	**45335 Ryerson**	Nucor	8505498	30U
		5361-1D-13	1	PLATE	CIRC 36.25 ID x 63 OD ROLL	1.000			SA-516-70		X	616	SLC	**45335 Ryerson**	Nucor	8505555	28U
		5361-1D-14	2	PLATE	CIRC 24.25 ID x 44.5 OD ROLL	0.750			SA-516-70		X	474	SLC	**45335 Ryerson**	SSAB	A81210	39U
		5361-1D-15	1	PLATE	PLATE CIRC 10.50" DIA	0.500			A-36			12	SLC	**45335 Ryerson**			
		5361-1D-16	1	PLATE	1/2" PLATE (VORTEX BRK)	0.500	6	8	SA-516-70		X	7	SLC	**45335 Ryerson**	Nucor	8505498	30U
		5361-1D-17	2	PLATE	1/2" SKETCH PL (VORTEX BRK)	0.500	3.75	6	SA-516-70		X	6	SLC	**45335 Ryerson**	Nucor	8505498	30U
		5361-1D-18	1	FLANGE	6" - 150# RF BLIND				SA-105		X	25	SLC	45289 MWPS	RNG	5912	
		5361-1D-19	1	FLANGE	3" - 150# RF BLIND				SA-105		X	11	SLC	45289 MWPS	Boltex	T217	
		5361-1D-20	1	GASKET	1/8" - 6" - 150#, RING TYPE, C-4401				KLINGERSIL			1	SLC	45281 KLINGER			
		5361-1D-21	1	GASKET	1/8" - 3" - 150#, RING TYPE, C-4401				KLINGERSIL			-	SLC	45281 KLINGER			
		5361-1D-22	8	STUD	3/4" DIA. FULL THREAD			4.25	SA-193-B7			4	SLC	45302 UINTAH			
		5361-1D-23	16	NUT	3/4" HEAVY HEX				SA-194-2H			3	SLC	45302 UINTAH			
		5361-1D-24	4	STUD	5/8" DIA. FULL THREAD			3.75	SA-193-B7			1	SLC	45302 UINTAH			
		5361-1D-25	8	NUT	5/8" HEAVY HEX				SA-194-2H			-	SLC	45302 UINTAH			
		5361-1E-1	1	HOUSING	VANE PAK HOUSING (BY AMACS)				SA-516-70		X	393	SLC	Furnished by Customer	Nucor	8507558	
		5361-1E-2	1	VANE PAK	VANE PAK W/ DISTRIBUTOR (BY AMACS)				304L SS			500	SLC	Furnished by Customer			
		5361-1E-3	1	PLATE	1/2" WEIR PLATE, SKETCH	0.500	32	112.125	SA-516-70		X	360	SLC	**45335 Ryerson**	Nucor	8505498	30U
		5361-1F-1	4	PLATE	1/2" PLATE, SKETCH W/HOLES	0.500	50.125	100.25	SA-240-304		X	175	SLC	**45335 Ryerson**	NAS	A19W	29U
		5361-1F-2	2	BEAM	W6 x 20 W/HOLES & SLOTS			123.5	304 SS			412	SLC	45349 Ryerson			
		5361-1F-3	4	PLATE	1/2" PLATE, SKETCH W/HOLES	0.500	6	7	SA-240-304		X	23	SLC	**45335 Ryerson**	NAS	A19W	29U
		5361-1F-4	4	PLATE	1/2" PLATE, SKETCH	0.500	5.25	7	SA-240-304		X	17	SLC	**45335 Ryerson**	NAS	A19W	29U
		5361-1F-5	156	NUT	3/8" HEAVY HEX				304 SS			5	SLC	45302 UINTAH			
		5361-1F-6	2	BAFFLE	DISTRIBUTION BAFFLE (BY AMACS)				304L SS			900	SLC	Furnished by Customer			
		5361-1G-1	1	PLATE	1/2" PLATE, SKETCH W/HOLES	0.500	30	36	SA-240-304			87	SLC	**45335 Ryerson**			
		5361-1G-2	1	PIPE	24" NOM XH, SKETCH	0.500		18.688	SA-312-TP304			144	SLC	45289 MWPS			
		5361-1G-3	1	PIPE	24" NOM XH, SKETCH	0.500		23.75	SA-312-TP304			145	SLC	45289 MWPS			
		5361-1G-4	1	PIPE	24" NOM XH, SKETCH	0.500		10.563	SA-312-TP304		X	59	SLC	45289 MWPS	Outokumpu	441917	
		5361-1G-5	2	PLATE	1/2" PLATE W/HOLES	0.500	4	12	SA-240-304			13	SLC	**45335 Ryerson**			
		5361-1G-6	4	PLATE	1/2" PLATE, SKETCH	0.500	2.25	3.5	SA-240-304			4	SLC	**45335 Ryerson**			
		5361-1G-7	2	PLATE	1/2" PLATE W/HOLES	0.500	2.5	70	SA-240-304		X	49	SLC	**45335 Ryerson**	NAS	A19W	29U
		5361-1G-8	2	PLATE	1/2" PLATE W/HOLE	0.500	5.5	7.813	SA-240-304		X	12	SLC	**45335 Ryerson**	NAS	A19W	29U
		5361-1G-9	4	PLATE	1/2" PLATE, SKETCH	0.500	4	9.688	SA-240-304		X	20	SLC	**45335 Ryerson**	NAS	A19W	29U
		5361-1G-10	1	PLATE	1/2" PLATE, SKETCH W/HOLES	0.500	6	12	SA-240-304		X	10	SLC	**45335 Ryerson**	NAS	A19W	29U
		5361-1G-11	1	DIFFUSER	INLET DIFFUSER ASSY (BY AMACS)				304L SS			942	SLC	Furnished by Customer			

Final Bill of Material

ASME CODE VESSEL	BY	BY RT	DATE 10/23/2018	JOB NO. **5361-S01**	REQUIRED DATE:	**12/21/18**
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	REV				TO PURCHASING:	**11/26/18**

Rev	Ship Pcs	Mark No.	Assy Pcs	Name	Description	Thk Inches	Width Inches	Length Inches	Material Specification	See Note	MTR	Weight	Ship To:	PO No. / Vendor	Manufacturer	Heat & Slab Number	Plate ID
		5361-1H-1	1	FLANGE	36" - 150# SERIES "B" RFWN XH BORE (35" I.D.)				SA-105		X	270	SLC	45009 IPP	Coastal	ACDXJ	
		5361-1H-2	1	PLATE	1/2" PLATE, ROLLED w/4" TANS	0.500	55.25	119.5	SA-516-70		X	874	SLC	**45335 Ryerson**	Nucor	8505498	30U
		5361-1H-3	1	HEAD	0.375" MIN x 36" OD ASME 2:1 SF=2"				SA-516-70		X	228	SLC	44997 CMF	Nucor	8505299	
		5361-1H-4	1	FLANGE	4" - 150# RFWN XH BORE				SA-105		X	16	SLC	45009 IPP	RNG	H6336	
		5361-1H-5	5	FLANGE	3" - 150# RF LWN			9	SA-105		X	127	SLC	45008 Ameriforge	FVC	C1000AF	
		5361-1H-6	1	PIPE	4" NOM XH, SKETCH	0.337		9.25	SA-312-TP304		X	10	SLC	45009 IPP	Seah	N08288	
		5361-1H-7	1	PIPE	4" NOM XH, SKETCH	0.337		24	SA-312-TP304		X	26	SLC	45009 IPP	Seah	N08288	
	1	5361-1H-B		GASKET	1/8" - 36" - 150# SERIES "B" RING TYPE C-4401				KLINGERSIL			1	SLC	45281 KLINGER			
	44	5361-1H-C		STUD	7/8" DIA FULL THREAD			6.75	SA-193-B7			51	SLC	45302 UINTAH			
	88	5361-1H-D		NUT	7/8" HEAVY HEX				SA-194-2H			26	SLC	45302 UINTAH			
		5361-1J-1	2	FLANGE	20" - 150# RFWN XH BORE				SA-105		X	399	SLC	45009 IPP	Norma	1231	
		5361-1J-2	2	FLANGE	20" - 150# RF BLIND				SA-105		X	541	SLC	45009 IPP	ST&H	805820E	
		5361-1J-3	2	GASKET	1/8" - 20" - 150# RING TYPE KLINGERSIL C-4401				KLINGERSIL			2	SLC	45281 KLINGER			
		5361-1J-4	4	PLATE	1-1/4" SKETCH PL W/ HOLE	1.250	3	5.5	A-36		X	16	SLC	**45335 Ryerson**	Nucor	8505747	27U
		5361-1J-5	2	PLATE	1-1/4" SKETCH PL W/ SLOT	1.250	4.188	4.813	A-36		X	9	SLC	**45335 Ryerson**	Nucor	8505747	27U
		5361-1J-6	2	PLATE	1-1/4" SKETCH PL W/ SLOT	1.250	4.188	4.813	A-36		X	9	SLC	**45335 Ryerson**	Nucor	8505747	27U
		5361-1J-7	2	ROD	1" DIA ROD W/ HOLES			15.5	A-36			7	SLC	**45335 Ryerson**			
		5361-1J-8	2	ROD	3/4" DIA ROD, BEND			12	A-36		X	3	SLC	**Stock**	Nucor	PL16105676	
		5361-1J-9	40	STUD	1-1/8" DIA FULL THREAD			6.25	SA-193-B7			70	SLC	45302 UINTAH			
		5361-1J-10	80	NUT	1-1/8" HEAVY HEX				SA-194-2H			46	SLC	45302 UINTAH			
		5361-1J-11	4	WASHER	1" STANDARD ROUND				STEEL			-	SLC	45302 UINTAH			
		5361-1J-12	4	COTTER	1/4" DIA COTTER PIN			1.5	STEEL			-	SLC	45302 UINTAH			
		5361-1J-13	2	PIPE	20" NOM XH	0.500		20.563	SA-106-B		X	357	SLC	45009 IPP	USS	MA6721	
		5361-1J-14	2	PLATE	CIRC 20.25 ID x 39" OD ROLL	1.000			SA-516-70		X	586	SLC	**45335 Ryerson**	Nucor	8505555	28U

Commercial Metal Forming

Commercial Metal Forming - O
341 West Collins Ave
Orange, CA 92867
PHONE: 714.532.6321
FAX:

PACKING LIST

SHIPMENT NO. 300227
PAGE NO. 2

SALES ORDER	CUSTOMER NO.	P.O. NUMBER	P.O. DATE	S.O. DATE	PLANT
999118	17913	0044986	09/21/18	09/21/18	OCW

SOLD TO: EATON METAL PRODUCTS*
4800 YORK ST.
DENVER, CO 80216

SHIP DATE: 11/16/18

PREPAID&ALLOW-FOB DE

B/L NO. 259767

SHIP TO: EATON METAL PRODUCTS
844 S. CHESTNUT STREET
SALT LAKE CITY, UT 84104
USA

MTR'S WITH SHIPMENT

ITEM	PART NO.	DESCRIPTION	REL	REQ DATE	DUE QTY	SHIP QTY
1	6392113201000	132"OD X 1"NOM SE 2:1 SA516-70 2"SF BEVEL PER PRINT SA516-70 MTRS 5420# (.85"MIN) #1-1	1	11/16/18	2	2

HEAT: JJP=FA38079 SLAB: P30709

5361
mk # 1-1

CARBON STEEL PARTS WHICH WERE COLD FORMED COMPLY WITH ASME SECTION VIII DIV. 1 UG-79 & UCS-79D.
PARTS: ✓ WERE NOT HEAT TREATED
______ WERE HEAT TREATED
ALL PARTS COMPLY WITH UG-81
CERTIFIED BY:____________________

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

SA516-70 5361 MK# 1-1 1" P30709

Reviewed to 2017 ASME Section II

"JJP"

검 사 증 명 서
MILL TEST CERTIFICATE

HYUNDAI STEEL
당진제철소 : 충남 당진시 송악읍 북부산업로 1480
1480 Bukbusaneup-Ro Songak-Eup, Dangjin-Si, Chungnam, Korea

주문번호 Order No. : E170400143
품 명 Commodity : Hot Rolled Steel Plate
제품규격 Specification : ASME SA516-70(2013)/ASTM A516-70(2015)
고객사 Customer : AMERICAN ALLOY
주문자 Contractor : METAL ONE AMERICA, INC.
증명서 번호 Certificate No. : 20170601-PS-022-013
발행일자 Date of Issue : 2017-06-01

제품치수 Dimension	수량 Quantity	중량 Weight (Kg)	제강번호 Heat No.	제품번호 Product No.	Position	인장시험 Tensile Test YP	TS	EL	YP-EL	RA	YR	YP Mtd	Division	화학성분 Chemical Composition(%) C	Si	Mn	P	S	Cr	Ni	B	Cu	Mo	Nb	Ti	V	Sol-Al	CEQ
				JJP		(N/㎟)		(%)	(%)	(%)	(%)			4	3	3	4	4	2	2	4	3	2	3	3	3	3	3
1"x170"x340"	1	7,436	P30709	FA83607601	T	345.2	524.5	49				2	L	1,713	357	1,136	135	36	14	1	3	26	9	16	2	2	45	409
1"x170"x340"	1	7,436	P30709	FA83607602	T	345.2	524.5	49				2	L	1,713	357	1,136	135	36	14	1	3	26	9	16	2	2	45	409

단위 Unit 2 : x100 3 : x1,000 4 : x10,000 5 : x100,000

*** Sub Total(010) *** 2 14,872(Kg)

*** Condition of supply : As-Rolled ***

*** Test Coupon Heat Treatment ***

** Method A ** * Applicable test items - Tensile Test

** Method A ** * 1.Normalizing(Times: 1) - Heating Temp : 900℃, Heating Rate : 170℃/Hr Max at above 400℃, Holding Time : 30 Min, Cooling Rate : Air Cooling

*** Lot Total *** 106 385,603(Kg) PO/Contract No. : 111005

*** Grade Total *** 106 385,603(Kg) Ceq(CEV). G=C+Mn/6+(Ni+Cu)/15+(Cr+Mo+V)/5

*** Last Item ***

APPROVED
ASME SEC. II
2015 Ed. ______ Ad.
CMF

NOTE
* Position - T:Top, M:Middle, B:Bottom
* Tensile test - Direction:Transverse, YP Mtd : 2 (0.2% off-set),5 (0.5% underload), U (Upper yield point), L (Lower yield point)
* Division - C:Check analysis, L:Ladle analysis

* The plate is fully killed and fine grained steel. Basic oxygen process and Vacuum degassing process were applied.This Mill Test Certificate is issued in accordance with EN 10204 Type 3.1

상기의 제품은 검사의 결과 지정된 규격에 합격한 것을 증명합니다.
WE HEREBY CERTIFY THAT THE MATERIAL HAS BEEN MADE AND TESTED IN ACCORDANCE WITH THE ABOVE SPECIFICATION AND THE REQUIREMENTS

Signature S. B. Park
Chief Of Quality Assurance Team

* 본 검사증명서는 원본인 전자문서(전자서명 정보 포함)로부터 출력된 사본입니다. 전자문서의 내용은 현대제철 고객포털에서 확인하실 수 있습니다.(http://sm.hyundai-steel.com/cs/cm/login.jsp)
* This Mill Test Certificate is a copy that has been printed from original electronic document(with digital signing).
You are able to check an original electronic document at hyundaisteel's customer portal(http://sm.hyundai-steel.com/cs/cm/login.jsp) * QRcode scanner App : 'QReal'
* [사용상 주의사항] 본 검사증명서에 명기된 규격 외 사용시 제품손상 및 안전상 문제가 발생할 수 있습니다.
* [Caution for Use] Damage on products and safety problems may arise if used other than to the spec stated in this Mill Test Certification.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

P064675 7/14/17 K

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

REPORT OF CHEMICAL/PHYSICAL TESTS

CERTIFICATE NO.	DATE	PAGE
1643589	Dec 21, 2018	1

ISO 9001
REGISTERED
U.S. PLATE PRODUCER

SOLD TO

EATON METAL PRODUCTS CO
PO BOX 16405
STOCKYARD STATION
DENVER, CO 80216
US

EATON METAL PRODUCTS CO.
844 CHESTNUT STREET
SALT LAKE CITY, UT 84104

MILL ORDER NO.	DATE
329921	

CUSTOMER ORDER NO. 0044980

JOB/REQ. NO. 5361-S01 01031

SHIPPING NO.	DATE
1643589	12/21/2018

CARRIER Trinity Transport

CAR/TRUCK NO. 4F002

THIS MATERIAL HAS BEEN MANUFACTURED, TESTED AND FOUND TO MEET THE SPECIFICATIONS AND PURCHASE ORDER REQUIREMENTS
CARBON STEEL PRESSURE VESSEL QUALITY PLATE ASTM A516-17 GRADE 70 ASME SA516 GRADE 70 2017. AS ROLLED KILLED FINE GRAIN NO WELD REPAIR. PRESSURE VESSEL QUALITY.

PHYSICAL PROPERTIES

ITEM NO	DESCRIPTION	HEAT NO.	SLAB	YIELD PSI X 100	TENSILE PSI X 100	% ELONG 8"	% ELONG 2"	% RA	HARDNESS BHN	BEND TEST	IMPACTS
1	0.8750 X 126.000ME X 413.500										
	PT# SA-516-70										
	1 PC 12929 LBS ^	N19015	A32	570	785	29					35U
	2 PCS 25858 LBS ^	N19840	A22	560	780	23					36U & 37U
	1 PC 12929 LBS ^	N19841	A23	575	810	23					38U
	4 PCS 51716 LBS TOTALS										

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

PO# 44980
5361
mk#1-2

CHEMICAL ANALYSIS

HEAT NO.	C	Mn	P	S	Si	Cu	Ni	V	Cb	Al	Cr	Mo	Ti	B	N	Ca			CE	McQuaid Ehn Grain Size
^N19015	.19	1.34	.013	.008	.28	.01	.05	.025	.000	.045	.02	.00	.000	.0000						
^N19840	.19	1.35	.012	.006	.31	.02	.05	.024	.000	.034	.02	.00	.000	.0000						
^N19841	.20	1.33	.013	.006	.30	.01	.05	.024	.000	.041	.02	.00	.000	.0000						

HEATS INDICATED WITH (+) WERE MELTED & MANUFACTURED IN THE USA. HEATS INDICATED WITH (^) WERE ROLLED IN THE USA.

.... END OF REPORT ....

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

Aaron Capps
Quality Coordinator

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

REPORT OF CHEMICAL/PHYSICAL TESTS

CERTIFICATE NO.	DATE	PAGE
1643429	Dec 19, 2018	1

MILL ORDER NO.	DATE
329921	

CUSTOMER ORDER NO. 0044980
JOB/REQ. NO. 5361-S01 01031

SHIPPING NO.	DATE
1643429	12/19/2018

CARRIER Trinity Transport
CAR/TRUCK NO. 14

ISO 9001 REGISTERED
U.S. PLATE PRODUCER

SOLD TO
EATON METAL PRODUCTS CO
PO BOX 16405
STOCKYARD STATION
DENVER, CO 80216
US

EATON METAL PRODUCTS CO.
844 CHESTNUT STREET
SALT LAKE CITY, UT 84104

THIS MATERIAL HAS BEEN MANUFACTURED, TESTED AND FOUND TO MEET THE SPECIFICATIONS AND PURCHASE ORDER REQUIREMENTS
CARBON STEEL PRESSURE VESSEL QUALITY PLATE ASTM A516-17 GRADE 70 ASME SA516 GRADE 70 2017. AS ROLLED KILLED FINE GRAIN NO WELD REPAIR. PRESSURE VESSEL QUALITY.

PHYSICAL PROPERTIES

ITEM NO	DESCRIPTION	HEAT NO.	SLAB	YIELD PSI X 100	TENSILE PSI X 100	% ELONG 8"	2"	% RA	HARDNESS BHN	BEND TEST	IMPACTS
1	0.8750 X 126.000ME X 413.500										
	PT# SA-516-70										
	1 PC 12929 LBS	^N19008	A33	575	790	23					31U
	1 PC 12929 LBS	^N19833	A23	575	810	23					32U
	1 PC 12929 LBS	^N19841	A27	575	810	25					34U
	1 PC 12929 LBS	^N20370	A22	565	800	22					33U
	4 PCS 51716 LBS TOTALS										

5361

5361 PO# 44980
mk# 1-3

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

CHEMICAL ANALYSIS

	HEAT NO.	C	Mn	P	S	Si	Cu	Ni	V	Cb	Al	Cr	Mo	Ti	B	N	Ca			CE	McQuaid Ehn Grain Size
31U	^N19008	.20	1.31	.015	.006	.28	.01	.05	.024	.000	.037	.02	.00	.000	.0000						
32U	^N19833	.20	1.39	.012	.004	.32	.02	.05	.024	.000	.039	.02	.00	.000	.0000						
34U	^N19841	.20	1.33	.013	.006	.30	.01	.05	.024	.000	.041	.02	.00	.000	.0000						
33U	^N20370	.19	1.33	.015	.005	.33	.01	.05	.024	.000	.040	.03	.00	.002	.0000						

HEATS INDICATED WITH (+) WERE MELTED & MANUFACTURED IN THE USA. HEATS INDICATED WITH (^) WERE ROLLED IN THE USA.

.... END OF REPORT ....

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

Aaron Capps
Quality Coordinator

08/29/2017 From: AMERICAN ALLOY STEEL, INC. To: EATON METAL PRODUCTS
P.O.#: 0043258 S.O.#: 580058 AA PL#: 5187341
Item: 1 (1 PC) 1/4" X 96" X 240"
TAG: MARK# 1B-1

ArcelorMitt

TEST CERTIFICATE

ARCELORMITTAL PLATE LLC

PAGE NO: 01 OF 05
FILE NO: 0284-01-43
MILL ORDER NO: 80489-002
MELT NO: D0872
SLAB NO: 39A
DATE: 07/18/17

SHIP TO:
AMERICAN ALLOY STEEL
C/O SKOL TRACK 21
6350 N ERIE AVE
OWASSO OK 00000

SOLD TO:
AMERICAN ALLOY STEEL, INC
P. O. BOX 40469
HOUSTON TX 77240-0469

SEND TO:

01-C

STEEL PLATE DIMENSIONS / DESCRIPTION

TOTAL QTY	GAUGE	WIDTH	LENGTH	DESCRIPTION	PIECE WEIGHT
9	.25"	96"	240"	RECTANGLE	1634#

CUSTOMER INFORMATION

CUSTOMER PO: 111583-OK

PART NO. 2

Certified a true copy of the
original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By: 8/29/17

SPECIFICATION(S)

THIS MATERIAL HAS BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH PURCHASE ORDER REQUIREMENTS AND SPECIFICATION(S).

ASTM A516 YR 10 GR 70
ASTM A516 YR 10 GR 65
ASTM A516 YR 10 GR 60
ASME SA516 ED 15 GRADE 70
ASME SA516 ED 15 GRADE 65
ASME SA516 ED 15 GRADE 60
PRODUCT OF COIL
THE MANAGEMENT SYSTEMS FOR MANUFACTURE OF THIS PRODUCT ARE CERTIFIED TO ISO 9001:2008 (CERTIFICATE NO. 30130) AND ISO 14001:2004 (CERTIFICATE NO. 49009).

CHEMICAL COMPOSITION (WT%) FOR ALL ELEMENTS EXCEPT H (PPM)

	C	MN	P	S	CU	SI	NI	CR	MO
MELT:D0872	.20	.93	.015	.004	.28	.19	.16	.19	.04
	V	TI	B	AL	CB				
MELT:D0872	.002	.003	.0002	.019	.001				

Reviewed to 2017 ASME Section II

5361-1
MK# 1-4
ID# 38R

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

AMERICAN ALLOY
PLATE # 5187341

WE HEREBY CERTIFY THE ABOVE INFORMATION IS CORRECT:

ARCELORMITTAL PLATE LLC
QUALITY ASSURANCE LABORATORY
139 MODENA ROAD
COATESVILLE, PA 19320

Loc Tran
SUPERVISOR – TEST REPORTING
LOC TRAN

08/29/2017 From: AMERICAN ALLOY STEEL, INC. To: EATON METAL PRODUCTS
P.O.#: 0043258 S.O.#: 580058 AA PL#: 5187341
Item: 1 (1 PC) 1/4" X 96" X 240"
TAG: MARK# 1B-1

TEST CERTIFICATE

PAGE NO: 03 OF 05
FILE NO: 0284-01-43
MILL ORDER NO: 80489-002
MELT NO: D0872
SLAB NO: 39A
DATE: 07/18/17

HEAT TREAT CONDITION SET TWO

MATL OR TEST	HEAT TREAT DESCRIPTION	NOM TEMP	HOLD MINS	COOL MTHD
TEST ONLY	NORMALIZE	1650F	30	AIR COOL

TENSILE PROPERTIES SET TWO

SLAB NO.	LOC	DIR	YIELD STRENGTH PSI X 1000	TENSILE STRENGTH PSI X 1000	ELONGATION AFTER FRACTURE GAGE LGTH	%
39A	BOT.	TRANS.	55	75	8.00"	22.0
39A	MID.	TRANS.	56	77	8.00"	23.0
39A	TOP	TRANS.	57	77	8.00"	23.0

WE HEREBY CERTIFY THE ABOVE
INFORMATION IS CORRECT:

ARCELORMITTAL PLATE LLC
QUALITY ASSURANCE LABORATORY
139 MODENA ROAD
COATESVILLE, PA 19320

SUPERVISOR – TEST REPORTING
LOC TRAN

08/29/2017 From: AMERICAN ALLOY STEEL, INC. To: EATON METAL PRODUCTS
P.O.#: 0043258 S.O.#: 580058 AA PL#: 5187341
Item: 1 (1 PC) 1/4" X 96" X 240"
TAG: MARK# 1B-1

TEST CERTIFICATE

PAGE NO: 04 OF 05
FILE NO: 0284-01-43
MILL ORDER NO: 80489-002
MELT NO: D0872
SLAB NO: 39A
DATE: 07/18/17

GENERAL INFORMATION

ALL STEEL HAS BEEN MELTED AND MANUFACTURED IN THE U.S.A.
TEST CERTS. ARE PREPARED IN ACCORD. WITH PROCEDURES
OUTLINED IN EN10204:2004 TYPE 3.1
MERCURY OR MERCURY COMPOUNDS ARE NOT USED IN THE
MANUFACTURE OF ARCELORMITTAL PLATE LLC PRODUCTS.
ALL STEEL HAS BEEN MANUFACTURED IN THE U.S.A.
ACID SOLUBLE ALUMINUM
FOR MORE INFORMATION AND PROCESSING GUIDELINES, REFER TO
WWW.USA.ARCELORMITTAL.COM/PLATE

MERCURY OR MERCURY COMPOUNDS ARE NOT USED IN THE MANUFACTURE OF ARCELORMITTAL PLATE LLC PRODUCTS.

B/L #17519 TTPX 80714

WE HEREBY CERTIFY THE ABOVE
INFORMATION IS CORRECT:

ARCELORMITTAL PLATE LLC
QUALITY ASSURANCE LABORATORY
139 MODENA ROAD
COATESVILLE, PA 19320

SUPERVISOR – TEST REPORTING
LOC TRAN

08/29/2017 From: AMERICAN ALLOY STEEL, INC. To: EATON METAL PRODUCTS
P.O.#: 0043258 S.O.#: 580058 AA PL#: 5187341
Item: 1 (1 PC) 1/4" X 96" X 240"
TAG: MARK# 1B-1

TEST CERTIFICATE

PAGE NO: 05 OF 05
FILE NO: 0284-01-43
MILL ORDER NO: 80489-002
MELT NO: D0872
SLAB NO: 39A
DATE: 07/18/17

MEXICAN GOVERMENT PRODUCT IDENTIFICATION REQUIREMENTS:

01. PRODUCT DESCRIPTION: HOT ROLLED CARBON STEEL PLATE CUT TO LENGTH

02. TYPE OF STEEL: NON-ALLOY

03. TYPE OF COATING USED: N/A

04. TYPE OF FINISHING OR COMPLEMENTARY MANUFACTURING: N/A

05. PROPRIETARY STANDARD: ASTM A516 YR 10 GR 70
ASTM A516 YR 10 GR 65
ASTM A516 YR 10 GR 60
ASME SA516 ED 15 GRADE 70
ASME SA516 ED 15 GRADE 65
ASME SA516 ED 15 GRADE 60

06. PRODUCT PRESENTATION: PLATE

07. ACCESSORIES INTEGRATED TO THE GOOD: N/A

08. PRODUCT DIMENSIONS:

GAUGE	WIDTH	LENGTH	
.25	96	240	INCHES
6.35MM	2438.4MM	6096MM	MILLIMETERS

09. TECHNICAL SPECIFICATION: N/A

10. PHYSICAL SPECIFICATIONS: NORMALIZE AIR COOL

11. COUNTRY OF ORIGIN: USA

12. CHEMICAL COMPOSITION: (WEIGHT %) DETAILED IN MILL TEST REPORT

13. PRODUCING MILL: ARCELORMITTAL PLATE LLC
SUPERVISOR TEST REPORTING, QUALITY, 930
139 MODENA ROAD
COATESVILLE, PA 19320

CONTACT PERSON: LOC TRAN
PHONE: (610) 238-7579
EMAIL: MAILTO:LOC.TRAN@ARCELORMITTAL.COM

14. CERIFICATE NUMBER: D0872

15. PLATE IDENTIFIER: 39A

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

WE HEREBY CERTIFY THE ABOVE
INFORMATION IS CORRECT:

ARCELORMITTAL PLATE LLC
QUALITY ASSURANCE LABORATORY
139 MODENA ROAD
COATESVILLE, PA 19320

Loc Tran

SUPERVISOR – TEST REPORTING
LOC TRAN

SSAB

Test Certificate

11

Form TC1: Revision 3: Date 7 Feb 2018

1770 Bill Sharp Boulevard, Muscatine, IA 52761-9412, US

Customer:
JOSEPH T. RYERSON & SON, INC.
ACCOUNTS PAYABLE DEPT.
PO BOX 91601
LUBBOCK
TX 79490-1601

Customer P.O. No.: 4500900643

Mill Order No.: 41-550133-01

Shipping Manifest: MT359274

Product Description: ASTM A516-70(17)/ASME SA516-70(17)

Ship Date: 15 Oct 18
Cert Date: 15 Oct 18

Cert No: 861737010
(Page 1 of 1)

Size: 0.375 X 96.00 X 240.0 (IN)

Tested Pieces				Tensiles							Charpy Impact Tests												
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in	Elong % 8in	Tst Dir	Hardness	Abs. Energy(FTLB) 1	2	3	Avg	% Shear 1	2	3	Avg	Tst Tmp	Tst Dir	Tst Sz (mm)	BDWTT Tmp	%Shr
ABI012	C54	0.373 (DISCRT)	L	55	77		29		T														

Chemical Analysis

Heat Id	C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	IIW	ORGN
A8I012	.17	.93	.009	.002	.17	.026	.023	.28	.09	.11	.03	.000	.024	.006	.0002	.38	USA

KILLED STEEL
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE
CEV (IIW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
NACE MR0175/ISO15156-2:2015 ANNEX A2.1.2 COMPLIANT
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
NO WELD REPAIR HAS BEEN PERFORMED ON THIS MATERIAL.
PRODUCTS SHIPPED:
A8I012 C54 PCES: 0, LBS: 19600

P045335
ID 40U
5361

mk# 1B-8

Orig'l

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Cust Part # : 160004835

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

Brian Wales
SENIOR METALLURGIST - PRODUCT

5361-1 Reviewed to 2017 ASME Section II
mk# 1C-1, 1J-1

NORMA (INDIA) LIMITED

48,Site IV industrial Area, Sahibabad, Ghaziabad-201010 (U.P) INDIA
Tel: 91-120-2896091, 2895404 Fax: 91-120-2895930 E-mail: normaindia@gmail. com

Works Test Certificate

NORMA/LAB NO-6539/14-15
INVOICE NO. E-400
DATE:-13-10-14

P. Order. No:	503/005034	Customer:-		Forging specification	ASME SA105 -09 ASTM A105 -12
Component	20"-150# WNRF XH FLG.				
Drawing No.				Steel Supplier	Adhunik Metaliks Ltd.
Machining STD	ANSI B16.5- 2009 ASME B16.5- 2009	Quantity:-	09Nos.	Mill Heat No.	14AI 145

NORMA HEAT NO-1231

TEST RESULTS

CHEMICAL COMPOSTION

Elements %	Specified Composition	Actual	
		NORMA LAB	MILL T.C.
Carbon	0.35max.	0.20	0.20
Manganese	0.60-1.05	1.11	1.10
Silicon	0.10-0.35	0.18	0.20
Sulphur	0.040max.	0.012	0.015
Phosphorous	0.035max.	0.016	0.015
Chromium	0.30max.	0.012	0.014
Nickel	0.40max.	0.009	0.007
Copper	0.40max.	0.012	0.009
Molybdenum	0.12max.	0.004	0.001
Vanadium	0.080max.	0.004	0.002
Carbon Equivalent (CE)	0.47max.	0.390	0.387

MECHANICAL PROPERTIES.

PROPERTIES	SPECIFIED	OBTAINED
Yield Strength (mpa)	250.00 min.	321.65
Tensile Strength (mpa)	485.00 min.	521.86
%Elongation in 50mm / 4D	22.00 min	31.76
Hardness HB.	187. max.	149-163
% Reduction of Area	30.00 min.	61.01

Specified carbon as per Purchase Order 0.25max.

Serrated face as per MSS-SP-6 With in limits of 125-250AARH

CARBON EQUIVALENT (CE)
$CE = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$

MARKING AS PER MSS-SP-25-2008
20"-150 XH SA/A105 1231 B16.5 NORMA INDIA.

Remarks:- We here by certify that the material described here in has been tested in accordance with the applicable specifications referred above and meets the requirements as per EN10204/3.1B & NACE Standard-MR0175-2003.

"As per ASTM A105 Table 1 Note:-For each reduction of 0.01% below the specified carbon maximum(0.35%).an increase of 0.06% manganese above the specified maximum (1.05%)will be permitted up to maximum 1.35% &NACE Standard MRO175/ISO15156 Standard
Country of Origin-India.

Checked by:
Metallurgist

Certified by:
Quality Control Manager

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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

Certificate No. MJH0003A-19/25 **Date :** AUG. 21. 2018
Customer
Contract No. 202261-00-1ST
Spec. For Material ASTM A105N-14,ASME SA105N-17,NACE MR0175/ISO 15156-2:2015,NACE MR0103/ISO 17495-1:2016
Heat Treatment 930℃ NORMALIZED & A.C

Certified to ISO9001/ ISO14001:2015,PED2014/68/EC by LRQA

Dimensional inspectionASME B16.5 - 2017

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen			Tension Test				Hardness Test (HB)		Charpy Impact Test (10X10mm Specimen Size)			
				D mm	GL mm	Max	Y.S MPa	T.S MPa	E.L %	R.A %	187		Indiv. 21J	Ave. 27J	Notch V	Temp. -29℃
				12.5	50.0	Min	250	485	22.0	30.0			Test Result (J)			Ave.(J)
BA150BR16	150LBS BL RF 16"	60	805820D	12.5	50.0		323	518	33	75	152	156	143	120	118	127
BA150BR20	150LBS BL RF 20"	60	805820E	12.5	50.0		323	518	33	75	152	156	143	120	118	127
	BLANK		BLANK					BLANK			BLANK					

5361-1
MK# 1C-2, 1J-2

Heat No./ Batch No.		Chemical Composition (%)																CE	NDE		
		C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V								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																	
	H	0.184	0.258	1.040	0.012	0.005	0.007	0.016	0.002	0.023	0.001							0.363			
805820D	P	0.175	0.250	1.030	0.014	0.004	0.007	0.019	0.003	0.023	0.001							0.353			
	H	0.184	0.258	1.040	0.012	0.005	0.007	0.016	0.002	0.023	0.001							0.363			
805820E	P	0.175	0.250	1.030	0.014	0.004	0.007	0.019	0.003	0.023	0.001							0.353			
										BLANK											

REMARK
- * H : Heat Analysis P : Product Analysis
- * Impact Test performed according to ASTM A370 & MESC 76/210/2017 Paragraph 8.5 / Table 4 & 5.
- * C:Mn = 1≤5
- * Mn is Permitted up to Max 1.65% (ASTM A105-14 TABLE 1, NOTE 1.)

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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

ST&H CORPORATION QUALITY MANAGEMENT

Manager of Q.A Dept. / JAY KIM
ST&H CORPORATION

ST-801-14-02

NUCOR
PLATE MILL

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

Mill Test Report

Page 1

1505 River Rd
Cofield, NC 27922
(252) 356-3700

NUCOR It's Our Nature

Issuing Date : 09/12/2018 B/L No. : 612940 Load No. : 623425 Our Order No. : 159438/1 Cust. Order No. : 4500893649

Vehicle No: NOKL 725090

Sold To:
RYERSON PROCUREMENT CORP
PO BOX 91601
LUBBOCK,TX 79490

Ship To:
RYERSON INC. DENVER
6600 HIGHWAY 85
COMMERCE CITY,CO 80022

Specification: 1.2500" x 96.000" x 240.000"
ASTM A36-14/ASTM A709 Grade 36-18/AASHTO M270Grade 36/ASME SA36 2015/2017 AASHTO M270-2017 36

Marking : 160005004

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
0505747	0.20	0.84	0.010	0.004	0.19	0.19	0.08	0.10	0.01	0.025	0.003	0.002	0.002		0.0042	0.0000	0.011	0.38	0.26

			Tensile Test				
Plate Serial No	Pieces	Tons	Qtr.	(psi) Yield	(psi) Tensile	Elong. % in 2"	Elong. % in 8"
8505747-04	3	12.25	T	40,900	69,700		27.2
			T	41,000	70,100		28.7

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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 (#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. Deprelis
T. A. Deprelis, Metallurgist

9/13/2018 8:48:15 AM

5361-1
PL ID # 270
mk# 1C-4,5,6
1J-4,5,6

NUCOR
NUCOR CORPORATION
NUCOR STEEL UTAH

Mill Certification

10/11/2016

MTR #: U1-357740
PO Box 100
7285 West 21200 North
PLYMOUTH, UT 84330
(435) 458-2300
Fax: (435) 458-2309

Sold To:
INTSEL STEEL WEST LLC
PO BOX 21119
HOUSTON, TX 77226-1119

Ship To:
INTSEL STEEL WEST
1887 SOUTH 700 WEST
SALT LAKE CITY, UT 84104
(801) 433-2210
Fax: (801) 972-6145

Customer P.O.	SLC-12130	Sales Order	268246.4
Product Group	Merchant Bar Quality	Part Number	3000075024004W0
Grade	A36/A529GR50/CSA44W/50W	Lot #	PL1610567651
Size	3/4" (.7500) Round	Heat #	PL16105676
Product	3/4" (.7500) Round 20'A36/A529-50/44W/50W	B.L. Number	U1-548929
Description	A36/A529-50/44W/50W	Load Number	U1-357740
Customer Spec		Customer Part #	

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

Roll Date: 8/13/2016 **Melt Date: 8/10/2016** **Qty Shipped LBS: 11,895** **Qty Shipped Pcs: 396**

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

C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb
0.19%	0.72%	0.010%	0.045%	0.24%	0.23%	0.09%	0.13%	0.018%	0.0016%	0.000%

Yield 1: 51,498psi	Tensile 1: 73,816psi	Elongation: 28% in 8"(% in 203.3mm)
Yield 2: 50,764psi	Tensile 2: 73,645psi	Elongation 26% in 8"(% in 203.3mm)
Weight Variation 000.0%		

Specification Comments: MEETS THE REQUIREMENTS OF: ASTM A36/A36M-12, A529/A529-05 GR50, CSA G40.21-04 GR44W(300W)&GR50W(350W) AASHTO M270/M270M-12 GR36(270), ASME SA36/SA36M-07

Comments: NUCOR - PLYMOUTH IS AN I.S.O. 9001 AND AN A.B.S. CERTIFIED MILL
CMTR COMPLIES WITH DIN EN 10204 - 3.1

1. ALL MANUFACTURING PROCESSES OF THE STEEL MATERIALS IN THIS PRODUCT, INCLUDING MELTING, CASTING, AND HOT ROLLING HAVE OCCURRED WITHIN THE UNITED STATES. ALL PRODUCTS PRODUCED ARE WELD FREE. MERCURY, IN ANY FORM, HAS NOT BEEN USED IN THE PRODUCTION OR TESTING OF THIS MATERIAL.
2. PROPOSITION 65 WARNING: THIS PRODUCT CONTAINS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER AND/OR BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM. FOR MORE INFORMATION, PLEASE CALL 1-435-458-2300.

Reviewed to 2017 ASME Section II

5361-1
MK# 1C-8, 1J-8

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Ryan Pennington
Division Metallurgist

5361-1 Reviewed to 2017 ASME Section II

MK#IC-13

DATE:	11/30/14
TIME:	04:05:47
SERIAL NO:	L0054107

UNITED STATES STEEL CORPORATION

TUBULAR PRODUCTS
CERTIFIED TEST REPORT

(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	VEHICLE I.D
DR00652 08	R03446	10P15701-CA	GONX310910

SOLD TO ADDRESS

MAIL TO ADDRESS

VENDOR

UNITED STATES STEEL CORP.
LORAIN TUBULAR OPERATIONS
2199 EAST 28TH ST.
LORAIN, OH 44055

SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-*45TH EDITION DATED 12/1/12 PSL-2 GRADE B AND GRADE X42 R N OR Q ASTM A53-*12 GRADE B ASTM A106-*13 GRADE B/C SPECIAL OD TOLERANCE ASME SA53-*2013 EDITION GRADE B ASME SA106-*2013 EDITION GRADE B/C BLK REG MILL COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 *:ISO 15156-2 2009 ED AND MR-0103-2012_ED

MATERIAL COND: AS ROLLED

O.D.: 20.000(508.000) in (mm)

WALL: 0.500 (12.700) in (mm)

PRODUCT IDENTIFICATION	TENSILE TEST TYPE/ ORIENTATION	TEST COND.	GAUGE WIDTH	YIELD PSI	EXT % .50	TENSILE PSI	Y/T	ELONG % (IN 2")	HARDNESS SCALE:	MIN HYDRO PSI	DWELL(SEC)
				MIN: 42100		MIN: 70000	MAX:	MIN:	MIN:	1900	5
			IN	MAX: 71800		MAX: 95000	0.93	29.0	MAX:		
MA6721 F157AA	STRIP/L/B	AR	1.500	50500	.50	78500	0.65	39.7		1900	5
X83582 E795AA	STRIP/L/B	AR	1.500	49700	.50	73000	0.62	45.5		1900	5

** END OF DATA THIS SHEET **

LEGEND: L - LONGITUDINAL U - UPSET T - TRANSVERSE NM - NORMALIZED QT - QUENCH & TEMPERED SR - STRESS RELIEVED AR - AS ROLLED TR - THERMOMECHANICAL ROLLED B - BODY W - WELD

PRODUCT IDENTIFICATION	TYPE		C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CO				C.E.* MAX .43
MA6721	HEAT		19	104	010	003	23	16	08	09	02	025		03	0003	002	003					.41
MA6721 F157AA	PROD		20	104	007	002	24	15	07	08	03	026		03	0002	001	001					.42
MA6721 F157AA	PROD		20	104	006	003	24	16	07	08	02	027		03	0002	001	001					.42
X83582	HEAT		20	104	008	007	23	02	01	09	01	038		03	0002	002	001					.40
X83582 E795AA	PROD		19	105	004	005	25	02	01	08	01	041		03	0001	002	003					.40
X83582 E795AA	PROD		21	105	003	009	25	01	01	08	01	042		03	0005	002	006					.41

** END OF DATA THIS SHEET **

*C.E. IS BASED ON THE FOLLOWING EQUATION(S): CE=C+MN/6+(CR+MO+V)/5+(NI+CU)/15

EATON METAL PRODUCTS COMPANY LLC SPD QUALITY

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT. ELEMENTS REPORTED IN MASS FRACTION (%)

UNITED STATES STEEL CORPORATION

TUBULAR PRODUCTS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 11/30/14
TIME: 04:05:47
SERIAL NO: L0054107

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	
DR00652 08	R03446	10P15701-CA	0019012

MATERIAL COND: AS ROLLED

O.D.: 20.000(508.000) in (mm)

WALL: 0.500 (12.700) in(mm)

CHARPY V-NOTCH IMPACT TESTING

PRODUCT IDENTIFICATION	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	DIR	TEST LOC.	TEMP	SIZE	TEST COND.	FT-LBS 1	FT-LBS 2	FT-LBS 3	FT-LBS AVG	% SHEAR 1	% SHEAR 2	% SHEAR 3	% SHEAR AVG
							DEG F										
MA6721 F157AA	OK				T	B	+ 32	3/4	AR	58	77	60	65	40	60	50	50
X83582 E795AA	OK				T	B	+ 32	3/4	AR	100	94	104	99	100	100	100	100

** END OF DATA THIS SHEET **

LEGEND L - LONGITUDINAL T - TRANSVERSE B - BODY W - WELD HAZ - HEAT AFFECTED ZONE

TESTING / INSPECTION INFORMATION

TEST / INSPECTION	YES	RESULTS / COMMENTS
FULL LENGTH VISUAL	X	
FULL LENGTH EMI	X	OD X OD/ID ___ L X L/T ___ 10.0% NOTCH
FULL LENGTH MPI		
FULL LENGTH UT	X	ID X OD/ID ___ L X L/T ___ 10.0% NOTCH
END AREA INSPECTION (PLAIN END)	X	MPI X UT ___
SPECIAL END AREA (SEA) INSP		MPI ___ UT ___
FULL LENGTH DRIFT		DRIFT MANDREL SIZE:

ADDITIONAL NOTES/COMMENTS

MELTED AND MANUFACTURED IN THE USA, NO REPAIRS BY WELDING, NO MERCURY COMPOUNDS ARE ADDED
TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT..
MANUFACTURED IN AN ISO 9001 CERTIFIED FACILITY - CERTIFICATE #32022.
PRODUCT WAS HOT ROLLED AND HOT FINISHED

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: BRAD KOURY - MANAGER, Q.A.

DATE 11/30/14

**

USS UNITED STATES STEEL CORPORATION

TUBULAR PRODUCTS
ADDITIONAL COMMENTS SHEET

DATE: 11/30/14
TIME: 04:05:51
PAGE: 1 OF 1

MILL ORDER/ITEM NO.	SHIPPERS NO.	P.O. NUMBER	HEAT	
DR00652 08		10P15701-CA		SERIAL NUMBER: L0054107

SOLD TO ADDRESS	MAIL TO ADDRESS	VENDOR
		UNITED STATES STEEL CORP LORAIN TUBULAR OPERATIONS 2199 EAST 28TH ST. LORAIN, OH 44055

HEAT MA6721 - MELTED AT:NUCOR STEEL MEMPHIS, MEMPHIS, TN 38109
HEAT X83582 - MELTED AT:FAIRFIELD WORKS, FAIRFIELD, AL 35064
END OF DATA

SSAB

Test Certificate

1770 Bill Sharp Boulevard, Muscatine, IA 52761-9412, US

Form TC1; Revision 3; Date 7 Feb 2018

9

Customer:
JOSEPH T. RYERSON & SON, INC.
ACCOUNTS PAYABLE DEPT,
PO BOX 91601
LUBBOCK
TX 79490-1601

Customer P.O. No.: 4500399993

Mill Order No.: 41-549855-01

Shipping Manifest: MT359175

Product Description: ASTM A516-70(17)/ASME SA516-70(17).

Ship Date: 12 Oct 18
Cert Date: 12 Oct 18

Cert No: 061736667
(Page 1 of 1)

Size: 0.750 X 95.00 X 240.0 (IN)

Tested Pieces				Tensiles							Charpy Impact Tests													
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in	Elong % 8in	Tst Dir	Hardness	Abs. Energy(FTLB) 1	2	3	Avg	% Shear 1	2	3	Avg	Tst Temp	Tst Dir	Tst Siz (mm)	DWTT Temp	%Shr	
A81210	C09	0.748 (DISCRT)	L	55	76		35		T															

Heat Id	C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	IIW	ORGN
A81210	.17	.99	.010	.002	.17	.028	.026	.28	.11	.08	.02	.001	.030	.002	.0003	.38	USA

KILLED STEEL
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE
CEV (IIW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
MTR EN 10204.2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
NO WELD REPAIR HAS BEEN PERFORMED ON THIS MATERIAL.
PRODUCTS SHIPPED:
A81210 C09 PCHS: 2, LBS: 9802

P045355
ID 39U
5361

mk# 1C-14
1D-14

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

(M) Cust Part # : 160004840

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

Brian Walos
SENIOR METALLURGIST - PRODUCT

COASTAL

COASTAL FLANGE

P.O. BOX 40443
HOUSTON, TX 77240-0443

MATERIAL CERTIFICATION

74569001 **MTR # : 857**

Page : 1 of 1

SOLD TO:

SHIP TO:

DATE	SALES ORDER #	CUST P.O.#	TAG NUMBER	SPECIFICATION
04/08/2016	160414	S630278		SA105

ITEM #	QTY	ITEM DESCRIPTION	HEAT CODE
	7	36" 150# RF WN XH "B" ASME B16.47	ACDXJ

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Cr	Ni	Mo	V	Cu
.20	.94	.006	.004	.29	.025	.021	.005	.001	.012

PHYSICAL PROPERTIES

Tensile PSI	Yield PSI	Elongation	REDUCTION OF AREA %	BHN	BHN
75565	47427	33	60	149	147

HEAT TREATMENT

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

SUPPLEMENTAL INFORMATION

I hereby certify that the reported figures are correct, as contained in the records of the corporation and that the material was manufactured in the United States of America under a ISO:9001:2008 certified Quality Management System. NACE MR0175 EN 10204 3.1

S361-1
MK# 1D-1, 1H-1
Reviewed to ASME 2017 Section II

Production Assistant

5361-1
mk# 1D-2

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. MJH0029A-05/08 **Date :** JUL 25. 2018
Customer
Contract No. 203880-00-1ST
Spec. For Material ASTM A105N-14,ASME SA105N-17,NACE MR0175/ISO 15156-2:2015,NACE MR0103/ISO 17495-1:2016
Heat Treatment 930°C NORMALIZED & A.C

Certified to ISO9001/ ISO14001:2015,PED2014/68/EC by LRQA

Dimensional inspectionASME B16.5 - 2017

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen			Tension Test				Hardness Test (HB)		Charpy Impact Test (10X10mm Specimen Size)			
				D mm	GL mm		Y.S MPa	T.S MPa	E.L %	R.A %			Indiv. 21J	Ave. 27J	Notch V	Temp. -29°C
				12.5	50.0	Max Min	250	485	22.0	30.0	187		Test Result (J)			Ave.(J)
BA300WRSTD20	300LBS WN RF STD 20"	5	N08178	12.5	50.0		324	506	38	70.5	143	146	48	80	73	67
BA600WRXH16	600LBS WN RF XH 16"	30	N08178	12.5	50.0		324	506	38	70.5	143	146	48	80	73	67
BA150BF24	150LBS BL FF 24"	10	N13378	12.5	50.0		364	506	32	65.5	143	146	123	129	112	121
BA150BR22	150LBS BL RF 22"	5	N13378	12.5	50.0		364	506	32	65.5	143	146	123	129	112	121
BA150BR24	150LBS BL RF 24"	100	N13378	12.5	50.0		364	506	32	65.5	143	146	123	129	112	121
BA150WRXH24	150LBS WN RF XH 24"	5	N13378	12.5	50.0		364	506	32	65.5	143	146	123	129	112	121
BA300BR20	300LBS BL RF 20"	10	N13378	12.5	50.0		364	506	32	65.5	143	146	123	129	112	121
BA300WR4024	300LBS WN RF S40 24"	10	N13378	12.5	50.0		364	506	32	65.5	143	146	123	129	112	121
BA6008R18	600LBS BL RF 18"	5	N13378	12.5	50.0		364	506	32	65.5	143	146	123	129	112	121
BA900BR18	900LBS BL RF 18"	5	N13378	12.5	50.0		364	506	32	65.5	143	146	123	129	112	121

Heat No./ Batch No.		Chemical Composition (%)																CE	NDE		
		C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V								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																	
N08178	H	0.199	0.220	1.040	0.014	0.005	0.005	0.014	0.002	0.013	0.001							0.376			
	P	0.195	0.216	1.050	0.012	0.003	0.008	0.021	0.001	0.012	0.001							0.375			
N13378	H	0.169	0.273	0.964	0.015	0.004	0.009	0.018	0.002	0.013	0.002							0.335			
	P	0.173	0.271	0.952	0.011	0.002	0.009	0.022	0.002	0.012	0.001							0.338			

BLANK

REMARK * H : Heat Analysis P : Product Analysis
* Impact Test performed according to ASTM A370 & MESC 76/210/2017 Paragraph 8.5 / Table 4 & 5.
* C:Mn = 1≤5

EATON METAL PRODUCTS COMPANY, LLC
SPD
QUALITY

ST&H CORPORATION
QUALITY MANAGEMENT

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. / JAY KIM
ST&H CORPORATION

ST-801-14-02

FVC
an AFGlobal Company

Material Test Report

Heat Code: DVB

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756 4800 York Street Denver, CO 80216	PO: 0045008	Sales Order: 169271	Line: 1
	Item Code: HBN060150090A001A1	Qty Shipped: 2	
	Item Desc: HBN RF 6"150X9" SA105		
	Mill Heat: A181215		

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.19				Cr	Chromium	0.14		✓	7440-47-3
Mn	Manganese	1.13		✓	7439-96-5	Mo	Molybdenum	0.03			
Mn:C		5.9				V	Vanadium	0.032			
P	Phosphorous	0.006				Cb	Columbium	0.001			
S	Sulphur	0.003				C.E.		0.43			
Si	Silicon	0.27				CuNiCrMoV		0.422			
Cu	Copper	0.15		✓	7440-50-8	CrMo		0.17			
Ni	Nickel	0.07		✓	7440-02-0						

5361-1
mk# 10-3

Mechanical Testing		Other	
Test Lab	AFG	VD	YES
Test Bar Size	SACRIFICIAL PIECE	Fully Killed	YES
HBW	163 - 163		
Elg (%)	28		
RA (%)	52		
Tensile Specimen Size (in)	.494		
Tensile (ksi)	77.8		
Yield (ksi)	51.4		
Gauge Length (in)	2		

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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.: 1348576
Certification Date: 10/27/2018
Issued By: John Sauceda

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

Material Test Report

Heat Code: DVB

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd.   Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756 4800 York Street Denver, CO 80216	PO: 0045008	Sales Order: 169271	Line: 1
	Item Code: HBN060150090A001A1	Qty Shipped: 2	
	Item Desc: HBN RF 6"150X9" SA105		
		Mill Heat: A181215	
Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A			

MARK #1D-3

Product compliant with NACE MR0175/ISO 15156-2:2015, Annex A (A.2.1.2, A2.1.3).

* No Weld repair performed.
* Ladle Chemical Analysis results are reported from the raw material suppliers MTR.
* Tensile taken from a round specimen. Measurement of elongation after fracture.
* Yield strength was determined using the .2% offset method, unless otherwise specified.
* All material supplied under this order is certified to be free of mercury contamination and no mercury bearing equipment was used in manufacturing, fabrication or testing.
* When reported on MTR: Tensile Testing Per ASTM E8; Brinell Hardness Per ASTM E10; Charpy Testing Per ASTM E23
* AF Global manufactures materials according to a certified Quality Management System conforming to ISO 9001:2015

Unless otherwise noted on PO, Dimensions of all standard pipe flanges and flange fittings (NPS 1/2 to NPS 24) per ASME B16.5-2013 , large diameter steel flanges (NPS 26 to 60) per ASME B16.47-2011, Orifice flanges per ASME B16.36-2015.

* FVC FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5

SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Certification No.: 1348576
Certification Date: 10/27/2018
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

FVC
an AFGlobal Company

Material Test Report

Heat Code: EKR

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756
4800 York Street
Denver, CO 80216

PO: 0045008
Sales Order: 169271
Line: 2
Item Code: HBN040150140A001SP
Qty Shipped: 1
Item Desc: HBN SA105 150# 4" x 12.25" RF
Mill Heat: C149949

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18				Cr	Chromium	0.09		✓	7440-47-3
Mn	Manganese	1.11		✓	7439-96-5	Mo	Molybdenum	0.04			
P	Phosphorous	0.009				V	Vanadium	0.034			
S	Sulphur	0.003				Cb	Columbium	0.001			
Si	Silicon	0.26				C.E.		0.42			
Cu	Copper	0.18		✓	7440-50-8	CuNiCrMoV		0.554			
Ni	Nickel	0.21		✓	7440-02-0	CrMo		0.13			

5361-1
mK# 1D-4

Mechanical Testing		Other	
Test Lab	AFG	VD	YES
HBW	163 - 163	Fully Killed	YES
Elg (%)	56	Made to Fine Grain Practice	YES
RA (%)	72		
Tensile Specimen Size (in)	.491		
Tensile (ksi)	80		
Yield (ksi)	54.9		
Gauge Length (in)	2		

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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.: 1350715
Certification Date: 11/10/2018
Issued By: John Sauceda

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

Material Test Report

Heat Code: EKR

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756	PO: 0045008	Sales Order: 169271	Line: 2
4800 York Street	Item Code: HBN040150140A001SP	Qty Shipped: 1	
Denver, CO 80216	Item Desc: HBN SA105 150# 4" x 12.25" RF		
	Mill Heat: C149949		
Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A			

MARK #1D-4

Product compliant with NACE MR0175/ISO 15156-2:2015, Annex A (A.2.1.2, A2.1.3).

* No Weld repair performed.
* Ladle Chemical Analysis results are reported from the raw material suppliers MTR.
* Tensile taken from a round specimen. Measurement of elongation after fracture.
* Yield strength was determined using the .2% offset method, unless otherwise specified.
* All material supplied under this order is certified to be free of mercury contamination and no mercury bearing equipment was used in manufacturing, fabrication or testing.
* When reported on MTR: Tensile Testing Per ASTM E8; Brinell Hardness Per ASTM E10; Charpy Testing Per ASTM E23
* AF Global manufactures materials according to a certified Quality Management System conforming to ISO 9001:2015

Unless otherwise noted on PO, Dimensions of all standard pipe flanges and flange fittings (NPS 1/2 to NPS 24) per ASME B16.5-2013 , large diameter steel flanges (NPS 26 to 60) per ASME B16.47-2011, Orifice flanges per ASME B16.36-2015.

* FVC FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Certification No.: 1350715
Certification Date: 11/10/2018
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

FVC
an AFGlobal Company

Material Test Report

Heat Code: DXN

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756
4800 York Street
Denver, CO 80216

PO: 0045008
Sales Order: 169271
Line: 3
Item Code: HBN030150090A001A1
Qty Shipped: 1
Item Desc: HBN RF 3"150X9" SA105
Mill Heat: A181216

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.17				Cr	Chromium	0.11		✓	7440-47-3
Mn	Manganese	1.12		✓	7439-96-5	Mo	Molybdenum	0.03			
Mn:C		6.5				V	Vanadium	0.034			
P	Phosphorous	0.006				Cb	Columbium	0.000			
S	Sulphur	0.002				C.E.		0.41			
Si	Silicon	0.26				CuNiCrMoV		0.354			
Cu	Copper	0.18		✓	7440-50-8	CrMo		0.14			
Ni	Nickel	0.07		✓	7440-02-0						

5361-1
mk# 1D-5

Mechanical Testing	
Test Lab	AFG
Test Bar Size	3.5X3.5X12
HBW	163 - 163
Elg (%)	30
RA (%)	71
Tensile Specimen Size (in)	.490
Tensile (ksi)	78.3
Yield (ksi)	52.8
Gauge Length (in)	2

Other	
VD	YES
Fully Killed	YES

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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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.: 1350283
Certification Date: 11/8/2018
Issued By: John Sauceda

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

Material Test Report

Heat Code: DXN

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756	PO: 0045008	Sales Order: 169271	Line: 3
4800 York Street	Item Code: HBN030150090A001A1	Qty Shipped: 1	
Denver, CO 80216	Item Desc: HBN RF 3"150X9" SA105		
		Mill Heat: A181216	

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

MARK #1D-5

Product compliant with NACE MR0175/ISO 15156-2:2015, Annex A (A.2.1.2, A2.1.3).

* No Weld repair performed.
* Ladle Chemical Analysis results are reported from the raw material suppliers MTR.
* Tensile taken from a round specimen. Measurement of elongation after fracture.
* Yield strength was determined using the .2% offset method, unless otherwise specified.
* All material supplied under this order is certified to be free of mercury contamination and no mercury bearing equipment was used in manufacturing, fabrication or testing.
* When reported on MTR: Tensile Testing Per ASTM E8; Brinell Hardness Per ASTM E10; Charpy Testing Per ASTM E23
* AF Global manufactures materials according to a certified Quality Management System conforming to ISO 9001:2015

Unless otherwise noted on PO, Dimensions of all standard pipe flanges and flange fittings (NPS 1/2 to NPS 24) per ASME B16.5-2013 , large diameter steel flanges (NPS 26 to 60) per ASME B16.47-2011, Orifice flanges per ASME B16.36-2015.

* FVC FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Certification No.: 1350283
Certification Date: 11/8/2018
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

FVC
an AFGlobal Company

Material Test Report

Heat Code: BWL

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756
4800 York Street
Denver, CO 80216

PO: 0045008

Sales Order: 169271 Line: 3

Item Code: HBN030150090A001A1

Qty Shipped: 2

Item Desc: HBN RF 3"150X9" SA105

Mill Heat: A171871

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.19				Cr	Chromium	0.08		✓	7440-47-3
Mn	Manganese	1.10		✓	7439-96-5	Mo	Molybdenum	0.03			
P	Phosphorous	0.009				V	Vanadium	0.014			
S	Sulphur	0.004				Cb	Columbium	0.000			
Si	Silicon	0.26				C.E.		0.41			
Cu	Copper	0.13		✓	7440-50-8	CuNiCrMoV		0.314			
Ni	Nickel	0.06		✓	7440-02-0	CrMo		0.11			

5361-1
mk# 1D-5

Mechanical Testing

Test Lab	AFG
Test Bar Size	3.5X3.5X12
HBW	149 - 156
Elg (%)	34
RA (%)	64
Tensile Specimen Size (in)	.493
Tensile (ksi)	78.8
Yield (ksi)	51.9
Gauge Length (in)	2

Other

VD	YES
Fully Killed	YES

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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.: 1350027
Certification Date: 11/7/2018
Issued By: Nancy Loos

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

Material Test Report

Heat Code: BWL

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756	PO: 0045008	Sales Order: 169271	Line: 3
4800 York Street	Item Code: HBN030150090A001A1	Qty Shipped: 2	
Denver, CO 80216	Item Desc: HBN RF 3"150X9" SA105		
		Mill Heat: A171871	
Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A			

MARK #1D-5

Product compliant with NACE MR0175/ISO 15156-2:2015, Annex A (A.2.1.2, A2.1.3).

* No Weld repair performed.
* Ladle Chemical Analysis results are reported from the raw material suppliers MTR.
* Tensile taken from a round specimen. Measurement of elongation after fracture.
* Yield strength was determined using the .2% offset method, unless otherwise specified.
* All material supplied under this order is certified to be free of mercury contamination and no mercury bearing equipment was used in manufacturing, fabrication or testing.
* When reported on MTR: Tensile Testing Per ASTM E8; Brinell Hardness Per ASTM E10; Charpy Testing Per ASTM E23
* AF Global manufactures materials according to a certified Quality Management System conforming to ISO 9001:2015

Unless otherwise noted on PO, Dimensions of all standard pipe flanges and flange fittings (NPS 1/2 to NPS 24) per ASME B16.5-2013 , large diameter steel flanges (NPS 26 to 60) per ASME B16.47-2011, Orifice flanges per ASME B16.36-2015.

* FVC FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Certification No.: 1350027
Certification Date: 11/7/2018
Issued By: Nancy Loos

Rina Sane - Metallurgical Lab Manager

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

5361-1
mk# 1D-6

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. MJH9943-01/08 **Date :** AUG. 01. 2018
Customer
Contract No. 199005-00
Spec. For Material ASTM A105N-14,ASME SA105N-17,NACE MR0175/ISO 15156-2:2015,NACE MR0103/ISO 17495-1:2016
Heat Treatment 930℃ NORMALIZED & A.C

Certified to ISO9001:2008, ISO14001:2004,PED2014/68/EC by LRQA

Dimensional inspectionASME B16.5 - 2017

ITEM / SIZE		Q'ty	Heat No./ Batch No.	Size of Test Specimen			Tension Test				Hardness Test (HB)	Charpy Impact Test (10X10mm Specimen Size)			
				D mm	GL mm	Max	Y.S MPa	T.S MPa	E.L %	R.A %	187	Indiv. 21J	Ave. 27J	Notch V	Temp. -29℃
				12.5	50.0	Min	250	485	22.0	30.0		Test Result (J)			Ave.(J)
BA900WRXH3	900LBS WN RF XH 3"	350	012898E	12.5	50.0		345	540	35	75	160 163	120	103	155	126
BA150BR1	150LBS BL RF 1"	500	012898F	12.5	50.0		345	540	35	75	160 163	120	103	155	126
BA150WRXXH3	150LBS WN RF XXH 3"	25	012898F	12.5	S0.0		345	540	35	75	160 163	120	103	155	126
BA900WRXH3	900L8S WN RF XH 3"	350	012898F	12.5	50.0		345	540	35	75	160 163	120	103	155	126
	BLANK		BLANK					BLANK			BLANK				

Heat No./ Batch No.		Chemical Composition (%)																	CE	NDE		
		C	SI	Mn	P	S	NI	Cr	Mo	Cu	V									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																		
	H	0.170	0.261	1.000	0.015	0.003	0.062	0.083	0.012	0.104	0.002								0.367			
012898E	P	0.174	0.280	1.020	0.020	0.002	0.108	0.131	0.002	0.123	0.001								0.386			
	H	0.170	0.261	1.000	0.015	0.003	0.062	0.083	0.012	0.104	0.002								0.367			
012898F	P	0.174	0.280	1.020	0.020	0.002	0.108	0.131	0.002	0.123	0.001								0.386			
										BLANK												

REMARK
- * H : Heat Analysis P : Product Analysis
- * Impact Test performed according to ASTM A370 & MESC 76/210/2017 Paragraph 8.5 / Table 4 & 5.
- * C:Mn = 1≤5
- * Mn is Permitted up to Max 1.65% (ASTM A105-14 TABLE 1, NOTE 1.)

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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. / JAY KIM
ST&H CORPORATION

ST-801-14-02

FVC
an AFGlobal Company

Material Test Report

Heat Code: DGT

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756 4800 York Street Denver, CO 80216	PO: 0045008	Sales Order: 169271	Line: 4
	Item Code: LWN020150090A001A1		Qty Shipped: 3
	Item Desc: LWN RF 2"150X9" SA105		
	Mill Heat: C140139		

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18				Cr	Chromium	0.05		✓	7440-47-3
Mn	Manganese	1.09		✓	7439-96-5	Mo	Molybdenum	0.02			
P	Phosphorous	0.005				V	Vanadium	0.035			
S	Sulphur	0.002				Cb	Columbium	0.001			
Si	Silicon	0.26				C.E.		0.41			
Cu	Copper	0.18		✓	7440-50-8	CuNiCrMoV		0.485			
Ni	Nickel	0.20		✓	7440-02-0	CrMo		0.07			

5361
mk# 1D-7

Mechanical Testing		Other	
Test Lab	AFG	VD	YES
Test Bar Size	SACRIFICIAL PIECE	Fully Killed	YES
HBW	179 - 179		
Elg (%)	28		
RA (%)	65		
Tensile Specimen Size (in)	.490		
Tensile (ksi)	86.6		
Yield (ksi)	56.8		
Gauge Length (in)	2		

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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.: 1348577
Certification Date: 10/27/2018
Issued By: John Sauceda

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

Material Test Report

Heat Code: DGT

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756
4800 York Street
Denver, CO 80216

PO: 0045008
Sales Order: 169271
Line: 4
Item Code: LWN020150090A001A1
Qty Shipped: 3
Item Desc: LWN RF 2"150X9" SA105
Mill Heat: C140139

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

MARK #1D-7

Product compliant with NACE MR0175/ISO 15156-2:2015, Annex A (A.2.1.2, A2.1.3).

* No Weld repair performed.
* Ladle Chemical Analysis results are reported from the raw material suppliers MTR.
* Tensile taken from a round specimen. Measurement of elongation after fracture.
* Yield strength was determined using the .2% offset method, unless otherwise specified.
* All material supplied under this order is certified to be free of mercury contamination and no mercury bearing equipment was used in manufacturing, fabrication or testing.
* When reported on MTR: Tensile Testing Per ASTM E8; Brinell Hardness Per ASTM E10; Charpy Testing Per ASTM E23
* AF Global manufactures materials according to a certified Quality Management System conforming to ISO 9001:2015

Unless otherwise noted on PO, Dimensions of all standard pipe flanges and flange fittings (NPS 1/2 to NPS 24) per ASME B16.5-2013 , large diameter steel flanges (NPS 26 to 60) per ASME B16.47-2011, Orifice flanges per ASME B16.36-2015.

* FVC FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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.: 1348577
Certification Date: 10/27/2018
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

5361-1
mk# 1D-8

BONNEY FORGE

MILL TEST REPORTS

Bonney Forge
14496 Croghan Pike
Mt. Union, PA 17066

CERTIFIED MILL TEST REPORT

Industrial Piping Products 9/26/2018

LOT NO.
1133

CHEMICAL ANALYSIS, PHYSICAL PROPERTIES, REMARKS

2" 6M A105 Coupling Threaded

C	0.160	MN	1.020	P	0.010	S	0.020	SI	0.250
NI	0.060	CR	0.130	MO	0.020	CU	0.180	CO	0.006
V	0.023	AL	0.025	CB	0.000				

CE(LONG FORMULA) = 0.381

T/S(PSI) 80000 Y/S(PSI) 51800 EL(%) 25.000 RA(%) 43.000

BRINELL HARDNESS 164, 163

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

1. CERTIFYING ASTM A105-14 / ASME SA105-17 EDITION.
2. THE MATERIAL SUPPLIED MEETS THE REQUIREMENTS OF NACE MR0175/ISO 15156-2.
3. THE MATERIAL SUPPLIED WAS INSPECTED AND MANUFACTURED IN ACCORDANCE WITH EN DIN 10204:2004 EDITION TYPE 3.1 INSPECTION DOCUMENT.
4. THE ELONGATION TEST RESULTS ARE OBTAINED USING STANDARD ROUND SPECIMEN, 2 INCH OR 50 MM GAGE LENGTH.

THIS DOCUMENT HAS BEEN ELECTRONICALLY SUBMITTED.

Cancel Logout

5361-1
MK# 1D-9

Reviewed to 2017 ASME Code Edition

UNITED STATES STEEL

TUBULAR PRODUCTS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 03/23/11
TIME: 05:19:12
SERIAL NO: L0035412

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	VEHICLE I.D.
DR00098 01	R83708	109454-00	LT8120

SOLD TO ADDRESS

MAIL TO ADDRESS

VENDOR
USS TUBULAR PRODUCTS
2199 EAST 28TH ST.
LORAIN, OH 44055

SPECIFICATION AND GRADE

PRESSURE PIPE CARBON SMLS HF ASTM A333-*10 GRADE 1 ASTM A333-*10 GRADE 6 ASME SA333-*2010 EDITION GRADE 1 ASME SA333-*2010 EDITION GRADE 6 ASTM A106-*08 GRADE B ASME SA106-*2010 EDITION GRADE B OD/ID WMPI SEA FOR TRANS&LONG FLAWS PER APISL E.3.3.1 AND E.6.1.2 BLK REG MILL COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 *:2003/COR.1:2005 AND MR0103-2007

MATERIAL COND: FULL BODY NORMALIZED

O.D.: 24.000(609.600) in (mm)

WALL: 0.500 (12.700) in (mm)

PRODUCT IDENTIFICATION	TENSILE TEST TYPE/ ORIENTATION	TEST COND.	GAUGE WIDTH IN	YIELD PSI	EXT % .50	TENSILE PSI	Y/T	ELONG % (IN 2")	HARDNESS SCALE: HRB	MIN HYDRO PSI	DWELL (SEC)
				MIN: 35000		MIN: 60000		MIN:	MIN:	900	5
				MAX:		MAX:	MAX:	35.0	MAX: 99.0		
MA2116 S500NA	STRIP/L/B	NM	1.500	55500	.50	78000	0.71	46.2	B 80.6	900	5
MA2116 S500NA	STRIP/L/B	NM	1.500	54500	.50	77500	0.70	44.0			

** END OF DATA THIS SHEET **

LEGEND: L - LONGITUDINAL
U - UPSET
T - TRANSVERSE
NM - NORMALIZED
QT - QUENCH & TEMPERED
SR - STRESS RELIEVED
AR - AS ROLLED
TR - THERMOMECHANICAL ROLLED
B - BODY
W - WELD

PRODUCT IDENTIFICATION	TYPE	C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CO	C.E.* MAX .50
MA2116	HEAT	20	1:02	010	003	21	09	05	10	02	028		03	0000	002	002		.41
MA2116 S500NA	PROD	20	1:09	014	006	25	12	05	10	03	042		04	0007	004	011		.43
MA2116 S500NA	PROD	20	1:09	013	005	25	12	05	10	03	039		04	0006	004	010		.42

** END OF DATA THIS SHEET **

*C.E. IS BASED ON THE FOLLOWING EQUATION(S): CE=C+(MN/6)+(CR+MO+V)/5+(NI+CU)/15

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

EATON METAL PRODUCTS COMPANY, LLC
SPD
QUALITY

UNITED STATES STEEL

TUBULAR PRODUCTS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 03/23/11
TIME: 05:19:12
SERIAL NO: L0035412

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	
DR0009B 01	R83708	109454-00	0020776

MATERIAL COND: FULL BODY NORMALIZED

O.D.: in (mm) 24.000 (609.600)

WALL: in (mm) 0.500 (12.700)

PRODUCT IDENTIFICATION	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	CHARPY V-NOTCH IMPACT TESTING												
					DIR	TEST LOC.	TEMP	SIZE	TEST COND.	FT-LBS				% SHEAR			
										1	2	3	AVG	1	2	3	AVG
							DEG F										
MA2116 S500NA	OK				L	B	- 50	FULL	NM	75	68	71	71	20	20	20	20

** END OF DATA THIS SHEET **

LEGEND L - LONGITUDINAL T - TRANSVERSE B - BODY W - WELD HAZ - HEAT AFFECTED ZONE

TESTING / INSPECTION INFORMATION

TEST / INSPECTION	YES	RESULTS / COMMENTS
FULL LENGTH VISUAL	X	
FULL LENGTH EMI	X	OD X OD/ID ____ L X LT ____ 10.0% NOTCH
FULL LENGTH MPI		
FULL LENGTH UT	X	ID X OD/ID ____ L X LT ____ 10.0% NOTCH
END AREA INSPECTION (PLAIN END)		MPI ____ UT ____
SPECIAL END AREA (SEA) INSP		MPI ____ UT ____
FULL LENGTH DRIFT		DRIFT MANDREL SIZE:

ADDITIONAL NOTES/COMMENTS

MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: R. HARRIS - MANAGER, Q.A.

DATE 03/23/11

S361-1
MK# 1D-10
Reviewed to 2017 ASME Section II

TMK IPSCO

TUBE TEST REPORT

Form QA-003 12/02/09 - Rev 2
Page 1 of 1

ORDER: 040998 004 | **HEAT:** 478063 | **P.O.:** M31010394 | **PART NO.**

SPECIFICATION(S) : ASME ASTM SA53/A53-10 GR B SA106/A106-11 GR B
API PSL1 GR B/X42 FORTY FOURTH EDITION
CERTIFIED NACE MR-01-75 DATED 10/15/09

GRADE: 1023M | **SIZE:** 3.500 X 0.600 DRL | **WPF:** 18.60 | **QUALITY:** SEAMLESS HOT FINISH

CONDITION (SPECIAL) : FINE GRAIN MELT PRACTICE
TEST METHODS USED: ASTM E415

TEST RESULTS CONFORM TO THE STANDARDS AND SPECIFICATION LISTED ABOVE.

	✓ C	✓ Mn	✓ S	✓ P	✓ Si	✓ Cr	✓ Ni	✓ Mo	✓ Cu	Al	✓ V	Cb	Ti	B
L	.21	.65	.002	.008	.29	.14	.10	.04	.23	.013	.005	.001	.0020	.0003
P	.21	.63	.003	.009	.28	.16	.09	.04	.19	.010	.003	.002	.0020	.0001
P	.21	.65	.003	.009	.30	.15	.09	.04	.19	.013	.003	.002	.0020	.0003

MATERIAL 100% MELTED AND MANUFACTURED IN THE USA.

Specimen ASTM E8	EUL	Yield KSI	Tensile KSI	ELNG 2 "	R/A	C.E.	Rockwell ASTM E18 Avg	Hydrotest
.750 " STR	0.5	✓ 49.3	✓ 77.4	40.0		.38	77.7 79.2 79.6 78.8 RB	3000 PSI 5 Sec Hold

EN 10204 TYPE 3.1b DATED 01/2005
FLAT(S) - SATISFACTORY
EMI INSPECTION - SATISFACTORY

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

8 / 31 / 12 Laurie Burnette

DATE **QUALITY ASSURANCE/KOPPEL**

MATERIAL WAS NOT EXPOSED TO MERCURY DURING PROCESSING.
NO WELDING OR WELD REPAIR PERFORMED ON THIS MATERIAL.
MATERIAL IS FREE OF HARMFUL RADIATION.

THIS CERTIFICATION MAY NOT BE REPRODUCED EXCEPT IN FULL.

5361-1 Reviewed to ASME code Edition 2017
mk# 1D-11

3" X 0.300" SMLS A53/API5L/A106
GR B/X-42 PEB DRL
Heat: 1609658
Your PO: 140733

ArcelorMittal South Africa Limited
Tubular Products
273 Genl. Hertzog Rd,
Peacehaven Vereeniging 1939
P O Box 48 Vereeniging 1930
South Africa

MATERIAL TEST CERTIFICATE
SEAMLESS TUBE

Telephone +27 (0)16 450 4220
Fax +27 (0)16 423 4906

Licensed under
API Spec 5L and 5CT
5L - 0319
5CT - 0419

ISO 9001: 2008
DE-395997 QM

Test Certificate
EN 10204:2004 TYPE 3.1

ArcelorMittal

Customer:
Order No: 4000023418
Certificate Reference No: 040062154010
Product: FULLY KILLED HOT FINISHED CARBON STEEL SEAMLESS TUBES
Specification: ISO3183:2012/API 5L:2012 L245/L290/B/X42 PSL1 ASTM A53B.12 A106B/C.15 A530.12 ASME SA53B.15 SA106B/C.15 SA530.15
Product Marking: ARCELORMITTAL SA ISO3183/Spec 5L-0319 MONOGRAM 05-17 ASTM/ASME A/SA106B/C A53B 3.500 0.300 40.000 L245/B L290/X42 PSL1 SMLS TESTED 3000 psi CAST NO: 1609658 PROD/O NO: T0442341810 MADE IN SOUTH AFRICA NDE

Customer Order/Contract No: SUS4 155556
Material No: 1000042255
Cast/Heat No: 1609658
Page 1 of 1

General Information

Quantity	Mass	Dimensions			Total Length
		Tube OD	Thickness	Length	
126	51,758.673(lb)	3.500(")	0.300(")	40.000 (ft)	5,040.000(ft)

Steel making process	Final Rolling Operation As Rolled
Basic Oxygen Furnace	Final hot rolling finished above 1580°F and cooled in still air

Chemical Composition

R22-(V+Nb+Ti) R24-(Nb+V)

Element(%)	C	Si	Mn	S	P	Cr	Ni	Mo	Cu	V	Al	Ti	Sn	Ca	N	B	Nb	CE	R22	R24
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maximum	0.200	-	1.30	0.030	0.030	0.50	0.50	0.150	0.500	-	-	-	-	-	-	-	-	0.41	0.15	0.060
Heat	0.120	0.16	1.05	0.004	0.013	0.03	0.01	0.001	0.005	0.043	0.030	0.002	0.001	0.0017	0.0026	0.0004	0.0005	0.31	0.05	0.043
Product	0.1204	0.1620	1.0460	0.0039	0.0128	0.0280	0.0140	0.0010	0.0050	0.0429	0.0300	0.0018	0.0007	0.0017	0.0026	0.0004	0.0005	0.3104	0.0452	0.0434
Product (ADD)	0.1204	0.1620	1.0460	0.0039	0.0128	0.0280	0.0140	0.0010	0.0050	0.0429	0.0300	0.0018	0.0007	0.0017	0.0026	0.0004	0.0005	0.3104	0.0452	0.0434

Mechanical Properties

Specification Limits	UTS (Rm) MPa	UTS (Rm) psi	Yield (0.5%) MPa	Yield (0.5%) psi	% EL 2 inch
Minimum		70000		42000	30.0
Maximum		-		-	-
(1) Actual		70343		51343	36.0
(2) Actual		70778		51923	39.0
(3) Actual					
(4) Actual					

	UTS (Rm) MPa	UTS (Rm) psi	Yield (0.5%) MPa	Yield (0.5%) psi	% EL 2 inch
(5) Actual					
(6) Actual					
(7) Actual					
Orientation & type of tensile test	Longitudinal, Strip				
Width of tensile piece (inch)	0.75 inch				
Orientation of impact test piece					

OTHER TESTS	
Category	Result
Hydrostatic	3000 psi for 5 Sec
NDI: EMI	PASS - ASTM E570 - 12.5% NOTCH
NDI: UT	UT not required
HV 22 lbs	150 153 153

Remarks:

Material in accordance with NACE MR0175:2015/ISO15156-2:2015, MR0103:2015. Dimensions to ASME B36.10M-2015.
The material conform to the hot yield strength requirements as per ASME, Sect II, Pt D, Table Y-1, 2015. All the material conform to the visual and dimensional requirements and is made to a suitable fine grain practice.

Quality Assurance Manager: PJ Venter *Date of Release: 2017.05.26* *Certified by:*

We hereby certify that the material was manufactured, tested and inspected to and fully comply with the requirements of referenced specifications. No changes, amendments or additions may be made to this document. Any changes which are effected shall invalidate this certificate.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

5361-)
mk# 1E-1

01/15/2019 From: AMERICAN ALLOY STEEL, INC. To: ARISTCO SEPARATION PRODUCTS, INC.
P.O.#: 23470 S.O.#: 621254 AA PL#: 5213109
Item: 1 (1 PC) 3/8" X 48" X 120" - HOT RO 4171K $ 6,750
COUNTRY OF ORIGIN/EXPORT: USA

AMERICAN ALLOY
PLATE #5213109

NUCOR
PLATE MILL

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

Mill Test Report

1505 River Rd
Cofield, NC 27922
(252) 356-3700

NUCOR
It's Our Nature.

Issuing Date : 11/12/2018 **B/L No. :** 518505 **Load No. :** 528340 **Our Order No. :** 161952/3 **Cust. Order No. :** 116824

Vehicle No: TTPX 803309

Specification: 0.3750" x 120.000" x 360.000"
ASTM A516 70-17/ASME SA516 70 PVQ 2015/2017 Normalized Test Coupons at 1650F Hold 30 Min per Inch of thickness Air Cooled NACE MR0175 Annex 2.1.2 (2015), MR0103(2010) Section 2.1.2 (2015) 13.1.1, 13.1.3) Compliant

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

Ship To:
AMERICAN ALLOY STEEL
6230 N HOUSTON ROSSLYN RD
BNSF TR 0 7223
MILE 034 LN SEG 402
NORTH HOUSTON,TX 77091

Marking : 116824

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
8507556	0.20	1.04	0.010	0.002	0.22	0.28	0.11	0.09	0.01	0.025	0.005	0.001	0.002		0.0018	0.0000	0.011	0.42	0.28

Plate Serial No	Pieces	Tons	Tensile Test Dir.	(psi) Yield	(psi) Tensile	Elong. % in 2"	Elong. % in 8"	
8507556-02	4	9.18	T	57,200	82,400		20.6	
			T	53,100	77,200		28.3	N
8507556-03	4	9.18	T	56,700	81,800		19.8	
			T	53,100	77,000		22.8	N
8507556-04	4	9.18	T	57,900	83,000		22.5	
			T	53,400	76,500		25.0	N
8507556-05	7	16.08	T	57,200	82,700		23.5	
			T	51,600	75,400		27.0	N
→ 8507556-06	4	9.18	T	58,000	82,700		21.8	
			T	53,500	77,600		24.6	N

MA TO
174 183
APP BY Pb 1/15/19

Certified a true copy of the original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By: Pb 12/12/18

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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:no-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 (A010340) by SRI Quality System Registrar (00765-09). 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. Doprado
T. A. Doprado, Metallurgist

11/10/2018 11:11:00 AM

12/12/2018 From: AMERICAN ALLOY STEEL, INC. To: RYERSON PROCUREMENT CORPORATION
P.O.#: 4700687702 S.O.#: 619274 AA PL#: 5210607
Item: 1 (1 PC) 1/2" X 120" X 120"

AMERICAN ALLOY
PLATE # 5210607

NUCOR
PLATE MILL

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

Mill Test Report
Page 3

1505 River Rd
Cofield, NC 27922
(252) 356-3700

NUCOR
It's Our Nature

Issuing Date : 09/20/2018 B/L No. : 614118 Load No. : 522348 Our Order No. : 159246/7 Cust. Order No. : 116318-UT

Vehicle No: NOKL 725178

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

Ship To:
AMERICAN ALLOY STEEL INC
1124 W 600 NORTH
UP-HRSVL-UCRY
TRACK 725 STATION UN005
OGDEN,UT 84404

Specification:
0.5000" x 120.000" x 480.000"
ASTM A516 70/65/60-17/ASME SA516-70/65/60 PVQ 2015/2017
Normalized Plate NACE MR0175 Annex 2.1.2 (2015), MR0103 (2010)
Section 2.1.2 Compliant (2015) 13.1.1, 13.1.2)Vacuum Degassed

Marking : 116318-UT

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
8505498	0.19	1.02	0.007	0.000	0.19	0.15	0.08	0.08	0.01	0.020	0.004	0.002	0.002	0.0060	0.0042	0.0000	0.008	0.40	0.26

			Tensile Test					Heat Treat			
Plate Serial No	Pieces	Tons	Dir.	Yield (psi)	Tensile (psi)	Elong. % in 2"	Elong. % in 8"	Norm (°F)	Time (min)	Temper (°F)	Time (min)
8505498-02	3	12.25	H-T	49,400	73,300	45.6		1650	23		

			Charpy Impacts	Absorbed Energy (Ft-lbs)					Lateral Expansion (in.)					Shear (%)						
Plate Serial No	Pieces	Tons	Dir.	(ft-lbs) 1	(ft-lbs) 2	(ft-lbs) 3	(ft-lbs) Ave	Min	(in.) 1	(in.) 2	(in.) 3	(in.) Ave	(in.) Min	(%) 1	(%) 2	(%) 3	(%) Ave	Min	Temp (°F)	Size
8505498-02	3	12.25	H-L	119.4	144.0	132.7	132.0	15											-50	10mm

mk# 1D-12, 1D-16, 1D-17, 1E-3
1H-2

5361

ID# 304

PO# 45335

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Certified a true copy of the
original, retained in our file.
AMERICAN ALLOY STEEL, INC.
Reviewed By:
JK 10/24/2018

HOT ROLLED CARBON STEEL PLATE
TEST COUPONS TAKEN FROM HEAT TREATED PLATE
Piece frequency charpy

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 (#0985-00). 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
T. A. Depretis, Metallurgist

9/27/2018 9:23:19 AM

1/2 x 120 x 120

NUCOR
PLATE MILL

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

Mill Test Report

Page 2

1505 River Rd
Cofield, NC 27922
(252) 356-3700

NUCOR
It's Our Nature

Issuing Date : 10/07/2018 **B/L No. :** 514849 **Load No. :** 525223 **Our Order No. :** 159439/1 **Cust. Order No. :** 4500893647

Vehicle No: ATW 53005

Sold To:
RYERSON PROCUREMENT CORP
PO BOX 91601
LUBBOCK,TX 79490

Ship To:
RYERSON INC. DENVER
6600 HIGHWAY 85
COMMERCE CITY,CO 80022

Specification: 1.0000" x 96.000" x 240.000"
ASTM A516 70-17/ASME SA516 70 SA516-485 PVQ 2015/2017 NACE MR0175 Annex 2.1.2 (2015), MR0103 (2010) Section 2.1.2(2015) 13.1.1, 13.1.2) Compliant

Marking : 160005134

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
8505555	0.20	1.05	0.008	0.000	0.20	0.24	0.10	0.07	0.01	0.039	0.004	0.002	0.002		0.0020	0.0001	0.011	0.41	0.28

			Tensile Test				
Plate Serial No	Pieces	Tons	Dir.	(psi) Yield	(psi) Tensile	Elong. % in 2"	Elong. % in 8"
8505555-07	4	13.06	T	46,600	75,500		20.2

5361-1
PL ID# 28U
mk# 1J-14, 1D-13

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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 (#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. Depretis

T. A. Depretis, Metallurgist

10/7/2018 2:00:14 PM

9

SSAB

Test Certificate

1770 Bill Sharp Boulevard, Muscatine, IA 52761-9412, US

Form TC1; Revision 3; Date 7 Feb 2018

Customer:
JOSEPH T. RYERSON & SON, INC.
ACCOUNTS PAYABLE DEPT.
PO BOX 91601
LUBBOCK
TX 79490-1601

Customer P.O. No.: 4500899993

Mill Order No.: 41-549855-01

Shipping Manifest: MT359173

Product Description: ASTM A516-70(17)/ASME SA516-70(17)

Ship Date: 12 Oct 18
Cert Date: 12 Oct 18

Cert No: 061736667
(Page 1 of 1)

Size: 0.750 X 95.00 X 240.0 (IN)

Tested Pieces			Tensiles								Charpy Impact Tests												
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in	Elong % 8in	Tst Dir	Hardness	Abs. Energy(FTLB) 1	2	3	Avg	% Shear 1	2	3	Avg	Tst Temp	Tst Dir	Tst Siz (mm)	DWTT Temp	DWTT %Shr
A81210	C09	0.748 (DISCRT)	L	55	76		35		T														

								Chemical Analysis										
Heat Id	C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	IIW		ORGN
A81210	.17	.99	.010	.002	.17	.028	.026	.28	.11	.08	.02	.001	.030	.002	.0003	.38		USA

KILLED STEEL
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE
CEV (IIW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
NO WELD REPAIR HAS BEEN PERFORMED ON THIS MATERIAL.
PRODUCTS SHIPPED:
A81210 C09 PCES: 2, LBS: 9007

P045335
ID 39U
5361

mk# 1C-14
ID-14

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

(M) Cust Part # : 160004840

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

Brian Wales
SENIOR METALLURGIST - PRODUCT

53512

6" 150# A105 RF Blind Flange Heat : H5912

536(-1

MK# 1D-18

Reviewed to ASME Section II

R.N. GUPTA & COMPANY LTD., C-55, FOCAL POINT, LUDHIANA -141 010 (INDIA)

RNG

MATERIAL / MILL TEST CERTIFICATE EN 10204 : 2004 - 3.1

NAME OF BUYER
MOUNTAIN WEST
PIPE AND SUPPLY
U.S.A.

CERTIFICATE NO. 11447 DATE 30/08/2017

RAW MATERIAL SPECIFICATION :

SPECIFICATION FOR INSPECTION :

P.O NO. 68434 DT. 14/04/2017

INVOICE NO. RNG/EXP/17-2143 DT. 26/08/2017

MECHANICAL REQUIREMENTS

Sr. No.	Description	Qty (PCS)	Heat No.	Supp. Code	Y.S(PSI) Min 36,000	T.S(PSI) Min 70,000	E% Min 22%	R.A% Min 30%	Heat Treatment	Soaking Time (Min.)	Hardness BHN 137-187
33	3/4 300# BLRF FLGS	50	H 5842	6	49486	79962	32.94	67.16	AS FORGED		160 - 162
34	1 150# BLRF FLGS	100	H 5899	6	52525	76814	34.60	64.02	AS FORGED		156 - 158
35	6 150# BLRF FLG	77	H 5956	19	51093	81122	34.46	66.49	AS FORGED		152 - 154
36	6 150# BLRF FLG	3	H 5912 ⇦	20	46865	74586	33.20	64.77	AS FORGED		144 - 146
37	3 150# BLRF	120	H 5913	20	50056	80353	32.20	65.00	AS FORGED		152 - 154
38	1 1/2 150# SORF FLGS	100	H 5932	6	48162	79678	31.84	68.52	AS FORGED		148 - 150
39	2 150# SORF FLGS	166	H 5915	20	50607	75801	33.14	64.29	AS FORGED		148 - 150
40	2 150# SORF FLGS	84	H 5914	20	49683	79640	32.00	65.35	AS FORGED		150 - 152

CHEMICAL REQUIREMENTS

		SPECIFIED ELEMENTS						UNSPECIFIED ELEMENTS				
Sr. No.	Heat No.	C.E. 0.47% Max	C 0.35 Max	Mn 0.60-1.25	P 0.035 Max.	S 0.04 Max.	SI .10 -0.35	Cu 0.40 Max.	Ni 0.40 Max	Cr 0.30 Max.	Mo 0.12 Max.	V 0.05 Max.
33	H 5842	0.38	0.21	1.00	0.021	0.011	0.22	0.005	0.008	0.006	0.003	0.003
34	H 5899	0.40	0.21	1.10	0.020	0.013	0.23	0.006	0.014	0.007	0.007	0.003
35	H 5956	0.41	0.20	1.23	0.025	0.019	0.21	0.003	0.010	0.015	0.003	0.002
36	H 5912	0.40	0.20	0.92	0.031	0.018	0.25	0.120	0.070	0.150	0.033	0.004
37	H 5913	0.41	0.21	0.93	0.029	0.016	0.22	0.170	0.057	0.120	0.019	0.004
38	H 5932	0.36	0.20	0.90	0.016	0.009	0.24	0.021	0.014	0.033	0.003	0.003
39	H 5915	0.39	0.19	0.92	0.030	0.016	0.20	0.150	0.065	0.130	0.024	0.004
40	H 5914	0.41	0.20	0.95	0.031	0.015	0.25	0.120	0.071	0.170	0.044	0.005

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Material in accordance with NACE MRO 175-2003 and NACE MRO 103
All Products were manufactured, Sampled, Tested and Inspected Solely by the manufacturer shown on this Test Report in accordance with indicated specification and were found to meet the requirements.

For R.N. GUPTA & COMPANY LTD. Page No : 5

METALLURGIST

No Weld Repair was performed and all products are free of Weld Repair.All Products are free of Mercury Contamination and Radioactivity.

Note: We hereby confirm that our QA system comply with the requirements of Annex I,section 4.3 of PED 2014/68/EU and it is certified by M/s DNV BUSINESS ASSURANCE vide Certificate No.4487-2014-CE-IND-DNV GL valid upto 31-03-2020, ISO 9001-2015 Certificate No. is 39752-2008-AQ-IND-RvA Valid upto 22/07/2020. Products also conform to requirements of ASTM A105-05/ASME SA105

ALL NORMALISED MATERIALS ARE HEAT TREATED AT TEMP. 920 DEGREE CENTIGRADE.

51480

3" 150# A105 RF BLIND FLANGE HEAT : T217

54285

boltex mfg. co. **Material Test Reports**

Heat Code: T217

MOUNTAIN WEST PIPE AND SUPPLY

ITEM

Ln#	Qty	Description	Mat'l Spec	Ht Cd	Mill Heat Number	CE
001	1	3" 150 RF BLIND	SA105-18	T217	CM3071639	0.4012

CHEMICAL PROPERTIES

* Ladle Chemical Properties Indicated with an Asterisk (*)

Ht Cd	C	Si	Mn	P	S	Cr	Al	Cu	Ni	Mo	V	Nb	Sn	N	B	Pb	Ti
T217	0.1900	0.2200	1.0500	0.0120	0.0170	0.0700	0.0010	0.2600	0.0700	0.0150	0.0010	0.0010	0.0090	0.0000	0.0001	0.0000	0.0000
*	0.1900	0.2200	1.0500	0.0120	0.0170	0.0700	0.0010	0.2600	0.0700	0.0150	0.0010	0.0010	0.0090	0.0000	0.0001	0.0000	0.0000

PHYSICAL PROPERTIES

Ht Cd	Tensl	Yield	%Elong	%R.A.	HBW	Charpy	Ft-Lbs	Lat Expsn	%-Shear	Test Temp
T217	80800	46300	35.00	64.85	159/163					

NOTES

Ht Cd	Note

New Heat Code

All products bearing the "BOLTEX" name or logo "b" with the heat number prefix listed on the legend below have been manufactured at our Houston, TX facilities from steel melted and forged in the U.S.A. All other products have been manufactured at our Houston, TX facilities from steel melted where indicated.

AR = Arkansas Steel (USA)
NU = Nucor Steel (USA)
WR = Warren Steel (USA)
CM or SI = Commercial Metals Corp (USA)
RE = Republic Steel (USA)
AB = ABS (Italy)
GER = Gerdau Steel (USA)
TI = Timken Steel (USA)

We certify our flanges are capable of passing a hydrostatic test compatible with their rating and all test results and process information contained herein are correct and true as contained in company records. All flanges meet NACE MR0-175 and/or MR0-103 Latest Revision.

Our quality system has been registered by DNV-GL to ISO 9001, Certificate No.: 142240-2013-AQ-RvA. Test results comply with: EN 10204-3.1. Our flanges satisfy the material requirements for PED 97/23/EC Annex 1-4.3.

Not withstanding the absence of a signature, the organization submitting either a printed certificate or an EDI transmitted certificates is responsible for content of the report. (ASTM/A 961-04a Section 19.4)

NOTICE: Any unauthorized downloading, reproduction, distribution, or use of this electronic media is hereby prohibited. Violators shall be prosecuted to the fullest extent of the law.

5361-1
MK# 1D-19

52104

5361-1 MK# 1F-1, 1F-3, 1F-4
PL ID# 29U
16-7-10

NAS NORTH AMERICAN STAINLESS

6870 Highway 42 East
Ghent, KY 41045-9615
(502) 347-6000

METALLURGICAL TEST REPORT

Certificate: 464901 01
Customer: 0075 809

Mail To:
RYERSON, INC.
6600 HIGHWAY 85
COMMERCE CITY, CO 80022

Ship To:
RYERSON, INC.
6600 HIGHWAY 85
COMMERCE CITY, CO 80022

Date: 11/29/2018 Page: 1

Steel: 304/304L

Finish: HRAP

Your Order: 4500900845

NAS Order: AN 0822184 01

Corrosion: ASTM A262/15 A 180Bend-OK

PRODUCT DESCRIPTION:

STAINLESS STEEL PLATE, HRAP; UNS 30400/30403
ASTM A240/17,A480/16b,A666/15;ASME SA240/17,SA480/17,SA666/17
CHEM ONLY ON FOLLOWING ASTM: A276/17,A479/17,A484/16,A312/16
CHEM ONLY ON FOLLOWING ASME: SA312/13,SA479/13

AMS 5511H/5513J XMRK; MIL-S-5059D AMD3(X CRN MEAS); MIL-S-4043B
NACE MR0175/ISO 15156-3:2009 A, MR0103/07;QQS766D-A X MAG PERM
MIN. SOLUTION ANNEAL TEMP 1900F, WATER QUENCHED

REMARKS:

Mat'l is Free of Mercury Contamination. No weld repairs.
EN 10204:2004 3.1; RoHS 1 & 2 Compliant
Material is Free of Radioactive Contamination
Steel Making Process: EAF, AOD, & Cont. Casting
Product Mfg.by a Quality Mgt.Sys. in Conf. w/ISO 9001
*Melted & Manufactured in the USA; Mat'l is DFARs Compliant
*Melted & Manufactured in the USA; Mat'l is DFARs Compliant

Product ID #	Coil #	Thickness	Width	Weight	--------Length-------		Mark	Pieces	COMMODITY CODE NO.
04A19W HC	* 04A19W HC	.5000	60.0000	1,050	PLATE	120.00	11	1	161001129

ANAB, ISO/IEC 17025, Certificate# L2323

CHEMICAL ANALYSIS

CM(Country of Melt) ES(Spain) US(United States) ZA(South Africa) JP(Japan)

Chemical Analysis per ASTM A751/14a

HEAT	CM	C %	CR %	CU %	MN %	MO %	N %	NI %	P %	S %
A19W	US	.0198	18.0380	.3980	1.8105	.3280	.0708	8.0105	.0320	.0010
		SI %								
		.2780								

MECHANICAL PROPERTIES

Product ID #	Coil #	l o c	d i r	UTS KSI	20C .2% YS KSI	20C ELONG %-2"	% Hard RB	R of A %
04A19W HC	04A19W HC	F	T	87.33	34.59	68.20	80.00	73.25

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

NAS hereby certifies that the analysis on this certification is correct. Based upon the results and the accuracy of the test methods used, the material meets the specifications stated. These results relate only to the items tested and this report cannot be reproduced, except in its entirety, without the written approval of NAS.

Technical Dept. Mgr.
KRIS LARK 11/29/2018

PO # 0045289
JOB # 5361-501
HEAT # 441917
MARK # 16-2, 16-3, 16-4

outokumpu
high performance stainless steel

****
* CERTIFICATION *
****

Page: 1

10/27/14
HEAT 441917

ORDER 0029146/026 B00023907

SHIP TO:
SOUTHWEST STAINLESS HOUSTON
8505 Monroe
800-231-8268
Houston TX 77061

------------------------------ YOUR ORDER & DATE ------------------------------

333678 10/27/14 CUST# SOUSTA02

------------------------------ ITEM DESCRIPTION ------------------------------

24" SCH80S TP304/TP304L A312

Country of Melt : SWE
Country of Mfg. : USA

------------------------------ SPECIFICATIONS ------------------------------

ASTM A312-13B/ASME SA312-13
QUALITY SYSTEM CERTIFIED TO:
PED 97/23/EC ANNEX 1, § 4.3
BY TUV SUD INDUSTRIE SERVICE
GMBH, NOTIFIED BODY 0036
TOLERANCE: ASTM A999
LONGITUDINAL WELDED
RANDOM LENGTHS
PLAIN ENDS
DESCALED, PICKLED, AND
PASSIVATED: ASTM A380

WELDED
MECHANICAL TESTING: ASTM A370
YIELD STRENGTH:0.2% OFFSET
COLD FINISHED
ELECTRIC FUSION WELDED (EFW)
IM EINVERNEHMEN MIT DEM TUV
SUD INDUSTRIE SERVICE GMBH
WIRD AUF EINE GEGENZEICHNUNG
LAUT SCHREIBEN VOM 05.AUGUST
2008 DURCH TUV SUD INDUSTRIE
SERVICE GMBH VERZICHTET

Certificate in conformance with EN10204-95 3.1.B / EN10204-2004 3.1

------------------------------ MECHANICAL & OTHER TESTS ------------------------------

	Tensile strength,KSI (MPa)	85.2	(587)
	Yield strength,KSI (MPa)	46.8	(323)
	Elongation % in 2	55.0	
Guided Bend Face OK			
	Bend Test		
	Hydrotest PSI (MPa)	700	(4.83)
NACE MR0175/ISO 15156:09	NACE MR0103-12		
HRB-84			

------------------------------ CHEMICAL COMPOSITION ------------------------------

Carbon	(C)	.020	Manganese	(Mn)	1.550
Phosphorus	(P)	.036	Sulphur	(S)	.001
Silicon	(Si)	.320	Chromium	(Cr)	18.330
Nickel	(Ni)	8.130	Nitrogen	(N)	.068

-- Continued --

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Reviewed to 2017 ASME Section II

Martha James
Martha James

COASTAL

COASTAL FLANGE

P.O. BOX 40443
HOUSTON, TX 77240-0443

MATERIAL CERTIFICATION

74567001 **MTR # : 857**

Page : 1 of 1

SOLD TO:

SHIP TO:

DATE	SALES ORDER #	CUST P.O.#	TAG NUMBER	SPECIFICATION
04/08/2016	160414	S630278		SA105

ITEM #	QTY	ITEM DESCRIPTION	HEAT CODE
	7	36" 150# RF WN XH "B" ASME B16.47	ACDXJ

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Cr	Ni	Mo	V	Cu
.20	.94	.006	.004	.29	.025	.021	.005	.001	.012

PHYSICAL PROPERTIES

Tensile PSI	Yield PSI	Elongation	REDUCTION OF AREA %	BHN	BHN
75565	47427	33	60	149	147

HEAT TREATMENT

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

SUPPLEMENTAL INFORMATION

I hereby certify that the reported figures are correct, as contained in the records of the corporation and that the material was manufactured in the United States of America under a ISO:9001:2008 certified Quality Management System. NACE MRO175 EN 10204 3.1

S361-1
MK# 1D-1, 1H-1
Reviewed to ASME 2017 Section II

Production Assistant

Commercial Metal Forming

Commercial Metal Forming - O
341 West Collins Ave
Orange, CA 92867
PHONE: 714.532.6321
FAX:

PACKING LIST

SHIPMENT NO. 300227
PAGE NO. 3

SALES ORDER	CUSTOMER NO.	P.O. NUMBER	P.O. DATE	S.O. DATE	PLANT
999119	17913	0044997	09/21/18	09/21/18	OCW

SOLD TO: EATON METAL PRODUCTS*
4800 YORK ST.
DENVER, CO 80216

SHIP DATE: 11/16/18

PREPAID&ALLOW-FOB DE

B/L NO. 259767

SHIP TO: EATON METAL PRODUCTS
844 S. CHESTNUT STREET
SALT LAKE CITY, UT 84104
USA

MTR'S WITH SHIPMENT

ITEM	PART NO.	DESCRIPTION	REL	REQ DATE	DUE QTY	SHIP QTY
1	4939400121	36"OD X .50"NOM SE 2:1 SA516-70 2"SF OSB 30 DEG .06"LAND SA516-70 N MTRS 240# (.375"MIN) 1H-3	1	11/05/18	1	1

HEAT: KGH=85005299 SLAB: 08

5361

MK # 1H-3

CARBON STEEL PARTS WHICH WERE COLD
FORMED COMPLY WITH ASME SECTION VIII
DIV. 1 UG-79 & UCS-79D.
PARTS: ✓ WERE NOT HEAT TREATED
_____ WERE HEAT TREATED
ALL PARTS COMPLY WITH UG-81
CERTIFIED BY:

SPD QUALITY

SA516-70 1/2 8505299

NUCOR PLATE MILL

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

Mill Test Report

Page 1

1505 River Rd
Cofield, NC 27922
(252) 356-3700

NUCOR It's Our Nature.

Issuing Date : 08/15/2018 B/L No. : 509940 Load No. : 520530 Our Order No. : 159120/5 Cust. Order No. : 7331578

Vehicle No: TTPX 804614

Sold To:
SAMUEL SON AND CO INC
6415 E CORVETTE ST
LOS ANGELES,CA 90040

Ship To:
SAMUEL C/O TRISTAR FLC
9600 KAISER WAY
BNSF SPUR #2142
FONTANA,CA 92336

Specification: ✓ 0.6000" x 96.000" x 480.000"
ASTM A516 70-17/ASME SA516 70 PVQ 2015/2017 Normalized Test
Coupons at 1650 F NACE MR0175 Annex 2.1.2 (2015), MR0103 (2010)
Section 2.1.2(2015) 13.1.1, 13.1.2)

Marking : 1344087

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
✓8505299	0.19	1.04	0.009	0.001	0.19	0.26	0.09	0.10	0.01	0.030	0.004	0.002	0.003		0.0027	0.0003	0.011	0.41	0.27

Plate Serial No	Pieces	Tons	Tensile Test Dir.	(psi) Yield	(psi) Tensile	Elong. % in 2"	Elong. % in 8"	
✓ 8505299-05	6	19.60	T	60,400	77,200		23.8	
KGF			T	51,800	72,200		26.6	N
✓ 8505299-06	6	19.60	T	53,500	77,500		24.0	
KGG			T	51,500	72,900		25.1	N
✓ 8505299-08	4	13.06	T	52,600	77,100		23.6	
KGH			T	51,200	72,600		27.1	N
✓ 8505299-09	4	13.06	T	52,600	77,300		23.0	
KGI			T	50,600	72,300		26.4	N

5361-1
MK# 14-3

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

APPROVED
ASME SEC. II
2017 Ed. ______ Ad.
CMF

Test coupons only, normalized 60 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 (#010940) by SRI Quality System Registrar (#0965-09). 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
T. A. Deprelis, Metallurgist

8/15/2018 10:10:45 AM

R068850 08/16/18 KJ

5361-1
MK#1H-4

RNG

R.N. GUPTA & COMPANY LTD., C-55, FOCAL POINT, LUDHIANA -141 010 (INDIA)

F-MTR-01-01

MATERIAL / MILL TEST CERTIFICATE EN 10204 : 2004 - 3.1

CERTIFICATE NO. 12560 DATE 27/03/2018

NAME OF BUYER

RAW MATERIAL SPECIFICATION : ASTM A105-14/ASME SA105-13

SPECIFICATION FOR INSPECTION : ANSI/ASME B16.5-2013

P.O NO. 68906 DT. 17/10/2017

INVOICE NO. EXP/17-2448 DT. 23/03/2018

MECHANICAL REQUIREMENTS

Sr. No.	Description	Qty (PCS)	Heat No.	Supp. Code	Y.S.(PSI) Min 36,000	T.S.(PSI) Min 70,000	E% Min 22%	R.A% Min 30%	Heat Treatment	Soaking Time (Min.)	Hardness BHN 137-187
1	4 150# WNRF XH FLGS	134	H 6336	20	49008	78514	33.40	66.94	AS FORGED		152 - 154
2	4 150# WNRF XH FLGS	1460	H 6342	20	48755	78565	33.70	69.37	AS FORGED		152 - 154
3	4 150# WNRF XH FLGS	1081	H 6343	20	49887	79793	33.70	67.09	AS FORGED		152 - 154

CHEMICAL REQUIREMENTS

		SPECIFIED ELEMENTS						UNSPECIFIED ELEMENTS				
Sr. No.	Heat No.	C.E. 0.47% Max	C 0.35 Max	Mn 0.60-1.25	P 0.035 Max.	S 0.04 Max.	Si .10 -0.35	Cu 0.40 Max.	Ni 0.40 Max	Cr 0.30 Max.	Mo 0.12 Max.	V 0.05 Max.
1	H 6336	0.38	0.20	0.89	0.029	0.020	0.24	0.130	0.045	0.092	0.021	0.004
2	H 6342	0.40	0.22	0.93	0.032	0.022	0.24	0.073	0.034	0.075	0.007	0.002
3	H 6343	0.40	0.22	0.93	0.031	0.021	0.23	0.078	0.030	0.077	0.008	0.003

Material in accordance with NACE MRO 175-2015/ISO-15156 and NACE MRO 103-2015
All Products were manufactured, Sampled, Tested and Inspected Solely by the manufacturer shown on this Test Report in accordance with indicated specification and were found to meet the requirements.

No Weld Repair was performed and all products are free of Weld Repair. All Products are free of Mercury Contamination and Radioactivity.

For R.N. GUPTA & COMPANY LTD. Page No : 1

METALLURGIST

Note: We hereby confirm that our QA system comply with the requirements of Annex I section 4.3 of PED 2014/68/EU and it is certified by M/s DNV BUSINESS ASSURANCE vide Certificate No.4437-2014-CE-IND-DNV GL valid upto 31-03-2020, ISO 9001-2015 Certificate No. is 39752-2008-AQ-IND-RvA Valid upto 22/07/2020. Products also conform to requirements of ASTM A105/ASME SA105

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

FVC
an AFGlobal Company

Material Test Report

Heat Code: C1000AF

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756 4800 York Street Denver, CO 80216	PO: 0045008	Sales Order: 169271	Line: 5
	Item Code: LWN030150090A001A1		Qty Shipped: 5
	Item Desc: LWN RF 3"150X9" SA105		
		Mill Heat: A141747	

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18			
Mn	Manganese	1.10		✓	7439-96-5
Mn:C		6.1			
P	Phosphorous	0.007			
S	Sulphur	0.005			
Si	Silicon	0.24			
Cu	Copper	0.16		✓	7440-50-8
Ni	Nickel	0.05		✓	7440-02-0

Element	(%wt)	Ladle	Product	EPCRA	CAS#
Cr	Chromium	0.10		✓	7440-47-3
Mo	Molybdenum	0.02			
V	Vanadium	0.022			
Cb	Columbium	0.000			
C.E.		0.40			
CuNiCrMoV		0.352			
CrMo		0.120			

5361
mk# 1H-5

Mechanical Testing

Test Lab	AFG
HBW	156 - 156
Elg (%)	33
RA (%)	65
Tensile Specimen Size (in)	.492
Tensile (ksi)	77.4
Yield (ksi)	48.6
Gauge Length (in)	2

Other

EF	Y

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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.: 1347385
Certification Date: 10/17/2018
Issued By: John Sauceda

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

Material Test Report

Heat Code: C1000AF

ISO 9001:2015 Certified

Forged Vessel Connections
An AFGlobal Company
13770 Industrial Rd. Houston, TX 77015
Sales: (713) 393-4200

Eaton Metal Produc 00011756	PO: 0045008	Sales Order: 169271	Line: 5
4800 York Street	Item Code: LWN030150090A001A1		Qty Shipped: 5
Denver, CO 80216	Item Desc: LWN RF 3"150X9" SA105		
		Mill Heat: A141747	

Spec: ASTM A105/A105M-(18)/ASME SA 105/SA 105M-(17) Section II Part A

MARK # 1H-5

Product compliant with NACE MR0175/ISO 15156-2:2015, Annex A (A.2.1.2, A2.1.3).

- * No Weld repair performed.
- * Ladle Chemical Analysis results are reported from the raw material suppliers MTR.
- * Tensile taken from a round specimen. Measurement of elongation after fracture.
- * Yield strength was determined using the .2% offset method, unless otherwise specified.
- * All material supplied under this order is certified to be free of mercury contamination and no mercury bearing equipment was used in manufacturing, fabrication or testing.
- * When reported on MTR: Tensile Testing Per ASTM E8; Brinell Hardness Per ASTM E10; Charpy Testing Per ASTM E23
- * AF Global manufactures materials according to a certified Quality Management System conforming to ISO 9001:2015

Unless otherwise noted on PO, Dimensions of all standard pipe flanges and flange fittings (NPS 1/2 to NPS 24) per ASME B16.5-2013 , large diameter steel flanges (NPS 26 to 60) per ASME B16.47-2011, Orifice flanges per ASME B16.36-2015.

* FVC FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5
SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Certification No.: 1347385
Certification Date: 10/17/2018
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

53617
mk# 1H-7, 1H-6
Reviewed to 2017 ASME Section II

SeAH CSS
SeAH Changwon Integrated Special Steel
147 Jeokhyeon-ro, Seongsan, Changwon, Gyeongnam, Korea

INSPECTION-CERTIFICATE

CERT. NO. : 150430-3043
MANUFACTURE NO. : KPOUU55BA5450

CUSTOMER :
SUPPLIER : POSCO Processing & Service Co.,Ltd
PURCHASE ORDER NO. : 5349
REF.CD:5349

STEEL GRADE : TP304/304L
SIZE : OD 4 NPS X WT SCH80S X 18 - 20 FT
ARTICLE : SEAMLESS AUSTENITIC STAINLESS STEEL PIPES

SPECIFICATION : ASTM A312
EDITION/ADDENDA : 11 EDITION / NO ADDENDA
STATE OF DELIVERY : SOLUTION TREATMENT
HOT FINISHED, PLAIN END

MELTING PROCESS : E.A.F.
V.O.D.
STRAND CASTING

Heat No.		Chemical Composition(wt.%)							Non-Metallic Inclusion Test
		✓ C	✓ SI	✓ MN	✓ P	✓ S	✓ NI	✓ CR	
Spec.	MIN.						8.000	18.000	
	MAX.	.035	1.000	2.000	.0450	.0300	11.000	20.000	
N08288 L		.013	.270	1.712	.0330	.0067	8.207	18.245	
N08288 P		.014	.264	1.745	.0329	.0073	8.298	18.219	

Test No. (Lot No.)		Tensile Properties				Hardness	Impact Test		Decarburized Depth (mm)		Grain Size No.	Additional Tests
		Y.S.(KSI)		T.S. (KSI)	EL. (%)	Body HRb			TOTAL	FERR.		Flattening test: GOOD Hydrostatic test: GOOD (2300PSI)
		0.2%										
Spec.	MIN.	30.0		75.0	35.0							
	MAX.					90						
5001-1		✓ 36.0		✓ 85.0	55.0	78						
5001-2		36.0		85.0	54.0	78						

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Lot No.	Bundle No.	Length (ft)	Number of Qt.	Total Length (F)	Weight Kg	Case No.
5P04625001	5P046250011	18 - 20	5	98.5	686	F40359
		TOTAL	5		686	

Additional Tests / Remarks

Corrosion Test: GOOD

CERTIFY TO ASTM A312-99/ASME SA312-98ED.(00ADD.)TP304/304L. ASTM A376-98/
ASME SA376-98ED.(00ADD.)TP304. UNS S30400/S30403
HEAT TREATMENT: 1050 ℃ FOR 5MIN.(WATER QUENCHED)
HARDNESS ACCORDING TO NACE MR-0175(02ED.). CORROSION TEST: ACC. TO MIL-P-24691/3
INSPECTION CERTIFICATE DIN 50049 3.1/EN 10204 3.1/ISO 10474 3.1B
EN 10204 Type 3.1 / NO REPAIR WELDING. FREE FROM MERCURY CONTAMINATION.

Our quality system is certified in accordance with ISO 9001: 2008 by DNV.

We here certify, that the material described above has been tested and complies with the terms of the order contract.

J. K. Lee
Team Manager, Quality Assurance Team
DATE : MAY. 01, 2015

5361-1 Reviewed to 2017 ASME Section II
mk# 1C-1, 1J-1

NORMA (INDIA) LIMITED

48,Site IV industrial Area, Sahibabad, Ghaziabad-201010 (U.P) INDIA.
Tel: 91-120-2896091, 2895404 Fax: 91-120-2895930 E-mail: normaindia@gmail. com

Works Test Certificate

NORMA/LAB NO-6539/14-15
INVOICE NO. E-400
DATE:-13-10-14

P. Order. No:	503/005034	Customer:-		Forging specification	ASME SA105 -09 ASTM A105 -12
Component	20"-150# WNRF XH FLG.				
Drawing No.				Steel Supplier	Adhunik Metaliks Ltd.
Machining STD	ANSI B16.5- 2009 ASME B16.5- 2009	Quantity:-	09Nos.	Mill Heat No.	14AI 145

TEST RESULTS

NORMA HEAT NO-1231

CHEMICAL COMPOSTION

Elements %	Specified Composition	Actual	
		NORMA LAB	MILL T.C.
Carbon	0.35max.	0.20	0.20
Manganese	0.60-1.05	1.11	1.10
Silicon	0.10-0.35	0.18	0.20
Sulphur	0.040max.	0.012	0.015
Phosphorous	0.035max.	0.016	0.015
Chromium	0.30max.	0.012	0.014
Nickel	0.40max.	0.009	0.007
Copper	0.40max.	0.012	0.009
Molybdenum	0.12max.	0.004	0.001
Vanadium	0.080max.	0.004	0.002
Carbon Equivalent (CE)	0.47max.	0.390	0.387

MECHANICAL PROPERTIES.

PROPERTIES	SPECIFIED	OBTAINED
Yield Strength (mpa)	250.00 min.	321.65
Tensile Strength (mpa)	485.00 min.	521.86
%Elongation in 50mm / 4D	22.00 min	31.76
Hardness HB.	187. max.	149-163
% Reduction of Area	30.00 min.	61.01

Remarks:- We here by certify that the material described here in has been tested in accordance with the applicable specifications referred above and meets the requirements as per EN10204/3.1B & NACE Standard-MR0175-2003.
"As per ASTM A105 Table 1 Note:-For each reduction of 0.01% below the specified carbon maximum(0.35%).an increase of 0.06% manganese above the specified maximum (1.05%)will be permitted up to maximum 1.35% &NACE Standard MRO175/ISO15156 Standard
Country of Origin-India.

Specified carbon as per Purchase Order 0.25max.

Serrated face as per MSS-SP-6 With in limits of 125-250AARH

CARBON EQUIVALENT (CE)

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

MARKING AS PER MSS-SP-25-2008
20"-150 XH SA/A105 1231 B16.5 NORMA INDIA.

Checked by:
Metallurgist

Certified by:
Quality Control Manager

EASTON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

5361-1
mk# 1C-2, 1J-2

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

Certificate No. MJH0003A-19/25 **Date :** AUG. 21. 2018
Customer
Contract No. 202261-00-1ST

Certified to ISO9001/ ISO14001:2015,PED2014/68/EC by LRQA

Spec. For Material ASTM A105N-14,ASME SA105N-17,NACE MR0175/ISO 15156-2:2015,NACE MR0103/ISO 17495-1:2016
Heat Treatment 930℃ NORMALIZED & A.C **Dimensional inspection** ASME B16.5 - 2017

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.
				12.5	50.0	Max Min	250	485	22.0	30.0	187		21J	27J	V	-29℃
													Test Result (J)			Ave.(J)
BA150BR16	150LBS BL RF 16"	60	805820D	12.5	50.0		323	518	33	75	152	156	143	120	118	127
BA150BR20	150LBS BL RF 20"	60	805820E	12.5	50.0		323	518	33	75	152	156	143	120	118	127
	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																	
805820D	H	0.184	0.258	1.040	0.012	0.005	0.007	0.016	0.002	0.023	0.001							0.363			
	P	0.175	0.250	1.030	0.014	0.004	0.007	0.019	0.003	0.023	0.001							0.353			
805820E	H	0.184	0.258	1.040	0.012	0.005	0.007	0.016	0.002	0.023	0.001							0.363			
	P	0.175	0.250	1.030	0.014	0.004	0.007	0.019	0.003	0.023	0.001							0.353			
									BLANK												

REMARK
- * H : Heat Analysis P : Product Analysis
- * Impact Test performed according to ASTM A370 & MESC 76/210/2017 Paragraph 8.5 / Table 4 & 5.
- * C:Mn = 1≤5
- * Mn is Permitted up to Max 1.65% (ASTM A105-14 TABLE 1, NOTE 1.)

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

ST&H CORPORATION QUALITY MANAGEMENT

EAST METAL PRODUCTS COMPANY LLC SPD QUALITY

Manager of Q.A Dept. / JAY KIM
ST&H CORPORATION

ST-801-14-02

NUCOR
PLATE MILL

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

Mill Test Report

Page 1

1505 River Rd
Cofield, NC 27922
(252) 356-3700

NUCOR

Issuing Date : 09/12/2018 B/L No. : 512940 Load No. : 623425 Our Order No. : 159438/1 Cust. Order No. : 4500893649

Vehicle No: NDKL 725000

Specification: 1.2500" x 96.000" x 240.000"
ASTM A36-14/ASTM A709 Grade 36-18/AASHTO M270Grade 36/ASME SA36 2015/2017 AASHTO M270-2017 36

Sold To:
RYERSON PROCUREMENT CORP
PO BOX 91001
LUBBOCK,TX 79490

Ship To:
RYERSON INC. DENVER
6600 HIGHWAY 85
COMMERCE CITY,CO 80022

Marking : 160006004

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
8505747	0.20	0.84	0.010	0.004	0.19	0.19	0.08	0.10	0.01	0.025	0.003	0.002	0.002		0.0042	0.0005	0.011	0.38	0.20

Plate Serial No	Pieces	Tons	Tensile Test				
			Dir.	(psi) Yield	(psi) Tensile	Elong. % in 2"	Elong. % in 8"
8505747-04	3	12.25	T	40,900	69,700		27.2
			T	41,000	70,100		20.7

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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 (#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. Ueprelis, Metallurgist

9/13/2018 8:48:15 AM

5361-1
PL ID # 270
mk# 1C-4,5,6
15-4,5,6

NUCOR
NUCOR CORPORATION
NUCOR STEEL UTAH

Mill Certification

10/11/2016

MTR #: U1-357740
PO Box 100
7285 West 21200 North
PLYMOUTH, UT 84330
(435) 458-2300
Fax: (435) 458-2309

Sold To: INTSEL STEEL WEST LLC
PO BOX 21119
HOUSTON, TX 77226-1119

Ship To: INTSEL STEEL WEST
1887 SOUTH 700 WEST
SALT LAKE CITY, UT 84104
(801) 433-2210
Fax: (801) 972-6145

Customer P.O.	SLC-12130	Sales Order	268246.4
Product Group	Merchant Bar Quality	Part Number	3000075024004W0
Grade	A36/A529GR50/CSA44W/50W	Lot #	PL1610567651
Size	3/4" (.7500) Round	Heat #	PL16105676
Product	3/4" (.7500) Round 20'A36/A529-50/44W/50W	B.L. Number	U1-548929
Description	A36/A529-50/44W/50W	Load Number	U1-357740
Customer Spec		Customer Part #	

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

Roll Date: 8/13/2016 Melt Date: 8/10/2016 Qty Shipped LBS: 11,895 Qty Shipped Pcs: 396

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

C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Cb
0.19%	0.72%	0.010%	0.045%	0.24%	0.23%	0.09%	0.13%	0.018%	0.0016%	0.000%

Yield 1: 51,498psi	Tensile 1: 73,816psi	Elongation: 28% in 8"(% in 203.3mm)
Yield 2: 50,764psi	Tensile 2: 73,645psi	Elongation 26% in 8"(% in 203.3mm)
Weight Variation 000.0%		

Specification Comments: MEETS THE REQUIREMENTS OF: ASTM A36/A36M-12, A529/A529-05 GR50, CSA G40.21-04 GR44W(300W)&GR50W(350W) AASHTO M270/M270M-12 GR36(270), ASME SA36/SA36M-07

Comments: NUCOR - PLYMOUTH IS AN I.S.O. 9001 AND AN A.B.S. CERTIFIED MILL
CMTR COMPLIES WITH DIN EN 10204 - 3.1

1. ALL MANUFACTURING PROCESSES OF THE STEEL MATERIALS IN THIS PRODUCT, INCLUDING MELTING, CASTING, AND HOT ROLLING HAVE OCCURRED WITHIN THE UNITED STATES. ALL PRODUCTS PRODUCED ARE WELD FREE. MERCURY, IN ANY FORM, HAS NOT BEEN USED IN THE PRODUCTION OR TESTING OF THIS MATERIAL.
2. PROPOSITION 65 WARNING: THIS PRODUCT CONTAINS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER AND/OR BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM. FOR MORE INFORMATION, PLEASE CALL 1-435-458-2300.

Reviewed to 2017 ASME Section II

5361-1
MK# 1C-8, 1J-8

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Ryan Pennington
Division Metallurgist

5361-1
mk# 15-13

Reviewed to 2017 ASME Section II

UNITED STATES STEEL CORPORATION

TUBULAR PRODUCTS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 11/30/14
TIME: 04:05:47
SERIAL NO: L0054107

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	VEHICLE I.D
DR00652 08	R03446	10P15701-CA	GONX310910

SOLD TO ADDRESS

MAIL TO ADDRESS

VENDOR
UNITED STATES STEEL CORP
LORAIN TUBULAR OPERATIONS
2199 EAST 28TH ST.
LORAIN, OH 44055

SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-*45TH EDITION DATED 12/1/12 PSL-2 GRADE B AND GRADE X42 R N OR Q ASTM A53-*12 GRADE B ASTM A106-*13 GRADE B/C SPECIAL OD TOLERANCE ASME SA53-*2013 EDITION GRADE B ASME SA106-*2013 EDITION GRADE B/C BLK REG MILL COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 *:ISO 15156-2 2009 ED AND MR-0103-2012_ED

MATERIAL COND: AS ROLLED

O.D.: 20.000(508.000) in (mm)

WALL: 0.500 (12.700) in (mm)

PRODUCT IDENTIFICATION	TENSILE TEST TYPE/ ORIENTATION	TEST COND.	GAUGE WIDTH	YIELD PSI	EXT % .50	TENSILE PSI	Y/T	ELONG % (IN 2")	HARDNESS SCALE:	MIN HYDRO PSI	DWELL(SEC)
				MIN: 42100		MIN: 70000	MAX:	MIN:	MIN:	1900	5
			IN	MAX: 71800		MAX: 95000	0.93	29.0	MAX:		
*MA6721 F157AA	STRIP/L/B	AR	1.500	50500	.50	78500	0.65	39.7		1900	5
X83582 E795AA	STRIP/L/B	AR	1.500	49700	.50	73000	0.68	45.5		1900	5
		**	END OF DATA THIS		SHEET	**					

LEGEND: L - LONGITUDINAL U - UPSET T - TRANSVERSE NM - NORMALIZED QT - QUENCH & TEMPERED SR - STRESS RELIEVED AR - AS ROLLED TR - THERMOMECHANICAL ROLLED B - BODY W - WELD

PRODUCT IDENTIFICATION	TYPE		C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CO			C.E.* MAX .43
MA6721	HEAT		19	104	010	003	23	16	08	09	02	025		03	0003	002	003				.41
MA6721 F157AA	PROD		20	104	007	002	24	15	07	08	03	026		03	0002	001	001				.42
MA6721 F157AA	PROD		20	104	006	003	24	16	07	08	02	027		03	0002	001	001				.42
X83582	HEAT		20	104	008	007	23	02	01	09	01	038		03	0002	002	001				.40
X83582 E795AA	PROD		19	105	004	005	25	02	01	08	01	041		03	0001	002	003				.40
X83582 E795AA	PROD		21	105	003	009	25	01	01	08	01	042		03	0005	002	006				.41
				**	END	OF	DATA	THIS	SHEET	**											

*C.E. IS BASED ON THE FOLLOWING EQUATION(S): CE=C+MN/6+(CR+MO+V)/5+(NI+CU)/15

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT. ELEMENTS REPORTED IN MASS FRACTION (%)

UNITED STATES STEEL CORPORATION

TUBULAR PRODUCTS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 11/30/14
TIME: 04:05:47
SERIAL NO: L0054107

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	
DR00652 08	R03446	10P15701-CA	0019012

MATERIAL COND: AS ROLLED

O.D.: in (mm) 20.000(508.000)

WALL: in (mm) 0.500 (12.700)

PRODUCT IDENTIFICATION	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	CHARPY V-NOTCH IMPACT TESTING DIR	TEST LOC.	TEMP	SIZE	TEST COND.	FT-LBS 1	FT-LBS 2	FT-LBS 3	FT-LBS AVG	% SHEAR 1	% SHEAR 2	% SHEAR 3	% SHEAR AVG
							DEG F										
MA6721 F157AA	OK				T	B	+ 32	3/4	AR	58	77	60	65	40	60	50	50
X83582 E795AA	OK				T	B	+ 32	3/4	AR	100	94	104	99	100	100	100	100

** END OF DATA THIS SHEET **

LEGEND L - LONGITUDINAL T - TRANSVERSE B - BODY W - WELD HAZ - HEAT AFFECTED ZONE

TESTING / INSPECTION INFORMATION

TEST / INSPECTION	YES	RESULTS / COMMENTS
FULL LENGTH VISUAL	X	
FULL LENGTH EMI	X	OD X OD/ID ____ L X L/T ____ 10.0% NOTCH
FULL LENGTH MPI		
FULL LENGTH UT	X	ID X OD/ID ____ L X L/T ____ 10.0% NOTCH
END AREA INSPECTION (PLAIN END)	X	MPI X UT ____
SPECIAL END AREA (SEA) INSP		MPI ____ UT ____
FULL LENGTH DRIFT		DRIFT MANDREL SIZE:

ADDITIONAL NOTES/COMMENTS

MELTED AND MANUFACTURED IN THE USA, NO REPAIRS BY WELDING, NO MERCURY COMPOUNDS ARE ADDED
TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.
MANUFACTURED IN AN ISO 9001 CERTIFIED FACILITY - CERTIFICATE #32022.
PRODUCT WAS HOT ROLLED AND HOT FINISHED

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: BRAD KOURY - MANAGER, Q.A.

DATE 11/30/14

**

UNITED STATES STEEL CORPORATION

TUBULAR PRODUCTS
ADDITIONAL COMMENTS SHEET

DATE: 11/30/14
TIME: 04:05:51
PAGE: 1 OF 1

MILL ORDER/ITEM NO.	SHIPPERS NO.	P.O. NUMBER	HEAT	
DR00652 08		10P15701-CA		SERIAL NUMBER: L0054107

SOLD TO ADDRESS	MAIL TO ADDRESS	VENDOR
		UNITED STATES STEEL CORP LORAIN TUBULAR OPERATIONS 2199 EAST 28TH ST. LORAIN, OH 44055

HEAT MA6721 - MELTED AT:NUCOR STEEL MEMPHIS, MEMPHIS, TN 38109
HEAT X83582 - MELTED AT:FAIRFIELD WORKS, FAIRFIELD, AL 35064
END OF DATA

NUCOR
PLATE MILL

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

Mill Test Report

Page 2

1505 River Rd
Cofield, NC 27922
(252) 356-3700

NUCOR
It's Our Name.

Issuing Date : 10/07/2018 **B/L No. :** 514849 **Load No. :** 525223 **Our Order No. :** 159439/1 **Cust. Order No. :** 4500893647

Vehicle No: ATW 53005

Sold To:
RYERSON PROCUREMENT CORP
PO BOX 91601
LUBBOCK,TX 79490

Ship To:
RYERSON INC. DENVER
6600 HIGHWAY 85
COMMERCE CITY,CO 80022

Specification: 1.0000" x 96.000" x 240.000"
ASTM A516 70-17/ASME SA516 70 SA516-485 PVQ 2015/2017 NACE MR0175 Annex 2.1.2 (2015), MR0103 (2010) Section 2.1.2(2015) 13.1.1, 13.1.2) Compliant

Marking : 160005134

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
8505555	0.20	1.05	0.008	0.000	0.20	0.24	0.10	0.07	0.01	0.039	0.004	0.002	0.002		0.0020	0.0001	0.011	0.41	0.28

Plate Serial No	Pieces	Tons	Tensile Test				
			Dir.	(psi) Yield	(psi) Tensile	Elong. % in 2"	Elong. % in 8"
8505555-07	4	13.06	T	46,600	75,500		20.2

5361-1
PL ID # 28U
mk# 1J-14, 1D-13

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

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 (#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. Deprelis

T. A. Deprelis, Metallurgist

10/7/2018 2:00:14 PM

NDE Reports

TEAM

Salt Lake City, UT	Denver, CO	Billings, MT	Farmington, NM
(801)397-2202	(720)579-0660	(406)371-5822	(505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1
Date: 3/22/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	Type Of Weld Butt Weld	Radiation Source IR- 192 ☑ CO- 60 ☐ X-Ray ☐	Film Type AGFA D5	Film Size 4.5 X 17	Penetrameter Type ASTM WIRE B
Specification Boiler/ Pressure Vessel	Drawing Number	Source Strength or MA/KV 87 CI	Emulsion Number 8250802N	Exp. Date 1/1/21	Penetrameter Material Stainless Steel
Procedure RT.ASME.1 R24	Pipe O.D./ Pipe Thickness .875" / Plate Thickness	Focal Spot Size (F) 0.124" / Exp. Time 2 MIN. 30 SEC.	Single Load ☑ Double Load ☐		Penetrameter Location Source Side ☑ Film Side ☐
Acceptance Criteria RT - ASME Sec. VIII	Joint Type Butt Weld / Material Carbon Steel	Thickness With Reinforcement (d) 1.187"	Film Technique SWE/SWV		Shim Material NA / Thickness NA
Exposure Technique B	Surface Condition As Welded	Source To Object (D) 20"	Screen Thickness .010"-.010"		ID Placement Lead on Film
Viewing Single ☑ Double ☐	Film Processing Auto ☐ Manual ☑		Screen material Lead		Location Marker Placement Film Side ☑ Source Side ☐
ISO Line #		Report #			

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
GS HD/32U	0-1	LK	X													2.64	2.54
GS 32U/37U	0-1	LK		X				X								2.34	2.57
GS 37U/35U	0-1	LK	X													2.65	2.64
GS 35U/31U	0-1	LK		X				X								2.61	2.43

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Client: ______________________ Date: ______________

NDE Inspector Andrew Gruber Date: 3/22/2019

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Client: Eaton Metals
Job Location: SLC, UT
Job Reference: 5361-1
Date: 3/28/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer Eaton Metals	**Type Of Weld** Butt Weld	**Radiation Source** IR- 192 ☑ CO- 60 ☐ X-Ray ○	**Film Type** AGFA D5 / **Film Size** 4.5 X 17	**Penetrameter Type** ASTM "B" Wire
Specification Boiler/ Pressure Vessel	**Drawing Number**	**Source Strength or MA/KV** 82 Ci	**Emulsion Number** 8850614N / **Exp. Date** 7/1/21	**Penetrameter Material** Stainless Steel
Procedure RT.ASME.1 R22	**Pipe O.D./ Pipe Thickness** 1 / **Plate Thickness**	**Focal Spot Size (F)** 0.124 / **Exp. Time** 12 min	Single Load ☑ Double Load ☐	**Penetrameter Location** Source Side ☑ Film Side ☑
Acceptanca Criteria RT - ASME Sec. VIII	**Joint Type** Butt Weld / **Material** Carbon Steel	**Thickness With Reinforcement (d)** 1.000	**Film Technique** SWE/SWV	**Shim Material** NA / **Thickness** NA
Exposure Technique C	**Surface Condition** As Welded	**Source To Object (D)** 40"	**Screen Thickness** .005"-.010"	**ID Placement** Flash on Film
Viewing Single ☑ Double ☐	**Film Processing** Auto ☐ Manual ☑		**Screen material** Lead	**Location Marker Placement** Film Side ☑ Source Side ☐
ISO Line #		Report #		

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
GS 32U/37U	0-1	LK	X													2.87	3.00
	1-2			X				X								2.87	2.74
	3-0		X		X										QC RES SD 3-29-19	3.02	3.03
GS 35U/31U	0-1	LK	X													3.37	3.32
	1-2		X													3.13	3.17
	3-0		X		X											3.24	3.03

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NDE Inspector Trevor Woolsey Date: 3/28/2019

Trevor Woolsey

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TEAM

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Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361

Date: 4/2/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	Type Of Weld Butt Weld		Radiation Source IR- 192 ☑ CO- 60 ☐ X-Ray ☐	Film Type AGFA D5	Film Size 4.5 X 17
Specification Boiler/ Pressure Vessel	Drawing Number		Source Strength or MA/KV 78 CI	Emulsion Number 8250602N	Exp. Date 1/1/21
Procedure RT.ASME.1 R24	Pipe O.D./ Pipe Thickness .875"	Plate Thickness	Focal Spot Size (F) 0.124"	Exp. Time 32 MIN	Single Load ☑ Double Load ☐
Acceptance Criteria RT - ASME Sec. VIII	Joint Type Butt Weld	Material Carbon Steel	Thickness With Reinforcement (d) 1.187"	Film Technique SWE/SWV	
Exposure Technique B	Surface Condition As Welded		Source To Object (D) 65"	Screen Thickness .010"-.010"	
Viewing Single ☑ Double ☐	Film Processing Auto ☐ Manual ☑			Screen material Lead	
ISO Line #			Report #		

Penetrameter Type: ASTM WIRE B
Penetrameter Material: Stainless Steel
Penetrameter Location: Source Side ☑ Film Side ☐
Shim Material: NA Thickness: NA
ID Placement: Lead on Film
Location Marker Placement: Film Side ☑ Source Side ☐

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
GS 32U/37U	2-3	LK		X											Weld Area Ground in to.	2.92	2.99
	3-4	LK		X				X								3.02	3.03
	4-5	LK		X				X								2.89	3.02
	5-6	LK		X				X								3.00	2.99
	6-7	LK		X				X								3.02	3.03
	7-8	LK		X				X								2.78	3.02
	8-9	LK	X													2.95	3.00
	9-10	LK		X	X											3.04	3.02
	10-11	LK	X													3.00	2.99
	11-12	LK	X													3.02	3.03
	12-13	LK	X													2.91	2.95
	13-14	LK	X			X										3.02	3.03
	14-15	LK	X													3.04	3.02
	15-16	LK	X													3.00	2.99
	16-17	LK	X													3.02	3.03
	17-18	LK	X													3.04	3.02
	18-19	LK		X	X											3.02	3.03
	19-20	LK	X													3.04	3.02
	20-21	LK	X													3.00	2.99
	21-22	LK	X													3.02	3.03
	22-23	LK	X												REJ Eaton QC SD 4-3-19	3.00	2.99
	23-24	LK		X		X										3.02	3.03
	24-25	LK	X													3.04	3.02
	25-26	LK	X													2.98	2.99
	26-27	LK	X													2.78	2.80
	27-28	LK		X		X										2.89	2.85
	28-3	LK	X														

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NDE Inspector Andrew Gruber Date: 4/2/2019

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Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361

Date: 4/9/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4.5 X 17
Penetrameter Type: ASTM WIRE B
Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 95 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel
Procedure: RT.ASME.1 R24
Pipe O.D./ Pipe Thickness: .875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 26 MIN
Single Load ☑ Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐
Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA
Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 65"
Screen Thickness: .010"-.010"
ID Placement: Lead on Film
Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐
ISO Line #:
Report #:

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
GS 32U/37U	1-2	LK	X												5361-1	3.06	3.00
	2-3	LK		X				X								3.02	3.03
	3-4	LK	X													3.08	3.02
	4-5	LK		X	X	X										3.00	2.99
	5-6	LK		X				X								3.02	3.03
	6-7	LK		X				X								3.00	3.02
	7-8	LK		X				X								2.95	3.00
	9-10	LK	X													3.04	3.02
	17-18	LK	X													3.00	2.99
	18-19	LK	X													3.09	3.03
	22-23	LK	X													2.91	2.95
	23-24	LK	X													3.02	3.03
	26-27	LK	X												Scuff marks	3.10	3.02
	3-0	LK		X	X											3.02	3.03

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Client: ____________ Date: ____________
NDE Inspector: Andrew Gruber Date: 4/9/2019

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Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361
Date: 4/11/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4.5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 95 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT.ASME.1 R24
Pipe O.D./ Pipe Thickness: .875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 26 MIN
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criterie: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 65"
Screen Thickness: .010"-.010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #:
Report #:

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
GS 32U/37U	2-3	LK	X												5361-1	2.89	2.99
	4-5	LK		X												2.81	2.88
	5-6	LK	X													2.95	3.02
	6-7	LK	X													3.00	2.99
	7-8	LK	X													2.89	3.03
	27-28	LK	X													3.00	3.02
	3-0	LK	X													3.00	3.00

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Client: Date:

NDE Inspector: Andrew Gruber
Date: 4/11/2019

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Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361
Date: 4/12/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR-192 ☑ CO-60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4.5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 95 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT.ASME.1 R24
Pipe O.D./ Pipe Thickness: .875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 26 MIN
Single Load ☑ Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 65"
Screen Thickness: .010"-.010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #:
Report #:

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
GS 32U/37U	4-5	LK	X												5361-1	2.89	2.86

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Client: ______________ Date: ______________

NDE Inspector: Andrew Gruber Date: 4/12/2019

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Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1

Date: 3/4/2019
Team W O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	**Type Of Weld** Butt Weld	**Radiation Source** IR- 192 ☑ CO- 60 ☐ X-Ray ☐	**Film Type** AGFA D5 **Film Size** 4.5 X 17	**Penetrameter Type** ASTM WIRE B
Specification Boiler/ Pressure Vessel	**Drawing Number**	**Source Strength or MA/KV** 102 CI	**Emulsion Number** 8250602N **Exp Date** 1/1/21	**Penetrameter Material** Stainless Steel
Procedure RT.ASME.1 R24	**Pipe O.D./ Pipe Thickness** .875" **Plate Thickness**	**Focal Spot Size (F)** 0.124" **Exp Time** 1 MIN 45 SEC.	Single Load ☑ Double Load ☐	**Penetrameter Location** Source Side ☑ Film Side ☐
Acceptance Criteria RT - ASME Sec. VIII	**Joint Type** Butt Weld **Material** Carbon Steel	**Thickness With Reinforcement (d)** 1.187"	**Film Technique** SWE/SWV	**Shim Material** NA **Thickness** NA
Exposure Technique B	**Surface Condition** As Welded	**Source To Object (D)** 20"	**Screen Thickness** .010"- 010"	**ID Placement** Lead on Film
Viewing Single ☑ Double ☐	**Film Processing** Auto ☐ Manual ☑		**Screen material** Lead	**Location Marker Placement** Film Side ☑ Source Side ☐
ISO Line #		Report #		

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 32U	0-1	RC	X													2.80	2.79
	1-2	RC	X													2.76	2.80
	2-3	RC	X													2.83	2.85
	3-4	RC	X													2.67	2.65
	4-5	RC	X													2.72	2.68
	5-6	RC	X													2.77	2.85
	6-7	RC	X													2.82	2.99
	7-8	RC	X													2.77	2.73
	8-9	RC	X													2.89	2.84
	9-10	RC		X				X								2.89	2.84

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Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs

Date: 3/13/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	Type Of Weld Butt Weld		Radiation Source IR- 192 ☑ CO- 60 ☐ X-Ray ☐	Film Type AGFA D5	Film Size 4 5 X 17
Specification Boiler/ Pressure Vessel	Drawing Number		Source Strength or MA/KV 94 CI	Emulsion Number 8250602N	Exp. Date 1/1/21
Procedure RT.ASME.1 R24	Pipe O.D./ Pipe Thickness .875"	Plate Thickness	Focal Spot Size (F) 0 124"	Exp. Time 2 MIN	Single Load ☑ Double Load ☐
Acceptance Criteria RT - ASME Sec VIII	Joint Type Butt Weld	Material Carbon Steel	Thickness With Reinforcement (d) 1.187"	Film Technique SWE/SWV	
Exposure Technique B	Surface Condition As Welded		Source To Object (D) 20"	Screen Thickness 010"- 010"	
Viewing Single ☑ Double ☐	Film Processing Auto ☐ Manual ☑			Screen material Lead	
ISO Line #			Report #		

Penetrameter Type: ASTM WIRE B
Penetrameter Material: Stainless Steel
Penetrameter Location: Source Side ☑ Film Side ☐
Shim Material: NA Thickness: NA
ID Placement: Lead on Film
Location Marker Placement: Film Side ☑ Source Side ☐

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	0-1	RC	X													2.66	2.24
	8-9	RC		X	X											2.90	2.95
LS 35U	0-1	RC	X			X										2.92	2.69
LS 36U	0-1	RC	X													3.15	3.16
	1-2	RC	X													3.08	3 05
	2-3	RC	X												scuff on film at 3 loction	3.18	3.17
	3-4	RC		X				X								3.15	3.16
	4-5	RC	X													2.87	2.89
	5-6	RC	X													2.86	2.84
	6-7	RC	X													2.86	2.88
	7-8	RC	X													3.12	3.11
	8-9	RC	X													3.04	3.07
	9-10	RC	X												scuff om film	3.16	3.20
LS 32U	9-10	RC	X													2.90	2.90
LS 38U	0-1	RC		X	X			X								2.84	2.74
LS 33U	0-1	RC		X	X											2.45	2.94
	1-2	RC		X				X								2.87	2.42
	2-3	RC	X													2.82	2.81
	3-4	RC	X													3.24	3.25
	4-5	RC	X													3.22	3 24
	5-6	RC	X													3.21	3 24
	6-7	RC	X													3.02	2.97
	7-8	RC		X				X								3.02	3 15
	8-9	RC	X			X										3.01	3.12
	9-10	RC	X													2.91	2.01

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Client ______________________ Date ______________

NDE Inspector ______________ Date: 3/13/2019

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Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1

Date: 3/4/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	Type Of Weld Butt Weld	Radiation Source IR- 192 ☑ CO- 60 ☐ X-Ray ☐	Film Type AGFA D5	Film Size 4.5 X 17	Penetrameter Type ASTM WIRE B
Specification Boiler/ Pressure Vessel	Drawing Number	Source Strength or MA/KV 102 CI	Emulsion Number 6250602N	Exp. Date 1/1/21	Penetrameter Material Stainless Steel
Procedure RT.ASME.1 R24	Pipe O.D./ Pipe Thickness .875" Plate Thickness	Focal Spot Size (F) 0.124" Exp. Time 1 MIN.45 SEC.	Single Load ☑ Double Load ☐		Penetrameter Location Source Side ☑ Film Side ☐
Acceptance Criteria RT - ASME Sec. VIII	Joint Type Butt Weld Materiel Carbon Steel	Thickness With Reinforcement (d) 1.187"	Film Technique SWE/SWV		Shim Material NA Thickness NA
Exposure Technique 8	Surface Condition As Welded	Source To Object (D) 20"	Screen Thickness .010"-.010"		ID Placement Lead on Film
Viewing Single ☑ Double ☐	Film Processing Auto ☐ Manual ☑		Screen material Lead		Location Marker Placement Film Side ☑ Source Side ☐
ISO Line #		Report #			

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 38U	0-1	RC		X				X								2.75	2.77
	1-2	RC	X													2.85	2.80
	2-3	RC	X													2.84	2.85
	3-4	RC	X													2.67	2.69
	4-5	RC	X													2.66	2.68
	5-6	RC	X													2.77	2.85
	6-7	RC	X													3.00	2.99
	7-8	RC	X													2.89	2.78
	8-9	RC	X													2.87	2.84
LS 31U	0-1	RC	X													2.78	2.77
	1-2	RC	X													2.80	2.81
	2-3	RC	X													2.90	2.91
	3-4	RC	X													2.89	2.88
	4-5	RC	X													3.02	3.00
	5-6	RC	X													2.78	2.79
	6-7	RC	X													2.89	2.88
	7-8	RC	X													2.99	3.00
	8-9	RC	X													2.84	2.95
	9-10	RC	X													3.00	3.02
LS 37U	0-1	RC	X													2.87	2.84
	1-2	RC	X													2.78	2.77
	2-3	RC	X													2.80	2.81
	3-4	RC	X													2.90	2.91
	4-5	RC	X													2.89	2.88
	5-6	RC	X													3.02	3.00
	6-7	RC	X													2.78	2.79
	7-8	RC	X													2.89	2.88
	8-9	RC	X													2.99	3.00
	9-10	RC	X													2.84	2.95

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Client: ______ Date: ______

NDE Inspector Andrew Gruber Date: 3/4/2019

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TEAM

Salt Lake City, UT (801)397-2202
Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs

Date: 3/13/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	Type Of Weld Butt Weld	Radiation Source IR-192 ☑ CO-60 ☐ X-Ray ☐	Film Type AGFA D5	Film Size 4.5 X 17	Penetrameter Type ASTM WIRE B
Specification Boiler/ Pressure Vessel	Drawing Number	Source Strength or MA/KV 94 CI	Emulsion Number 8250602N	Exp. Date 1/1/21	Penetrameter Material Stainless Steel
Procedure RT.ASME.1 R24	Pipe O.D./Pipe Thickness .875" — Plate Thickness	Focal Spot Size (F) 0.124" — Exp. Time 2 MIN	Single Load ☑ Double Load ☐		Penetrameter Location Source Side ☑ Film Side ☐
Acceptance Criteria RT - ASME Sec. VIII	Joint Type Butt Weld — Material Carbon Steel	Thickness With Reinforcement (d) 1.187"	Film Technique SWE/SWV		Shim Material NA — Thickness NA
Exposure Technique B	Surface Condition As Welded	Source To Object (D) 20"	Screen Thickness .010"-.010"		ID Placement Lead on Film
Viewing Single ☑ Double ☐	Film Processing Auto ☐ Manual ☑		Screen material Lead		Location Marker Placement Film Side ☑ Source Side ☐
ISO Line #		Report #			

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	0-1	RC	X													2.66	2.24
	8-9	RC		X	X											2.90	2.95
LS 35U	0-1	RC	X			X										2.92	2.69
LS 36U	0-1	RC	X													3.15	3.16
	1-2	RC	X													3.08	3.05
	2-3	RC	X												scuff on film at 3 loction	3.18	3.17
	3-4	RC		X				X								3.15	3.16
	4-5	RC	X													2.87	2.89
	5-6	RC	X													2.86	2.84
	6-7	RC	X													2.86	2.88
	7-8	RC	X													3.12	3.11
	8-9	RC	X													3.04	3.07
	9-10	RC	X												scuff om film	3.16	3.20
LS 32U	9-10	RC	X													2.90	2.90
LS 38U	0-1	RC		X	X			X								2.84	2.74
LS 33U	0-1	RC		X	X											2.45	2.94
	1-2	RC		X				X								2.87	2.42
	2-3	RC	X													2.82	2.81
	3-4	RC	X													3.24	3.25
	4-5	RC	X													3.22	3.24
	5-6	RC	X													3.21	3.24
	6-7	RC	X													3.02	2.97
	7-8	RC		X				X								3.02	3.15
	8-9	RC	X			X										3.01	3.12
	9-10	RC	X													2.91	2.01

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Client ____________________ Date ____________

NDE Inspector ____________________ Date: 3/13/2019
Andrew Gruber

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TEAM Salt Lake City, UT (801)397-2202 | Denver, CO (720)579-0660 | Billings, MT (406)371-5822 | Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs
Date: 3/15/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	Type Of Weld Butt Weld	Radiation Source IR- 192 ☑ CO- 60 ☐ X-Ray ☐	Film Type AGFA D5	Film Size 4.5 X 17
Specification Boiler/ Pressure Vessel	Drawing Number	Source Strength or MA/KV 94 CI	Emulsion Number 8250602N	Exp. Date 1/1/21
Procedure RT.ASME.1 R24	Pipe O.D./ Pipe Thickness .875" — Plate Thickness	Focal Spot Size (F) 0.124" — Exp. Time 2 MIN	Single Load ☑ Double Load ☐	
Acceptance Criteria RT - ASME Sec. VIII	Joint Type Butt Weld — Material Carbon Steel	Thickness With Reinforcement (d) 1.187"	Film Technique SWE/SWV	
Exposure Technique B	Surface Condition As Welded	Source To Object (D) 20"	Screen Thickness .010"-.010"	
Viewing Single ☑ Double ☐	Film Processing Auto ☐ Manual ☑		Screen material Lead	

Penetrameter Type: ASTM WIRE 8
Penetrameter Material: Stainless Steel
Penetrameter Location: Source Side ☑ Film Side ☐
Shim Material: NA
Thickness: NA
ID Placement: Lead on Film
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #
Report #

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	8-9	RC	X													3.30	3.33
	9-10	RC		X	X			X								3.16	3.14
[redacted] LS 38U	0-1	RC		X	X			X								2.92	2.69
LS 36U	3-4	RC	X													3.31	3.30
LS 33U	0-1	RC	X													3.09	3.07
	1-2	RC	X													3.03	2.99
	2-3	RC	X													2.98	2.99

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Client ______________ Date ______________

NDE Inspector ______________ Date: 3/15/2019
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TEAM

Salt Lake City UT (801)397-2202 | Denver CO (720)579-0660 | Billings MT (406)371-5822 | Farmington NM (505)899-4115

Client: EATON METALS
Job Location: S.L.C Ut
Job Reference: 5361-1 REPAIRS
Date: 3/19/2019
Team W O: 1116-001390
Client P O: 45650

Customer: EATON METALS	Type Of Weld: Butt Weld	Radiation Source: IR-192 CO-60 X-Ray	Film Type: AGFA D5 Film Size: 4.5 X 17	Penetrameter Type: ASTM B WIRE
Specification: Boiler/ Pressure Vessel	Drawing Number:	Source Strength or MA/KV: 102	Emulsion Number: 9150609N Exp. Date: 10/1/21	Penetrameter Material: Stainless Steel
Procedure: RT ASME 1 R24	Pipe O.D / Pipe Thickness: .875 Plate Thickness:	Focal Spot Size (F): 0.117 Exp. Time: 1 min 45 sec	Single Load Double Load	Penetrameter Location: Source Side Film Side
Acceptance Criteria: RT - ASME Sec. VIII	Joint Type: Butt Weld Material: Carbon Steel	Thickness With Reinforcement (d): 1.187	Film Technique: SWE/SWV	Shim Material: Thickness:
Exposure Technique: G	Surface Condition: As Welded	Source To Object (D): 18 000	Screen Thickness: 005"- 010"	ID Placement: Lead on Film
Viewing: Single Double	Film Processing: Auto Manual		Screen material: Lead	Location Marker Placement: Film Side Source Side
ISO Line #		Report #		

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 33U	7-8	RC	X		X	X										2.03	2.03
LS 34U	8-9	RC	X		X											2.02	2.04
	9-10	RC	X		X											2.03	2.02
LS 38U	0-1	RC	X		X	X										2.07	2.04

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NDE Inspector: Chad Cross Date: 3/19/2019

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TEAM

Salt Lake City, UT (801)397-2202
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Billings MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1
Date: 3/5/2019
Team W O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	Type Of Weld Butt Weld	Radiation Source IR- 192 ☑ CO- 60 ☐ X-Ray ☐	Film Type AGFA D5	Film Size 4 5 X 17
Specification Boiler/ Pressure Vessel	Drawing Number	Source Strength or MA/KV 102 CI	Emulsion Number 8250602N	Exp. Date 1/1/21
Procedure RT ASME 1 R24	Pipe O.D./Pipe Thickness .875"	Plate Thickness	Focal Spot Size (F) 0.124"	Exp. Time 1 MIN 45 SEC
Acceptance Criteria RT - ASME Sec. VIII	Joint Type Butt Weld	Material Carbon Steel	Thickness With Reinforcement (d) 1.187"	Film Technique SWE/SWV
Exposure Technique B	Surface Condition As Welded		Source To Object (D) 20"	Screen Thickness .010"-.010"
Viewing Single ☑ Double ☐	Film Processing Auto ☐ Manual ☑			Screen material Lead
ISO Line #			Report #	

Single Load ☑
Double Load ☐

Penetrameter Type: ASTM WIRE B
Penetrameter Material: Stainless Steel
Penetrameter Location: Source Side ☑ Film Side ☐
Shim Material: NA
Thickness: NA
ID Placement: Lead on Film
Location Marker Placement: Film Side ☑ Source Side ☐

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 33U	0-1	RC		X				X								2.75	2.77
	1-2	RC	X												Scuff mark on film at the 2 location	2.78	2.74
	2-3	RC	X												Scuff mark on film at the 2 location.	2.77	2.77
	3-4	RC		X				X								2.67	2.69
	4-5	RC		X				X								2.66	2.68
	5-6	RC		X				X								2.77	2.85
	6-7	RC		X				X								2.75	2.88
	7-8	RC	X													2.89	2.78
	8-9	RC	X													2.87	2.84
	9-10	RC	X													2.77	2.77
LS 36U	0-1	RC		X				X								2.80	2.81
	1-2	RC		X				X								2.90	2.91
	2-3	RC		X				X								2.89	2.88
	3-4	RC		X				X								3.02	3.00
	4-5	RC		X				X								2.78	2.79
	5-6	RC	X													2.89	2.88
	6-7	RC	X													2.99	3.00
	7-8	RC		X				X								2.84	2.95
	8-9	RC		X				X								3.00	3.02
	9-10	RC	X													2.87	2.84
LS 35U	0-1	RC		X	X											2.78	2.77
	1-2	RC	X													2.66	2.62
	2-3	RC	X													2.90	2.91
	3-4	RC	X													2.50	2.52
	4-5	RC	X													2.55	2.59
	5-6	RC	X													2.60	2.60
	6-7	RC	X													2.89	2.88
	7-8	RC	X													2.78	2.77
	8-9	RC	X													2.75	2.70
	9-10	RC	X														

EATON METAL PRODUCTS COMPANY LLC
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Client: ______________________ Date: ____________

NDE Inspector: Andrew Gruber Date: 3/5/2019

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Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs

Date: 3/13/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	Type Of Weld Butt Weld		Radiation Source IR- 192 ☑ CO- 60 ☐ X-Ray ☐	Film Type AGFA D5	Film Size 4 5 X 17	Penetrameter Type ASTM WIRE B
Specification Boiler/ Pressure Vessel	Drawing Number		Source Strength or MA/KV 94 CI	Emulsion Number 8250602N	Exp. Date 1/1/21	Penetrameter Material Stainless Steel
Procedure RT.ASME.1 R24	Pipe O.D./ Pipe Thickness .875"	Plate Thickness	Focal Spot Size (F) 0.124"	Exp. Time 2 MIN	Single Load ☑ Double Load ☐	Penetrameter Location Source Side ☑ Film Side ☐
Acceptance Criteria RT - ASME Sec VIII	Joint Type Butt Weld	Materiel Carbon Steel	Thickness With Reinforcement (d) 1.187"	Film Technique SWE/SWV	Shim Material NA	Thickness NA
Exposure Technique 8	Surface Condition As Welded		Source To Object (D) 20"	Screen Thickness .010"-.010"	ID Placement Lead on Film	
Viewing Single ☑ Double ☐	Film Processing Auto ☐ Manual ☑			Screen material Lead	Location Marker Placement Film Side ☑ Source Side ☐	
ISO Line #			Report #			

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	0-1	RC	X													2.66	2.24
	8-9	RC		X	X											2.90	2.95
LS 35U	0-1	RC	X			X										2.92	2.69
LS 36U	0-1	RC	X													3.15	3.16
	1-2	RC	X													3.08	3.05
	2-3	RC	X												scuff on film at 3 loction	3.18	3.17
	3-4	RC		X				X								3.15	3.16
	4-5	RC	X													2.87	2.89
	5-6	RC	X													2.86	2.84
	6-7	RC	X													2.86	2.88
	7-8	RC	X													3.12	3.11
	8-9	RC	X													3.04	3.07
	9-10	RC	X												scuff om film	3.16	3.20
LS 32U	9-10	RC	X													2.90	2.90
LS 38U	0-1	RC		X	X			X								2.84	2.74
LS 33U	0-1	RC		X	X											2.45	2.94
	1-2	RC		X				X								2.87	2.42
	2-3	RC	X													2.82	2.81
	3-4	RC	X													3.24	3.25
	4-5	RC	X													3.22	3.24
	5-6	RC	X													3.21	3.24
	6-7	RC	X													3.02	2.97
	7-8	RC		X				X								3.02	3.15
	8-9	RC	X			X										3.01	3.12
	9-10	RC	X													2.91	2.01

EATON METAL PRODUCTS COMPANY
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Client: ______________ Date: ______________

NDE Inspector ______________ Date. 3/13/2019
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H & H X-Ray Services, Inc.
14251 U.S. Highway 30, Pocatello, ID 83202
Phone: 208-232-2663 Fax: 208-232-2772

Radiographic Inspection Report

No. BI42919

Customer Eaton metal products
Date 4/29/19
Job No. 19-0357-11
Item description 5361-1
Job Location Pocatello idaho
P.O. No. 45758
Procedure No. Rt 1310
Code Specification Asme v
Type Material C/s
Acceptance Standard Asme VIII uw-52
Pipe
Plate X
Other
Percent Inspection Spot
Geometric Unsharpness (Ug) .005
Penetrameter B
Effective Focal Spot .124
Source size .106X.064
Density 2.0-4.0
Source Ir192
Curies 62.3
Pb Screens back .010
Pb Screens front .010
Single load X
Single wall view X
Exposure time 3m 10sec
Develop time 5min@ 68*
Shim N/A
Double load
Double wall view
Reinforcement 1/8"
Source to object distance 21
Distance from source side of object to film .875
Single Wall exposure X
Double wall exposure

Film No.	Weld No.	Serial No./Piece No.	View	Film size	Thickness	S.F.D	Accept	Reject	Defect code	Comments
		31u-33u	9-10	4.5x17	.875	21.875	✓		Ei	

CERTIFIED RADIOGRAPHIC INTERPRETER
AWS
1809007N
EXP. 9/01/2021 CRI
Jacob Mowat
SIGNED

DEFECT CODE

IP - Incomplete penetration
CV - Concavity Root
IF - Incomplete fusion
C - Crack
EI - Elongated Inclusion
CX - Convexity Root
UC - Undercut
OX - Oxidation
RI - Rounded Inclusion
DT - Drop Through
BT - Burn through
FA - Film Artifact

FILM USED:

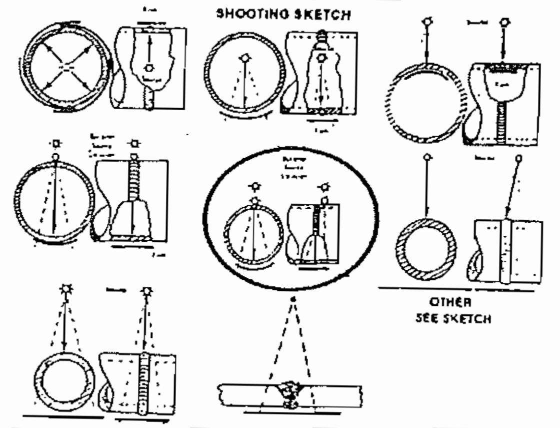
1 FILMS 4.5 X 17 TYPE Agfa d5
FILMS X TYPE
FILMS X TYPE

Total hrs. Total Mileage Number of Welds

Brandon Latimer
Radiographer
Level II

Cinthia latimer
Radiographer Ass't
Level I

Film delivery
Date



TEAM

Salt Lake City, UT (801)397-2202
Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1
Date: 3/5/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4.5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 102 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT ASME.1 R24
Pipe O.D./ Pipe Thickness: .875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 1 MIN 45 SEC
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 20"
Screen Thickness: 010"-.010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #:
Report #:

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 33U	0-1	RC		X				X								2.75	2.77
	1-2	RC	X												Scuff mark on film at the 2 location.	2.78	2.74
	2-3	RC	X												Scuff mark on film at the 2 location.	2.77	2.77
	3-4	RC		X				X								2.67	2.69
	4-5	RC		X				X								2.66	2.68
	5-6	RC		X				X								2.77	2.85
	6-7	RC		X				X								2.75	2.88
	7-8	RC	X													2.89	2.78
	8-9	RC	X													2.87	2.84
	9-10	RC	X													2.77	2.77
LS 36U	0-1	RC		X				X								2.80	2.81
	1-2	RC		X				X								2.90	2.91
	2-3	RC		X				X								2.89	2.88
	3-4	RC		X				X								3.02	3.00
	4-5	RC		X				X								2.78	2.79
	5-6	RC	X													2.89	2.88
	6-7	RC	X													2.99	3.00
	7-8	RC		X				X								2.84	2.95
	8-9	RC		X				X								3.00	3.02
	9-10	RC	X													2.87	2.84
LS 35U	0-1	RC		X	X											2.78	2.77
	1-2	RC	X													2.66	2.62
	2-3	RC	X													2.90	2.91
	3-4	RC	X													2.50	2.52
	4-5	RC	X													2.55	2.59
	5-6	RC	X													2.60	2.60
	6-7	RC	X													2.89	2.88
	7-8	RC	X													2.78	2.77
	8-9	RC	X													2.75	2.70
	9-10	RC	X														

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Client: ____________ Date: ____________

NDE Inspector: Andrew Gruber Date: 3/5/2019

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TEAM

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Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs
Date: 3/13/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR-192 ☑ CO-60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4.5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 94 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT.ASME.1 R24
Pipe O.D./Pipe Thickness: 875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 2 MIN
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: 8
Surface Condition: As Welded
Source To Object (D): 20"
Screen Thickness: 010"-.010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #:
Report #:

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	0-1	RC	X													2.66	2.24
	8-9	RC		X	X											2.90	2.95
LS 35U	0-1	RC	X			X										2.92	2.69
LS 36U	0-1	RC	X													3.15	3.16
	1-2	RC	X													3.08	3.05
	2-3	RC	X												scuff on film at 3 loction	3.18	3.17
	3-4	RC		X				X								3.15	3.16
	4-5	RC	X													2.87	2.89
	5-6	RC	X													2.86	2.84
	6-7	RC	X													2.86	2.88
	7-8	RC	X													3.12	3.11
	8-9	RC	X													3.04	3.07
	9-10	RC	X												scuff om film	3.16	3.20
LS 32U	9-10	RC	X													2.90	2.90
LS 38U	0-1	RC		X	X			X								2.84	2.74
LS 33U	0-1	RC		X	X											2.45	2.94
	1-2	RC		X				X								2.87	2.42
	2-3	RC	X													2.82	2.81
	3-4	RC	X													3.24	3.25
	4-5	RC	X													3.22	3.24
	5-6	RC	X													3.21	3.24
	6-7	RC	X													3.02	2.97
	7-8	RC		X				X								3.02	3.15
	8-9	RC	X			X										3.01	3.12
	9-10	RC	X													2.91	2.01

Client ______ Date ______

NDE Inspector Andrew Gruber Date 3/13/2019

Form MS.RT.ASME

"Client has final authority and responsibility for interpelation and acceptance of examination and reports"

TEAM

Salt Lake City, UT (801)397-2202
Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference 5361-1 Repairs
Date 3/15/2019
Team W.O. 1116-001390
Client P.O · 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4 5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 94 CI
Emulsion Number: 8250602N
Exp Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT.ASME 1 R24
Pipe O D / Pipe Thickness: .875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp Time: 2 MIN
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 20"
Screen Thickness: 010"-.010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #
Report #

Weld No.	View	Weld I.D	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	8-9	RC	X													3 30	3.33
	9-10	RC		X	X			X								3 16	3.14
LS 38U	0-1	RC		X	X			X								2.92	2.69
LS 36U	3-4	RC	X													3.31	3.30
LS 33U	0-1	RC	X													3.09	3 07
	1-2	RC	X													3.03	2 99
	2-3	RC	X													2.98	2.99

SPD QUALITY

Client ______ Date ______
NDE Inspector ______ Date 3/15/2019
Andrew Gruber

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TEAM

Salt Lake City UT (801)397-2702
Denver CO (720)579-0680
Billings, MT (406)371-5822
Farmington NM (505)599-4115

Client EATON METALS
Job Location S.L.C. Ut.
Job Reference 5361-1 REPAIRS
Date 3/19/2019
Team W.O. 1116-001390
Client P.O. 45650

Customer EATON METALS	Type Of Weld Butt Weld	Radiation Source IR-192 CO-60 X-Ray	Film Type AGFA D5 Film Size 4.5 X 17	Penetrameter Type ASTM B WIRE
Specification Boiler/ Pressure Vessel	Drawing Number	Source Strength or MA/KV 102	Emulsion Number 9150600N Exp. Date 10/1/21	Penetrameter Material Stainless Steel
Procedure RT ASME 1 R24	Pipe O.D / Pipe Thickness .875 Plate Thickness	Focal Spot Size (F) 0.117 Exp. Time 1 min 45 sec	Single Load Double Load	Penetrameter Location Source Side Film Side
Acceptance Criteria RT - ASME Sec. VIII	Joint Type Butt Weld Material Carbon Steel	Thickness With Reinforcement (d) 1.187	Film Technique SWE/SWV	Shim Material Thickness
Exposure Technique G	Surface Condition As Welded	Source To Object (D) 18.000	Screen Thickness .005"-.010"	ID Placement Lead on Film
Viewing Single Double	Film Processing Auto Manual		Screen material Lead	Location Marker Placement Film Side Source Side
ISO Line #		Report #		

Weld No	View	Weld I.D	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 33U	7-8	RC	X		X	X										2.03	2.03
LS 34U	8-9	RC	X		X											2.02	2.04
	9-10	RC	X		X											2.03	2.02
LS 38U	0-1	RC	X		X	X										2.07	2.04

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Client ______ Date ______

NDE Inspector Chad Cross Date 3/19/2019
Chad Cross

Form MS RT ASME

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H & H X-Ray Services, Inc.
14251 U.S. Highway 30, Pocatello, ID 83202
Phone: 208-232-2663 Fax: 208-232-2772

Radiographic Inspection Report

No. BI33019

Customer Eaton metal products
Date 3/30/19
Job No. 19-0357-11
Item description 5361-1
Job Location Pocatello idaho
P.O. No. 45758
Procedure No. Rt 1310
Code Specification Asme v
Type Material C/s
Acceptance Standard Asme VIII uw-52
Pipe
Plate X
Other
Percent Inspection 100%
Geometric Unsharpness (Ug) .005
Penetrometer B
Effective Focal Spot .124
Source size .106x.064
Density 2.0-4.0
Source Ir192
Curies 86.6
Pb Screens back .010
Pb Screens front .010
Single load X
Single wall view X
Exposure time 2 min 45 sec
Develop time 5min@ 68*
Shim N/A
Double load
Double wall view
Reinforcement 1/8"
Source to object distance 21
Distance from source side of object to film .875
Single Wall exposure X
Double wall exposure

Film No.	Weld No.	Serial No./Piece No.	View	Film size	Thickness	S.F.D	Accept	Reject	Defect code	Comments
		33u-38u	0-1	4.5x17	1.45	21.875		X	Ei	

EATON METAL PRODUCTS COMPANY LLC
AD
QUALITY

DEFECT CODE

IP - Incomplete penetration	EI - Elongated Inclusion	RI - Rounded Inclusion
CV - Concavity Root	CX - Convexity Root	DT - Drop Through
IF - Incomplete fusion	UC - Undercut	BT - Burn through
C - Crack	OX - Oxidation	FA - Film Artifact

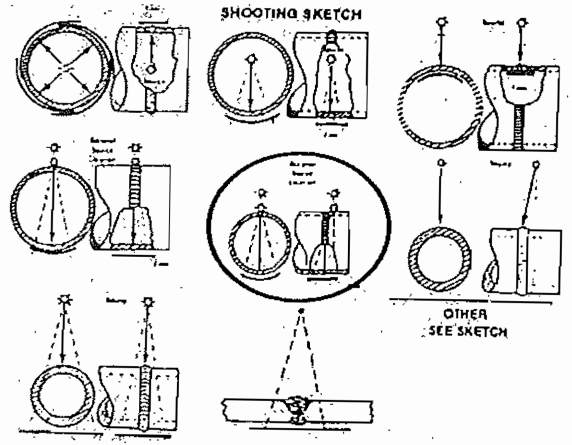
FILM USED:

1 FILMS 4.5 X 17 TYPE Agfa d5
FILMS X TYPE
FILMS X TYPE

Total hrs. Total Mileage Number of Weids

Brandon Latimer II
Radiographer Level
Cinthia latimer I
Radiographer Ass't Level
Film delivery Date

SHOOTING SKETCH



H & H X-Ray Services, Inc.
14251 U.S. Highway 30, Pocatello, ID 83202
Phone: 208-232-2663 Fax: 208-232-2772

Radiographic Inspection Report

No. BI4-319

Customer Eaton metal products
Date 4/3/19
Job No. 19-0357-11
Item description 5361-1
Job Location Pocatello idaho
P.O. No. 45758
Procedure No. RI 1310
Code Specification Asme v
Type Material C/s
Acceptance Standard Asme VIII uw-52
Pipe
Plate X
Other
Percent Inspection 100%
Geometric Unsharpness (Ug) .005
Penetrometer B
Effective Focal Spot .124
Source size .106x.064
Density 2.0-4.0
Source Ir192
Curies 86.6
Pb Screens back .010
Pb Screens front .010
Single load X
Single wall view X
Exposure time 2 min 45 sec
Develop time 5min@ 68*
Shim N/A
Double load
Double wall view
Reinforcement 1/8"
Source to object distance 21
Distance from source side of object to film .875
Single Wall exposure X
Double wall exposure

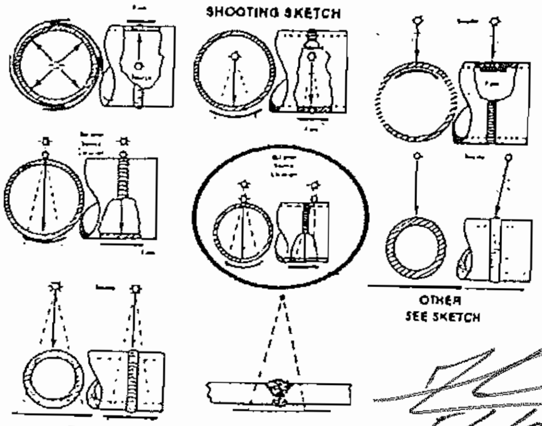
Film No.	Weld No.	Serial No./Piece No.	View	Film size	Thickness	S.F.D	Accept	Reject	Defect code	Comments
		33u-38u	0-1	4.5x17	.875	21.875	✓		Ri	
			2-0				✓		Ri	
			2-3				✓		Ri	

AWS® CERTIFIED RADIOGRAPHIC INTERPRETER
1809007N
EXP. 9/01/2021 CRI
Jacob Mowat
SIGNED

DEFECT CODE
IP - Incomplete penetration
CV - Concavity Root
IF - Incomplete fusion
C - Crack
EI - Elongated Inclusion
CX - Convexity Root
UC - Undercut
OX - Oxidation
RI - Rounded Inclusion
DT - Drop Through
BT - Burn through
FA - Film Artifact

FILM USED:
1 FILMS 4.5 x 17 TYPE Agfa d5
FILMS x TYPE
FILMS x TYPE
Total hrs. Total Mileage Number of Welds

Brandon Latimer Radiographer II Level
Cinthia latimer Radiographer Ass't I Level
Film delivery Date



5/1/19

The recorded results are the opinion of the technician to the best of his knowledge based on the information provided to him by the customer at the time of the inspection.

H & H X-Ray Services, Inc.
14251 U.S. Highway 30, Pocatello, ID 83202
Phone: 208-232-2663 Fax: 208-232-2772

Radiographic Inspection Report

No. BI33019

Customer Eaton metal products
Date 3/30/19
Job No. 19-0357-11
Item description 5361-1
Job Location Pocatello idaho
P.O. No. 45758
Procedure No. Rt 1310
Code Specification Asme v
Type Material C/s
Acceptance Standard Asme VIII uw-52
Pipe
Plate X
Other
Percent Inspection 100%
Geometric Unsharpness (Ug) .005
Penetrameter B
Effective Focal Spot .124
Source size .106x.064
Density 2.0-4.0
Source Ir192
Curies 86.6
Pb Screens back .010
Pb Screens front .010
Single load X
Single wall view X
Exposure time 2 min 45 sec
Develop time 5min@ 68*
Shim N/A
Double load
Double wall view
Reinforcement 1/8"
Source to object distance 21
Distance from source side of object to film .875
Single Wall exposure X
Double wall exposure

Film No.	Weld No.	Serial No./Piece No.	View	Film size	Thickness	S.F.D	Accept	Reject	Defect code	Comments
		38u-36u	0-1	4.5x17	1.45	21.875		X	Ei	

AD
QUALITY

DEFECT CODE

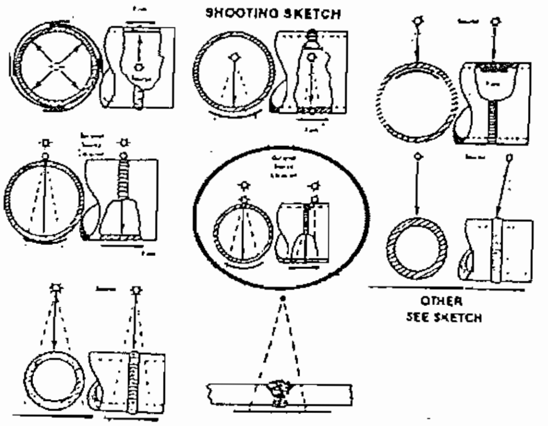
IP - Incomplete penetration	EI - Elongated Inclusion	RI - Rounded Inclusion
CV - Concavity Root	CX - Convexity Root	DT - Drop Through
IF - Incomplete fusion	UC - Undercut	BT - Burn through
C - Crack	OX - Oxidation	FA - Film Artifact

FILM USED:
1 FILMS 4.5 x 17 TYPE Agfa d5
FILMS x TYPE
FILMS x TYPE

Total hrs. Total Mileage Number of Welds

Brandon Latimer Radiographer II Level
Cinthia latimer Radiographer Ass't I Level
Film delivery Date

SHOOTING SKETCH



The recorded results are the opinion of the technician to the best of his knowledge based on the information provided to him by the customer at the time of the inspection.

H & H X-Ray Services, Inc.

14251 U.S. Highway 30, Pocatello, ID 83202
Phone: 208-232-2663 Fax: 208-232-2772

Radiographic Inspection Report

No. Bl4319

Customer Eaton metal products
Date 4/3/19
Job No. 19-0357-11
Item description 5361-1
Job Location Pocatello idaho
P.O. No. 45758
Procedure No. Rt 1310
Code Specification Asme v
Type Material C/s
Acceptance Standard Asme VIII uw-52
Pipe
Plate X
Other
Percent Inspection 100%
Geometric Unsharpness (Ug) .005
Penetrameter B
Effective Focal Spot .124
Source size .106x.064
Density 2.0-4.0
Source Ir192
Curies 86.6
Pb Screens back .010
Pb Screens front .010
Single load X
Single wall view X
Exposure time 2 min 45 sec
Develop time 5min@ 68*
Shim N/A
Double load
Double wall view
Reinforcement 1/8"
Source to object distance 21
Distance from source side of object to film .875
Single Wall exposure X
Double wall exposure

Film No.	Weld No.	Serial No./Piece No.	View.	Film size	Thickness	S.F.D	Accept	Reject	Defect code	Comments
		38u-36u	0-1	4.5x17	.875	21.875	✓			
			2-0				✓		Fa	
			2-3				✓			

CERTIFIED RADIOGRAPHIC INTERPRETER
1809007N
AWS®
EXP. 9/01/2021
CRI
Jacob Mowat
SIGNED J. Mowat

DEFECT CODE

IP - Incomplete penetration	EI - Elongated Inclusion	RI - Rounded Inclusion
CV - Concavity Root	CX - Convexity Root	DT - Drop Through
IF - Incomplete fusion	UC - Undercut	BT - Burn through
C - Crack	OX - Oxidation	FA - Film Artifact

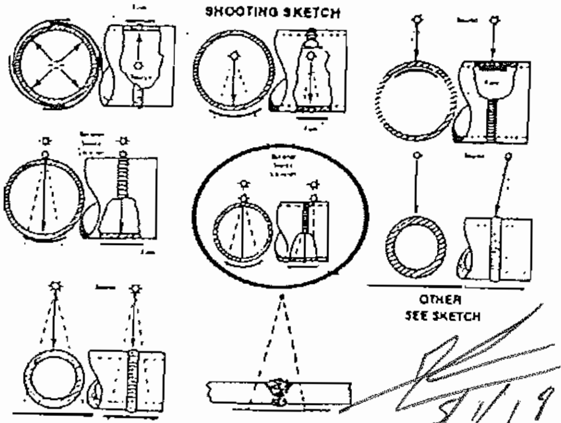
FILM USED:

1 FILMS 4.5 x 17 TYPE Agfa d5
FILMS x TYPE
FILMS x TYPE

Total hrs. Total Mileage Number of Welds

Brandon Latimer Radiographer II Level
Cinthia latimer Radiographer Ass't I Level
Film delivery Date

SHOOTING SKETCH



5/1/19

The recorded results are the opinion of the technician to the best of his knowledge based on the information provided to him by the customer at the time of the inspection.

TEAM

Salt Lake City, UT (801)397-2202 | Denver, CO (720)579-0660 | Billings MT (406)371-5822 | Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1
Date. 3/5/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4.5 X 17
Penetrameter Type: ASTM WIRE 8

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 102 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT.ASME 1 R24
Pipe O.D./ Pipe Thickness: 875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 1 MIN 45 SEC.
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: 8
Surface Condition: As Welded
Source To Object (D): 20"
Screen Thickness: 010"-.010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #:
Report #:

Weld No.	View	Weld I D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 33U	0-1	RC		X				X								2.75	2.77
	1-2	RC	X												Scuff mark on film at the 2 location	2.78	2.74
	2-3	RC	X												Scuff mark on film at the 2 location.	2.77	2.77
	3-4	RC		X				X								2.67	2.69
	4-5	RC		X				X								2.66	2.68
	5-6	RC		X				X								2.77	2.85
	6-7	RC		X				X								2.75	2.88
	7-8	RC	X													2.89	2.78
	8-9	RC	X													2.87	2.84
	9-10	RC	X													2.77	2.77
LS 36U	0-1	RC		X				X								2.80	2.81
	1-2	RC		X				X								2.90	2.91
	2-3	RC		X				X								2.89	2.88
	3-4	RC		X				X								3.02	3.00
	4-5	RC		X				X								2.78	2.79
	5-6	RC	X													2.89	2.88
	6-7	RC	X													2.99	3.00
	7-8	RC		X				X								2.84	2.95
	8-9	RC		X				X								3.00	3.02
	9-10	RC	X													2.87	2.84
LS 35U	0-1	RC		X	X											2.78	2.77
	1-2	RC	X													2.66	2.62
	2-3	RC	X													2.90	2.91
	3-4	RC	X													2.50	2.52
	4-5	RC	X													2.55	2.59
	5-6	RC	X													2.60	2.60
	6-7	RC	X													2.89	2.88
	7-8	RC	X													2.78	2.77
	8-9	RC	X													2.75	2.70
	9-10	RC	X														

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Client: ______ Date ______
NDE Inspector: Andrew Gruber Date 3/5/2019

Form MS RT.ASME

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TEAM

Salt Lake City, UT (801)397-2202
Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs
Date: 3/13/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4.5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 94 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT.ASME.1 R24
Pipe O.D./ Pipe Thickness: .875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 2 MIN
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 20"
Screen Thickness: .010"-.010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #:
Report #:

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	0-1	RC	X													2.66	2.24
	8-9	RC		X	X											2.90	2.95
LS 35U	0-1	RC	X			X										2.92	2.69
LS 36U	0-1	RC	X													3.15	3.16
	1-2	RC	X													3.08	3.05
	2-3	RC	X												scuff on film at 3 loction	3.18	3.17
	3-4	RC		X				X								3.15	3.16
	4-5	RC	X													2.87	2.89
	5-6	RC	X													2.86	2.84
	6-7	RC	X													2.86	2.88
	7-8	RC	X													3.12	3.11
	8-9	RC	X													3.04	3.07
	9-10	RC	X												scuff om film	3.16	3.20
LS 32U	9-10	RC	X													2.90	2.90
LS 38U	0-1	RC		X	X			X								2.84	2.74
LS 33U	0-1	RC		X	X											2.45	2.94
	1-2	RC		X				X								2.87	2.42
	2-3	RC	X													2.82	2.81
	3-4	RC	X													3.24	3.25
	4-5	RC	X													3.22	3.24
	5-6	RC	X													3.21	3.24
	6-7	RC	X													3.02	2.97
	7-8	RC		X				X								3.02	3.15
	8-9	RC	X			X										3.01	3.12
	9-10	RC	X													2.91	2.01

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Client: ______________ Date: ______________
NDE Inspector: Andrew Gruber Date 3/13/2019

Form MS.RT.ASME

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TEAM ® Salt Lake City, UT (801)397-2202 | Denver, CO (720)579-0660 | Billings, MT (406)371-5822 | Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs
Date: 3/15/2019
Team W.O. 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4 5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 94 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT.ASME.I R24
Pipe O.D / Pipe Thickness: .875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 2 MIN
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 20"
Screen Thickness: .010"-.010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #:
Report #:

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	8-9	RC	X													3.30	3 33
	9-10	RC		X	X			X								3.16	3.14
LS 38U	0-1	RC		X	X			X								2.92	2 69
LS 36U	3-4	RC	X													3.31	3.30
LS 33U	0-1	RC	X													3.09	3.07
	1-2	RC	X													3 03	2 99
	2-3	RC	X													2 98	2.99

SPD QUALITY

Client ______________________ Date ______________

NDE Inspector ______________________ Date 3/15/2019
Andrew Gruber

Form MS.RT ASME

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H & H X-Ray Services, Inc.
14251 U.S. Highway 30, Pocatello, ID 83202
Phone: 208-232-2663 Fax: 208-232-2772

Radiographic Inspection Report

No. BI33019

Customer Eaton metal products
Date 3/30/19
Job No. 19-0357-11
Item description 5361-1
Job Location Pocatello idaho
P.O. No. 45758
Procedure No. Rt 1310
Code Specification Asme v
Type Material C/s
Acceptance Standard Asme VIII uw-52
Pipe
Plate X
Other
Percent Inspection 100%
Geometric Unsharpness (Ug) .005
Penetrameter B
Effective Focal Spot .124
Source size .106x.064
Density 2.0-4.0
Source Ir192
Curies 86.6
Pb Screens back .010
Pb Screens front .010
Single load X
Single wall view X
Exposure time 2 min 45 sec
Develop time 5min@ 68*
Shim N/A
Double load
Double wall view
Reinforcement 1/8"
Source to object distance 21
Distance from source side of object to film .875
Single Wall exposure X
Double wall exposure

Film No.	Weld No.	Serial No./Piece No.	View	Film size	Thickness	S.F.D	Accept	Reject	Defect code	Comments
		36u-34u	0-1	4.5x17	1.45	21.875		X	Ri	Repair in long Seam Will Shot 15

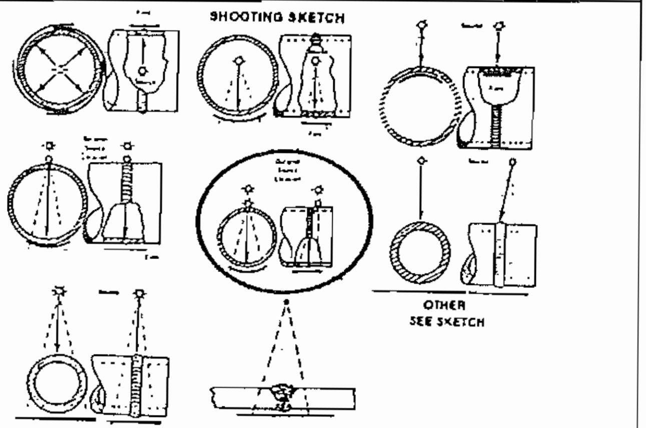
AD
QUALITY

DEFECT CODE

IP - Incomplete penetration
CV - Concavity Root
IF - Incomplete fusion
C - Crack
EI - Elongated Inclusion
CX - Convexity Root
UC - Undercut
OX - Oxidation
RI - Rounded Inclusion
DT - Drop Through
BT - Burn through
FA - Film Artifact

FILM USED:
1 FILMS 4.5 X 17 TYPE Agfa d5
FILMS X TYPE
FILMS X TYPE
Total hrs.
Total Mileage
Number of Welds

Brandon Latimer
Radiographer
II
Level
Cinthia latimer
Radiographer Ass't
I
Level
Film delivery
Date



The recorded results are the opinion of the technician to the best of his knowledge based on the information provided to him by the customer at the time of the inspection.

TEAM

Salt Lake City, UT (801)397-2202
Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1

Date: 3/5/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer EATON METAL	**Type Of Weld** Butt Weld		**Radiation Source** IR- 192 ☑ CO- 60 ☐ X-Ray ☐	**Film Type** AGFA D5	**Film Size** 4.5 X 17
Specification Boiler/ Pressure Vessel	**Drawing Number**		**Source Strength or MA/KV** 102 CI	**Emulsion Number** 8250602N	**Exp. Date** 1/1/21
Procedure RT.ASME.1 R24	**Pipe O.D./ Pipe Thickness** .875"	**Plate Thickness**	**Focal Spot Size (F)** 0.124"	**Exp. Time** 1 MIN.45 SEC.	Single Load ☑ Double Load ☐
Acceptance Criteria RT - ASME Sec. VIII	**Joint Type** Butt Weld	**Material** Carbon Steel	**Thickness With Reinforcement (d)** 1.187"	**Film Technique** SWE/SWV	
Exposure Technique B	**Surface Condition** As Welded		**Source To Object (O)** 20"	**Screen Thickness** .010"-.010"	
Viewing Single ☑ Double ☐	**Film Processing** Auto ☐ Manual ☑			**Screen material** Lead	
ISO Line #			Report #		

Penetrameter Type ASTM WIRE B	
Penetrameter Material Stainless Steel	
Penetrameter Location Source Side ☑ Film Side ☐	
Shim Material NA	**Thickness** NA
IO Placement Lead on Film	
Location Marker Placement Film Side ☑ Source Side ☐	

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	0-1	RC		X				X								2.60	2.61
	1-2	RC	X													2.69	2.70
	2-3	RC	X													2.83	2.85
	3-4	RC	X													2.67	2.65
	4-5	RC	X													2.78	2.68
	5-6	RC	X													2.77	2.85
	6-7	RC	X													2.82	2.99
	7-8	RC	X													2.77	2.73
	8-9	RC		X				X								2.89	2.84
	9-10	RC	X													2.70	2.80

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Client: ______________ Date: ______________

NDE Inspector Andrew Gruber Date: 3/5/2019

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TEAM

Salt Lake City, UT (801)397-2202
Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs
Date: 3/13/2019
Team W.O: 1116-001390
Client P.O.: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4 5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 94 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT ASME 1 R24
Pipe O.D./ Pipe Thickness: 875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 2 MIN
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 20"
Screen Thickness: .010"- 010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #
Report #

Weld No.	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	0-1	RC	X													2 66	2.24
	8-9	RC		X	X											2.90	2.95
LS 35U	0-1	RC	X			X										2.92	2.69
LS 36U	0-1	RC	X													3.15	3.16
	1-2	RC	X													3.08	3.05
	2-3	RC	X												scuff on film at 3 loction	3.18	3.17
	3-4	RC		X				X								3.15	3.16
	4-5	RC	X													2.87	2.89
	5-6	RC	X													2.86	2.84
	6-7	RC	X													2.86	2.88
	7-8	RC	X													3.12	3.11
	8-9	RC	X													3.04	3.07
	9-10	RC	X												scuff om film	3.16	3.20
LS 32U	9-10	RC	X													2.90	2.90
LS 38U	0-1	RC		X	X			X								2.84	2.74
LS 33U	0-1	RC		X	X											2.45	2.94
	1-2	RC		X				X								2.87	2.42
	2-3	RC	X													2.82	2.81
	3-4	RC	X													3.24	3.25
	4-5	RC	X													3.22	3.24
	5-6	RC	X													3.21	3.24
	6-7	RC	X													3 02	2 97
	7-8	RC		X				X								3.02	3 15
	8-9	RC	X			X										3.01	3.12
	9-10	RC	X													2.91	2.01

EATON METAL PRODUCTS COMPANY LLC
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Client ______________ Date ______________

NDE Inspector ______________ Date: 3/13/2019
Andrew Gruber

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TEAM

Salt Lake City, UT (801)397-2202
Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METAL
Job Location: SLC, Utah
Job Reference: 5361-1 Repairs
Date: 3/15/2019
Team W O: 1116-001390
Client P O: 45650

Customer: EATON METAL
Type Of Weld: Butt Weld
Radiation Source: IR- 192 ☑ CO- 60 ☐ X-Ray ☐
Film Type: AGFA D5
Film Size: 4 5 X 17
Penetrameter Type: ASTM WIRE B

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 94 CI
Emulsion Number: 8250602N
Exp. Date: 1/1/21
Penetrameter Material: Stainless Steel

Procedure: RT ASME.1 R24
Pipe O.D / Pipe Thickness: .875"
Plate Thickness:
Focal Spot Size (F): 0.124"
Exp. Time: 2 MIN
Single Load ☑
Double Load ☐
Penetrameter Location: Source Side ☑ Film Side ☐

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187"
Film Technique: SWE/SWV
Shim Material: NA
Thickness: NA

Exposure Technique: B
Surface Condition: As Welded
Source To Object (D): 20"
Screen Thickness: .010"- 010"
ID Placement: Lead on Film

Viewing: Single ☑ Double ☐
Film Processing: Auto ☐ Manual ☑
Screen material: Lead
Location Marker Placement: Film Side ☑ Source Side ☐

ISO Line #
Report #

Weld No.	View	Weld I.D	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 34U	8-9	RC	X													3.30	3.33
	9-10	RC		X	X			X								3.16	3.14
LS 38U	0-1	RC		X	X			X								2.92	2.69
LS 36U	3-4	RC	X													3.31	3.30
LS 33U	0-1	RC	X													3.09	3.07
	1-2	RC	X													3.03	2.99
	2-3	RC	X													2.98	2.99

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Client ______________ Date ______________

NDE Inspector ______________ Date 3/15/2019
Andrew Gruber

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Salt Lake City, UT (801)397-2202
Denver, CO (720)579-0660
Billings, MT (406)371-5822
Farmington, NM (505)599-4115

Client: EATON METALS
Job Location: S.L.C. Ut
Job Reference: 5361-1 REPAIRS
Date: 3/19/2019
Team W.O.: 1116-001390
Client P.O.: 45650

Customer: EATON METALS
Type Of Weld: Butt Weld
Radiation Source: IR-192 CO-60 X-Ray
Film Type: AGFA D5
Film Size: 4.5 X 17
Penetrameter Type: ASTM B WIRE

Specification: Boiler/ Pressure Vessel
Drawing Number:
Source Strength or MA/KV: 102
Emulsion Number: 9150609N
Exp. Date: 10/1/21
Penetrameter Material: Stainless Steel

Procedure: RT ASME 1 R24
Pipe O.D./ Pipe Thickness: 875
Plate Thickness:
Focal Spot Size (F): 0.117
Exp. Time: 1 min 45 sec
Single Load
Double Load
Penetrameter Location: Source Side Film Side

Acceptance Criteria: RT - ASME Sec. VIII
Joint Type: Butt Weld
Material: Carbon Steel
Thickness With Reinforcement (d): 1.187
Film Technique: SWE/SWV
Shim Material:
Thickness:

Exposure Technique: G
Surface Condition: As Welded
Source To Object (D): 18.000
Screen Thickness: .005"-.010"
ID Placement: Lead on Film

Viewing: Single Double
Film Processing: Auto Manual
Screen material: Lead
Location Marker Placement: Film Side Source Side

ISO Line #:
Report #:

Weld No	View	Weld I.D.	Accept	Reject	Porosity	Slag	Crack	Incomplete Fusion	Incomplete Penetration	Undercut	Burn Through	Surface Indication	Tungsten Inclusion	Concavity	Remarks	Penetrameter Density	Weld Density
LS 33U	7-8	RC	X		X	X										2.03	2.03
LS 34U	8-9	RC	X		X											2.02	2.04
	9-10	RC	X		X											2.03	2.02
LS 38U	0-1	RC	X		X	X										2.07	2.04

EATON METAL PRODUCTS COMPANY LLC
SPD
QUALITY

Client ______________ Date ______________

NDE Inspector: Chad Cross Date 3/19/2019

Form MS RT ASME

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H & H X-Ray Services, Inc.

14251 U.S. Highway 30, Pocatello, ID 83202
Phone: 208-232-2663 Fax: 208-232-2772

Radiographic Inspection Report

No. BI33019

Customer Eaton metal products | Date 3/30/19 | Job No. 19-0357-11

Item description 5361-1 | Job Location Pocatello idaho | P.O. No. 45758

Procedure No. Rt 1310 | Code Specification Asme v | Type Material C/s

Acceptance Standard Asme VIII uw-52 | Pipe | Plate X | Other | Percent Inspection 100%

Geometric Unsharpness (Ug) .005 | Penetrometer B | Effective Focal Spot .124 | Source size .106X.064 | Density 2.0-4.0

Source Ir192 | Curies 86.6 | Pb Screens back .010 | Pb Screens front .010 | Single load X | Single wall view X

Exposure time 2 min 45 sec | Develop time 5min@ 68* | Shim N/A | Double load | Double wall view

Reinforcement 1/8" | Source to object distance 21 | Distance from source side of object to film .875 | Single Wall exposure X | Double wall exposure

Film No.	Weld No.	Serial No./Piece No.	View	Film size	Thickness	S.F.D	Accept	Reject	Defect code	Comments
		34u-hd2	0-1	4.5x17	1.45	21.875		X	Ei	

EATON METAL PRODUCTS COMPANY LLC
AD
QUALITY

DEFECT CODE

IP - Incomplete penetration
CV - Concavity Root
IF - Incomplete fusion
C - Crack
EI - Elongated Inclusion
CX - Convexity Root
UC - Undercut
OX - Oxidation
RI - Rounded Inclusion
DT - Drop Through
BT - Burn through
FA - Film Artifact

FILM USED:

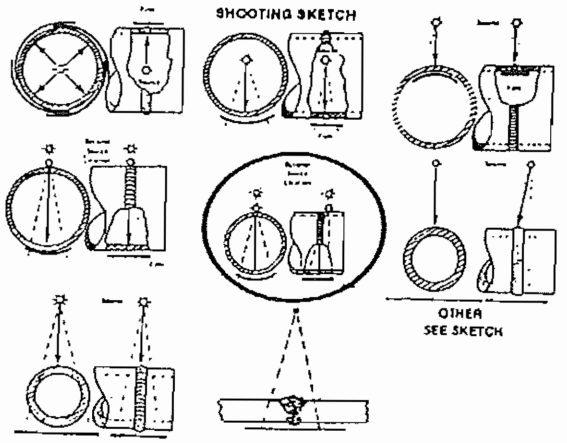
1 FILMS 4.5 x 17 TYPE Agfa d5
FILMS x TYPE
FILMS x TYPE

Total hrs. Total Mileage Number of Welds

Brandon Latimer II
Radiographer Level

Cinthia latimer I
Radiographer Ass't Level

Film delivery Date



The recorded results are the opinion of the technician to the best of his knowledge based on the information provided to him by the customer at the time of the inspection.

H & H X-Ray Services, Inc.
14251 U.S. Highway 30, Pocatello, ID 83202
Phone: 208-232-2663 Fax: 208-232-2772

Radiographic Inspection Report

No. Bl4319

Customer Eaton metal products
Date 4/3/19
Job No. 19-0357-11
Item description 5361-1
Job Location Pocatello idaho
P.O. No. 45758
Procedure No. Rt 1310
Code Specification Asme v
Type Material C/s
Acceptance Standard Asme VIII uw-52
Pipe
Plate X
Other
Percent Inspection 100%
Geometric Unsharpness (Ug) .005
Penetrameter B
Effective Focal Spot .124
Source size .106x.064
Density 2.0-4.0
Source Ir192
Curies 86.6
Pb Screens back .010
Pb Screens front .010
Single load X
Single wall view X
Exposure time 2 min 45 sec
Develop time 5min@ 68*
Shim N/A
Double load
Double wall view
Reinforcement 1/8"
Source to object distance 21
Distance from source side of object to film .875
Single Wall exposure X
Double wall exposure

Film No.	Weld No.	Serial No./Piece No.	View	Film size	Thickness	S.F.D	Accept	Reject	Defect code	Comments
		34u-hd2	0-1	4.5x17	.875	21.875	✓		Ri	
			0-2				✓		Ri	
			2-3				✓		Ri	

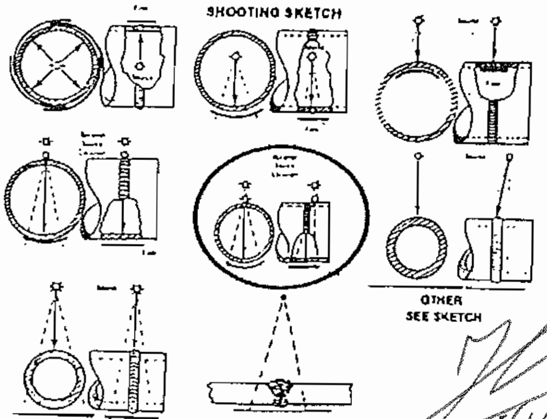
AWS CERTIFIED RADIOGRAPHIC INTERPRETER
1809007N
EXP. 9/01/2021
Jacob Mowat
CRI
SIGNED: J Mowat

DEFECT CODE

IP - Incomplete penetration	EI - Elongated Inclusion	RI - Rounded Inclusion
CV - Concavity Root	CX - Convexity Root	DT - Drop Through
IF - Incomplete fusion	UC - Undercut	BT - Burn through
C - Crack	OX - Oxidation	FA - Film Artifact

FILM USED:
1 FILMS 4.5 x 17 TYPE Agfa d5
FILMS x TYPE
FILMS x TYPE
Total hrs. Total Mileage Number of Welds

Brandon Latimer Radiographer II Level
Cinthia latimer Radiographer Ass't I Level
Film delivery Date



4/1/19

The recorded results are the opinion of the technician to the best of his knowledge based on the information provided to him by the customer at the time of the inspection.

Eaton Metal Products Company LLC
ENGINEERS DESIGNERS FABRICATORS
PETROLEUM EQUIPMENT
(303) 296-4800 FAX: (303) 296-5736

Weld Procedure Specifications

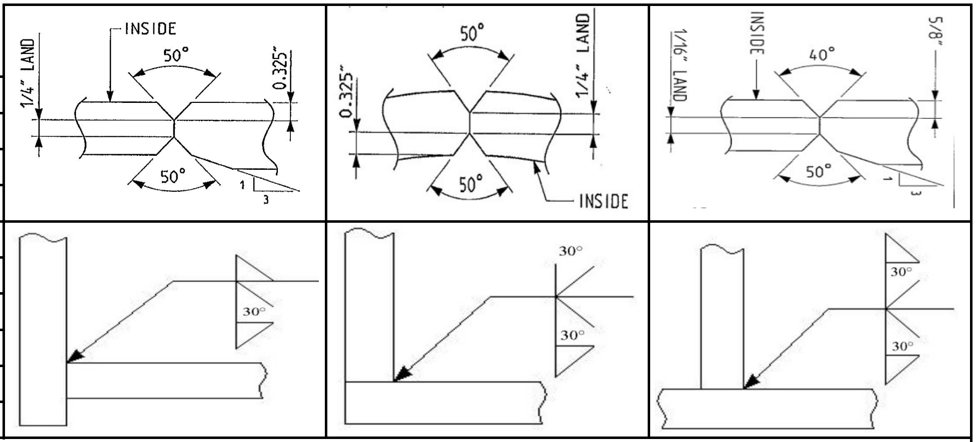
WELDING PROCEDURE SPECIFICATION (ASME IX)
EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P1-EM14K1-A **Revision** 0 **Date** 10/27/2014
Supporting PQR No P1G1-P1G2-EM14KT-A20U-1
Welding Process SAW **Type** Machine
Impact Qualified WPS No **to** N/A **at** N/A

JOINTS (QW-402)

Joint Design	All
Groove Type	Any
Root Spacing	0" - 3/8"
Fillet	All
Root Face	≥ 1/16"
Backing	Yes
Backing Type	Weld/Base/Temporary Metal
Groove Angle	See Typical Joint Details
Back gouge	Carbon Arc and/or Grind
Retainers	Prohibited
Notes That Apply	1 & 2

Typical



Note 1: Customer representative shall accept all weld joint designs specified on job specific drawings.

Note 2: Back gouge and/or grind to sound metal is required when this procedure is used for the first pass in a groove joint that requires cjp.

BASE METALS (QW-403)

Thickness Qualified 1"
Thickness Range: Groove 3/16" to 1-1/2" Fillet No Min to No Max
P-No 1 Group No N/A to P-No 1 Group No N/A
Maximum Pass Thickness < 1/2"

FILLER METALS (QW-404)

SFA #/Specification	5.17		
AWS Classification	EM14K		
F-No	6		
A-No	1		
Filler Metal Diameter	3/32" - 1/8"		
Filler Metal Product Form	Solid		
Filler Metal Trade Name	ESAB Spoolarc 71		
Thickness Range:			
Groove	No Min	to	1-1/2"
Fillet	No Min	to	No Max
Electrode-Flux Class	F7A2-EM14K		
Flux Trade Name	ESAB OK FLUX 10.71		
Flux Type	Neutral		
Alloy Flux	N/A		
Recrushed Slag	Prohibited		
Supplemental Filler	None		
Alloy Elements	N/A		

ELECTRICAL (QW-409)

Current and Polarity	DCEP
Heat Input (MAX)	N/A
Other	N/A

PREHEAT (QW-406)

Minimum Preheat Temp	100°F Base Metal 3/16" - 1"
Minimum Preheat Temp	200°F Base Metal > 1"
Maximum Interpass Temp	500°F
Preheat Maintenance	Prior During
Other	Maintain until welding is complete

POSITIONS (QW-405)

Position(s) of Groove	1G
Welding Progression	N/A
Position(s) of Fillet	1F, 2F
Other	N/A

WPS No P1-P1-EM14K1-A **Revision** 0 **Date** 10/27/2014

Supporting PQR No P1G1-P1G2-EM14KT-A20U-1

POST WELD HEAT TREATMENT (QW-407)

Temperature Range: None

Time at Temperature Range: None

TECHNIQUE (QW-410)

String or Weave Bead	N/A
Maximum Pass Width	7/8"
Initial Cleaning	Brushing and/or Chipping
Interpass Cleaning	Brushing/Chipping
Multiple or Single Pass (Per Side)	Single or Multiple
Multiple or Single Electrodes	Single
Contact Tube to Work Distance	3/4" - 1"
Electrode Spacing (2 Arcs)	N/A
Angle of Electrode (SAW)	10° Drag - 10° Push
Peening	Prohibited
Oscillation for Automatic/Machine Welding	None

ELECTRICAL (QW-409)

Non-Waveform Controlled Welding

Weld Pass(es)	Process	Filler Metal		Current and Polarity	Amps	Volts	Travel Speed (Ipm)	Heat Input (MAX)
		Class	Diameter					
Root/Hot	SAW	EM14K	3/32" - 1/8"	DCEP	350 - 450	25 - 29	16 - 24	N/A
Hot/Fill	SAW	EM14K	3/32" - 1/8"	DCEP	400 - 500	28 - 32	18 - 22	N/A
Cap	SAW	EM14K	3/32" - 1/8"	DCEP	400 - 450	30 - 32	18 - 20	N/A

Use amps, volts, and travel speed to calculate heat input. Amps x Volts x 60 ÷ Travel Speed = Heat Input

This Weld Procedure Specification was prepared and accepted by Dan Durtschi on 10/27/2014

Accepted By ____________________ Plant 1 Denver, CO

Accepted By ____________________ Plant 2 Salt Lake City, UT

Accepted By ____________________ Plant 3 Pocatello, ID

AWS
Daniel Durtschi
CWI 11030421
QC1 EXP. 3/1/2017

All units referenced on WPS are in English (Standard, e.g. psi, inches, etc.) unless specifically noted.

Uncontrolled copy if not signed by plant representative

PROCEDURE QUALIFICATIOIN RECORD (ASME IX)
EATON METAL PRODUCTS COMPANY LLC

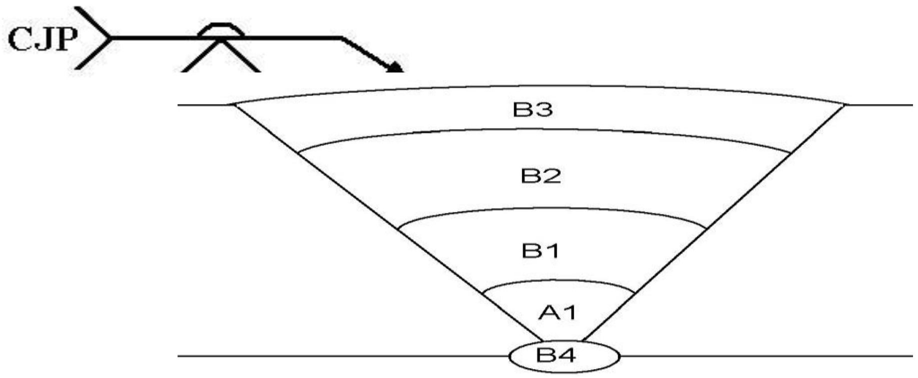
PQR No. P1G1-P1G2-EM14KT-A20U-1 **Date of Welding** 6/3/2014
Weld Process(es) (A) GMAWP (B) SAW **Type(s)** Semiautomatic/Machine

JOINT DETAILS (QW-402)

Joint Design	Butt Joint
Groove Type	Single V Groove
Root Spacing	0"
Root Face	1/8"
Backing	Yes
Backing Type	Base Metal/Weld Metal
Groove Angle	60°
Back gouged	No
Retainers	None

POSITION (QW-405)

Test Position	1G
Progression	N/A



BASE METALS (QW-403)

Material Spec (1) A-36 to (2) SA-516-70 P-No 1 Gr# 1 to P-No 1 Gr# 2
Type/Grade, or UNS Number N/A to N/A Heat Treated Condition Hot Rolled
Material Thickness (T) 1" Diameter of Test Coupon N/A

FILLER METALS (QW-404)

	(A)	(B)
SFA Specification	5.18	5.17
AWS Classification	ER70S-6	EM14k
F-No	6	6
A-No	1	1
Filler Metal Trade Name	Lincoln SuperArc L-59	ESAB SpoolArc 71
Filler Metal Product Form	Solid	Solid
Supplemental Filler Metal	None	None
Alloy Elements	N/A	N/A
Electrode Flux Class	N/A	F7A2-EM14K
Flux Trade Name	N/A	ESAB OK FLUX 10.71
Flux Type	N/A	Neutral
Alloy Flux	N/A	N/A
Recrushed Slag Used	N/A	No
Weld Metal Thickness (t)	1/4" Consumed by SAW	1"
Maximum Pass Thickness	1/4"	5/32"
ELECTRODE		
Electrode Spacing (2 Arcs)	N/A	3/4" Center to Center
Angle	N/A	Lead 0° Drag,Trail 12° Push
Contact Tube to Work	3/8"	1"

GAS (QW-408)

	Gases	Mixture (%)	Flow Rate (cfh)
Shielding	Ar/CO2	90/10	35
Trailing	None	None	None
Backing	None	None	None
Gas Cup Size	5/8"		

PREHEAT (QW-406)

Minimum Temperature	200
Preheat Maintenance	Prior/During

TECHNIQUE (QW-410)

Multipass or Single Pass (per side)	(A) Single, (B) Multiple
Single or Multiple Electrodes	(A) Single, (B) Multiple
Initial and Interpass Cleaning	Brushing/Grinding
Transfer Mode	(A) Pulsed-Spray, (B) N/A
Peening Performed	None
Maximum Pass Width	1"
Oscillation (Machine)	None

POST WELD HEAT TREATMENT (QW-407)

Temperature	None
Time	None

ELECTRICAL (QW-409)

			Diameter		Current and Polarity		Amps		Volts				
Pass(es)	Process	Class	Lead	Trail	Lead	Trail	Lead	Trail	Lead	Trail	Travel Speed (Ipm)	Heat Input (J/in)	Interpass Temp (°F)
A1	GMAWP	ER70S-6	.052"		DCEP		230		23.5		15	21,620	Preheat
B1	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	500	28	30	32	59,625	Preheat
B2	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	500	31	32	32	64,875	390°
B3	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	550	33	33	30	75,900	474°
B4	SAW	EM14K	1/8"	1/8"	DCEP	AC	800	450	35	35	30	87,500	422°

Heat input calculated using QW-409.1 (a), No instantaneous energy readout.

PQR No. P1G1-P1G2-EM14KT-A20U-1 **Date** 6/3/2014

TENSILE TESTS (QW-150)

Specimen No	Width (in)	Thickness (in)	Diameter (in)	Area (in)	Ultimate Total Load (lbs)	Ultimate Stress (psi)	Location of Failure
1	0.746"	0.695"	N/A	0.5185"	38,171	73,500	Base Metal
2	0.745"	0.692"	N/A	0.5155"	38,041	74,000	Base Metal

GUIDED-BEND TESTS (QW-160)

Type and Figure No	Result	Type and Figure No	Result
Transverse Side Bend (QW-462.2)	Pass	Transverse Side Bend (QW-462.2)	Pass
Transverse Side Bend (QW-462.2)	Pass	Transverse Side Bend (QW-462.2)	Pass

TOUGHNESS TESTS (QW-170)

Specimen No	Notch Location	Specimen Size (in)	Notch Size (in)	Test Temp (F)	Impact Values (Ft LBS)	Shear %	Mils	Drop Weight Break
1	Weld Metal	.394x.394	0.315	-20	104	N/A	N/A	N/A
2	Weld Metal	.394x.395	0.315	-20	91	N/A	N/A	N/A
3	Weld Metal	.394x.395	0.315	-20	124	N/A	N/A	N/A
4	HAZ A-36	.394x.394	0.315	-20	83	N/A	N/A	N/A
5	HAZ A-36	.394x.395	0.315	-20	105	N/A	N/A	N/A
6	HAZ A-36	.394x.395	0.315	-20	106	N/A	N/A	N/A
7	HAZ SA-516	.394x.395	0.315	-20	111	N/A	N/A	N/A
8	HAZ SA-516	.394x.395	0.315	-20	82	N/A	N/A	N/A
9	HAZ SA-516	.394x.395	0.315	-20	75	N/A	N/A	N/A

Impact testing performed to ASME VIII

HARDNESS TEST - ROCKWELL B

Base Metal				Heat Affected Zone			Weld Metal		
A-36	75 Rb	77 Rb	77 Rb	81 Rb	80 Rb	81 Rb	90 Rb	91 Rb	91 Rb
SA-516	88 Rb	77 Rb	77 Rb	93 Rb	91 Rb	90 Rb			

DEPOSITED CHEMICAL ANALYSIS

C	Si	Mn	P	S	Al	V	Cr	Ni	Fe	Ce
0.100	0.590	1.410	0.015	0.013	N/A	N/A	0.051	0.059	N/A	N/A

Chemical Analysis Conforms to A# 1

MATERIAL TRACABILITY

Item Description A-36 Heat Number A2K326 Manufacturer SSAB

Item Description SA-516-70 Heat Number B2G551 Manufacturer SSAB

WELDING INFORMATION

Welding machine used (A) Lincoln 455m/STT w/ 25m Feeder box (B) Power Wave AC/DC 1000 w/ Lincoln Power Feed 10A Controller

Welder Name Richard Carter ID Number 28117 Stamp RC

TESTING INFORMATION

Tests Conducted By MSI Testing Inc. Laboratory Test Number 14-154 Date of Testing 6/5/2014

Preparation and welding of test coupon was witnessed by Jacob Mowat

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME IX.

This Procedure Qualification Record was prepared and accepted by Jake Mowat on 6/9/2014

Accepted By ________________ Plant 1 Denver, CO

Accepted By ________________ Plant 2 Salt Lake City, UT

Accepted By ________________ Plant 3 Pocatello, ID

Jacob Mowat
CWI 13100541
QC1 EXP. 10/1/2016

All units referenced on PQR are in English (Standard, I.e. psi, inches, etc.) unless specifically noted.

Uncontrolled copy if not signed by plant representative

WELDING PROCEDURE SPECIFICATION (ASME IX)
EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P1-EM14K2-A **Revision** 0 **Date** 6/19/2014

Supporting PQR No P1G1-P1G2-EM14KT-A20U-1

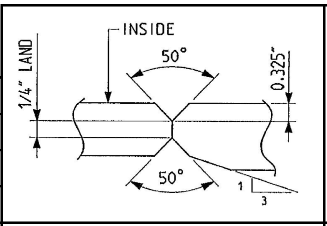
Welding Process SAW **Type** Machine

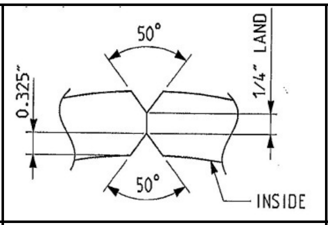
Impact Qualified WPS No **to** N/A **at** N/A

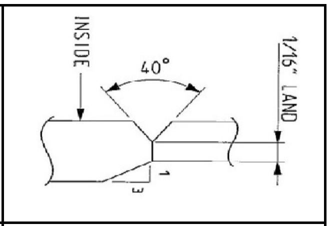
JOINTS (QW-402)

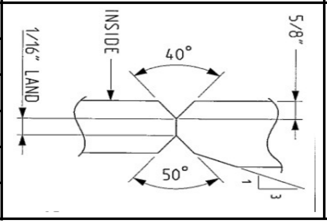
Joint Design	All
Groove Type	Any
Root Spacing	0" - 1/4"
Fillet	Any
Root Face	0" - 3/8"
Backing	Yes
Backing Type	Weld/Base Metal,Temporary
Groove Angle	See Typical Joint Details
Back gouge	Yes (Carbon Arc and/or Grind)
Retainers	Prohibited
Notes That Apply	1,2

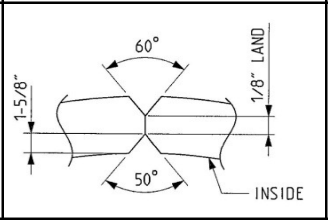
Typical











Note 1: Customer representative shall accept all weld joint designs specified on job specific drawings.

Note 2: Back gouge and/or grind to sound metal is required when this procedure is used for the first pass in a groove joint that requires cjp.

BASE METALS (QW-403)

Thickness Qualified 1"

Thickness Range: Groove 3/16" to 1 - 1/2" Fillet No Min. to No Max

P-No 1 Group No N/A to P-No 1 Group No N/A

Maximum Pass Thickness ≤ 1/2"

Heat Treated Condition N/A

FILLER METALS (QW-404)

SFA #/Specification	5.17		
AWS Classification	EM14K		
F-No	6		
A-No	1		
Filler Metal Diameter	3/32" - 5/32"		
Filler Metal Product Form	Solid		
Filler Metal Trade Name	ESAB Spool Arc 71		
Thickness Range:			
Groove	3/16"	to	1 - 1/2"
Fillet	No Min.	to	No Max
Electrode-Flux Class	F7A4-EM14K		
Flux Trade Name	ESAB OK 10.71		
Flux Type	Neutral		
Alloy Flux	N/A		
Recrushed Slag	Prohibited		
Supplemental Filler	None		
Alloy Elements	N/A		

ELECTRICAL (QW-409)

Current and Polarity	DCEP
Heat Input (MAX)	85,000 J/in.
Other	None

PREHEAT (QW-406)

Minimum Preheat Temp	100°F Base Metal 3/16" - 1"
Minimum Preheat Temp	200°F Base Metal > 1"
Maximum Interpass Temp	500°F
Preheat Maintenance	Maintian Until Welding is Complete
Other	None

POSITIONS (QW-405)

Position(s) of Groove	1G
Welding Progression	N/A
Position(s) of Fillet	1F, 2F
Other	None

WPS No P1-P1-EM14K2-A **Revision** 0 **Date** 6/19/2014

Supporting PQR No P1G1-P1G2-EM14KT-A20U-1

POST WELD HEAT TREATMENT (QW-407)

Temperature Range None

Time at Temperature Range None

Note: Vessels that will be exposed to environments that could cause stress corrosion cracking shall have a minimum hold temperature of 1150°F.

Note: For welds that may be exposed to enviroments that could cause stress corrosion cracking the minimum PWHT hold time shall be one hour per inch for thicknesses exceeding one inch

Note: A specific PWHT procedure shall be developed for each job.

TECHNIQUE (QW-410)

String or Weave Bead	N/A
Maximum Pass Width	1"
Initial Cleaning	Grinding
Interpass Cleaning	Chipping
Multiple or Single Pass (Per Side)	Single or Multiple pass(es) per side
Multiple or Single Electrodes	Single or Multiple Electrode(s)
Contact Tube to Work Distance	3/4" - 7/8"
Electrode Spacing (2 Arcs)	5-16" - 3/8" Center to Center
Angle of Electrode (SAW)	5° Drag
Peening	Prohibited
Oscillation for Automatic/Machine Welding	No

ELECTRICAL (QW-409)

Non-Waveform Controlled Welding

Weld Pass(es)	Process	Filler Metal		Current and Polarity	Amps	Volts	Travel Speed (Ipm)	Heat Input (MAX)
		Class	Diameter					
First Pass	SAW	EM14K	3/32"-5/32"	DCEP	450 - 600	28 - 30	26 - 32	85,000 J/in.
Fill Passes	SAW	EM14K	3/32"-5/32"	DCEP	600 - 700	28 - 33	20 - 30	85,000 J/in.
Cap Passes	SAW	EM14K	3/32"-5/32"	DCEP	550 - 600	33 - 35	24 - 30	85,000 J/in.

Use amps, volts, and travel speed to calculate heat input. Amps x Volts x 60 ÷ Travel Speed = Heat Input

This Weld Procedure Specification was prepared and accepted by Jake Mowat on 6/19/2014

Accepted By ____________________ Plant 1 Denver, CO

Accepted By ____________________ Plant 2 Salt Lake City, UT

Accepted By ____________________ Plant 3 Pocatello, ID

Jacob Mowat
CWI 13100541
QC1 EXP. 10/1/2016

All units referenced on WPS are in English (Standard, e.g. psi, inches, etc.) unless specifically noted.

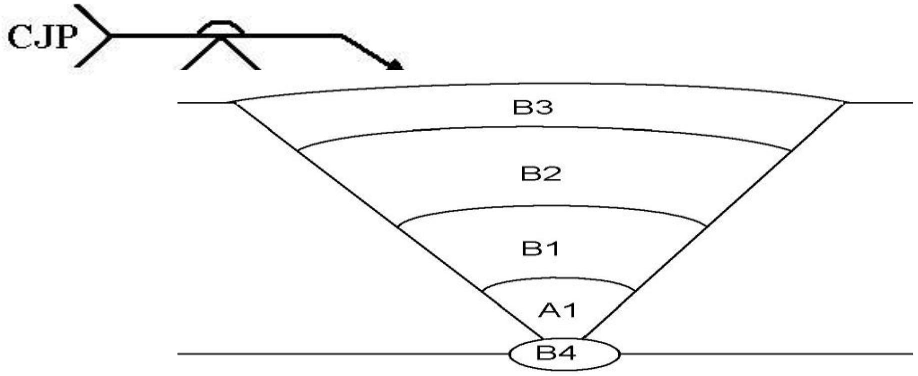
Uncontrolled copy if not signed by plant representative

PROCEDURE QUALIFICATIOIN RECORD (ASME IX)
EATON METAL PRODUCTS COMPANY LLC

PQR No. P1G1-P1G2-EM14KT-A20U-1 **Date of Welding** 6/3/2014
Weld Process(es) (A) GMAWP (B) SAW **Type(s)** Semiautomatic/Machine

JOINT DETAILS (QW-402)

Joint Design	Butt Joint
Groove Type	Single V Groove
Root Spacing	0"
Root Face	1/8"
Backing	Yes
Backing Type	Base Metal/Weld Metal
Groove Angle	60°
Back gouged	No
Retainers	None



POSITION (QW-405)

Test Position	1G
Progression	N/A

BASE METALS (QW-403)

Material Spec (1) A-36 to (2) SA-516-70 P-No 1 Gr# 1 to P-No 1 Gr# 2
Type/Grade, or UNS Number N/A to N/A Heat Treated Condition Hot Rolled
Material Thickness (T) 1" Diameter of Test Coupon N/A

FILLER METALS (QW-404)

	(A)	(B)
SFA Specification	5.18	5.17
AWS Classification	ER70S-6	EM14k
F-No	6	6
A-No	1	1
Filler Metal Trade Name	Lincoln SuperArc L-59	ESAB SpoolArc 71
Filler Metal Product Form	Solid	Solid
Supplemental Filler Metal	None	None
Alloy Elements	N/A	N/A
Electrode Flux Class	N/A	F7A4-EM14K
Flux Trade Name	N/A	ESAB OK FLUX 10.71
Flux Type	N/A	Neutral
Alloy Flux	N/A	N/A
Recrushed Slag Used	N/A	No
Weld Metal Thickness (t)	1/4" Consumed by SAW	1"
Maximum Pass Thickness	1/4"	5/32"
ELECTRODE		
Electrode Spacing (2 Arcs)	N/A	3/4" Center to Center
Angle	N/A	Lead 0° Drag,Trail 12° Push
Contact Tube to Work	3/8"	1"

GAS (QW-408)

	Gases	Mixture (%)	Flow Rate (cfh)
Shielding	Ar/CO2	90/10	35
Trailing	None	None	None
Backing	None	None	None
Gas Cup Size	5/8"		

PREHEAT (QW-406)

Minimum Temperature	200
Preheat Maintenance	Prior/During

TECHNIQUE (QW-410)

Multipass or Single Pass (per side)	(A) Single, (B) Multiple
Single or Multiple Electrodes	(A) Single, (B) Multiple
Initial and Interpass Cleaning	Brushing/Grinding
Transfer Mode	(A) Pulsed-Spray, (B) N/A
Peening Performed	None
Maximum Pass Width	1"
Oscillation (Machine)	None

POST WELD HEAT TREATMENT (QW-407)

Temperature	None
Time	None

ELECTRICAL (QW-409)

Pass(es)	Process	Class	Diameter		Current and Polarity		Amps		Volts		Travel Speed (Ipm)	Heat Input (J/in)	Interpass Temp (°F)
			Lead	Trail	Lead	Trail	Lead	Trail	Lead	Trail			
A1	GMAWP	ER70S-6	.052"		DCEP		230		23.5		15	21,620	Preheat
B1	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	500	28	30	32	119,625	Preheat
B2	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	500	31	32	32	129,937	390°
B3	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	550	33	33	30	151,800	474°
B4	SAW	EM14K	1/8"	1/8"	DCEP	AC	800	450	35	35	30	175,000	422°

Heat input calculated using QW-409.1 (a), No instantaneous energy readout.

PQR No. P1G1-P1G2-EM14KT-A20U-1 **Date** 6/3/2014

TENSILE TESTS (QW-150)

Specimen No	Width (in)	Thickness (in)	Diameter (in)	Area (in)	Ultimate Total Load (lbs)	Ultimate Stress (psi)	Location of Failure
1	0.746"	0.695"	N/A	0.5185"	38,171	73,500	Base Metal
2	0.745"	0.692"	N/A	0.5155"	38,041	74,000	Base Metal

GUIDED-BEND TESTS (QW-160)

Type and Figure No	Result	Type and Figure No	Result
Transverse Side Bend (QW-462.2)	Pass	Transverse Side Bend (QW-462.2)	Pass
Transverse Side Bend (QW-462.2)	Pass	Transverse Side Bend (QW-462.2)	Pass

TOUGHNESS TESTS (QW-170)

Specimen No	Notch Location	Specimen Size (in)	Notch Size (in)	Test Temp (F)	Impact Values (Ft LBS)	Shear %	Mils	Drop Weight Break
1	Weld Metal	.394x.394	0.315	-20	104	N/A	N/A	N/A
2	Weld Metal	.394x.395	0.315	-20	91	N/A	N/A	N/A
3	Weld Metal	.394x.395	0.315	-20	124	N/A	N/A	N/A
4	HAZ A-36	.394x.394	0.315	-20	83	N/A	N/A	N/A
5	HAZ A-36	.394x.395	0.315	-20	105	N/A	N/A	N/A
6	HAZ A-36	.394x.395	0.315	-20	106	N/A	N/A	N/A
7	HAZ SA-516	.394x.395	0.315	-20	111	N/A	N/A	N/A
8	HAZ SA-516	.394x.395	0.315	-20	82	N/A	N/A	N/A
9	HAZ SA-516	.394x.395	0.315	-20	75	N/A	N/A	N/A

Impact testing performed to ASME VIII

HARDNESS TEST - ROCKWELL B

Base Metal				Heat Affected Zone			Weld Metal		
A-36	75 Rb	77 Rb	77 Rb	81 Rb	80 Rb	81 Rb	90 Rb	91 Rb	91 Rb
SA-516	88 Rb	77 Rb	77 Rb	93 Rb	91 Rb	90 Rb			

DEPOSITED CHEMICAL ANALYSIS

C	Si	Mn	P	S	Al	V	Cr	Ni	Fe	Ce
0.100	0.590	1.410	0.015	0.013	N/A	N/A	0.051	0.059	N/A	N/A

Chemical Analysis Conforms to A# 1

MATERIAL TRACABILITY

Item Description A-36 Heat Number A2K326 Manufacturer SSAB
Item Description SA-516-70 Heat Number B2G551 Manufacturer SSAB

WELDING INFORMATION

Welding machine used (A) Lincoln 455m/STT w/ 25m Feeder box (B) Power Wave AC/DC 1000 w/ Lincoln Power Feed 10A Controller
Welder Name Richard Carter ID Number 28117 Stamp RC

TESTING INFORMATION

Tests Conducted By MSI Testing Inc. Laboratory Test Number 14-154 Date of Testing 6/5/2014
Preparation and welding of test coupon was witnessed by Jacob Mowat

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME IX.

This Procedure Qualification Record was prepared and accepted by Jake Mowat on 6/9/2014

Accepted By ______________________ Plant 1 Denver, CO

Accepted By ______________________ Plant 2 Salt Lake City, UT

Accepted By ______________________ Plant 3 Pocatello, ID

Jacob Mowat
CWI 13100541
QC1 EXP. 10/1/2016

All units referenced on PQR are in English (Standard, I.e. psi, inches, etc.) unless specifically noted.

Uncontrolled copy if not signed by plant representative

WELDING PROCEDURE SPECIFICATION (ASME IX)
EATON METAL PRODUCTS COMPANY LLC

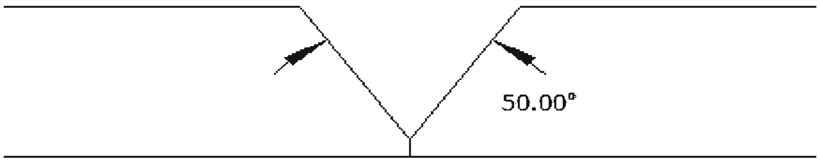
WPS No P1-P1-EM14KT-A **Revision** 2 **Date** 12/15/2014
Supporting PQR No P1G1-P1G2-EM14KT-A20U-1
Welding Process SAW **Type** Machine
Impact Qualified WPS No **to** N/A **at** N/A

JOINTS (QW-402)

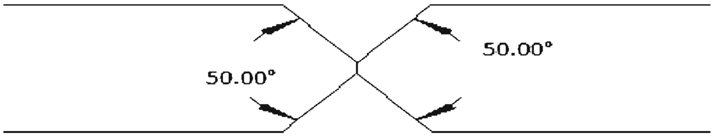
Joint Design	All
Groove Type	Any
Root Spacing	0" - 3/16"
Fillet	Any
Root Face	1/16" - 3/16"
Backing	Yes
Backing Type	Weld/Base Metal, Temporary
Groove Angle	50° - 60°
Back gouge	No or Yes (Carbon Arc and or Grind)
Retainers	Prohibited
Notes That Apply	1,2

Typical

Single V Groove Joint



Double V Groove Joint



Note 1: Customer representative shall accept all weld joint designs specified on job specific drawings.

Note 2: For joints that will not get back gouged a GMAW seal pass is required as shown on page 2.

Thickness Qualified 1"
Thickness Range: Groove 3/16" to 1-1/2" Fillet No Min. to No Max
P-No 1 Group No N/A to P-No 1 Group No N/A
Maximum Pass Thickness ≤ 1/2"

FILLER METALS (QW-404)

SFA #/Specification	5.17		
AWS Classification	EM14K		
F-No	6		
A-No	1		
Filler Metal Diameter	1/8"		
Filler Metal Product Form	Solid		
Filler Metal Trade Name	ESAB Spool Arc 71		
Thickness Range:			
Groove	No Min.	to	8"
Fillet	No Min.	to	No Max
Electrode-Flux Class	F7A2-EM14K		
Flux Trade Name	ESAB OK Flux 10.71		
Flux Type	Neutral		
Alloy Flux	N/A		
Recrushed Slag	Prohibited		
Supplemental Filler	None		
Alloy Elements	N/A		

ELECTRICAL (QW-409)

Current and Polarity	DCEP/AC
Heat Input (MAX)	95,000 J/In
Other	None

PREHEAT (QW-406)

Minimum Preheat Temp	100°F Base Metal 3/16" - 1"
Minimum Preheat Temp	200°F Base Metal > 1"
Maximum Interpass Temp	550°F
Preheat Maintenance	Maintain Until Welding is Complete
Other	None

POSITIONS (QW-405)

Position(s) of Groove	1G
Welding Progression	N/A
Position(s) of Fillet	1F, 2F
Other	None

POST WELD HEAT TREATMENT (QW-407)

Temperature Range	None
Time at Temperature Range	None

WPS No P1-P1-EM14KT-A **Revision** 2 **Date** 12/15/2014

Supporting PQR No P1G1-P1G2-EM14KT-A20U-1

TECHNIQUE (QW-410)

String or Weave Bead	String
Maximum Pass Width	1"
Initial Cleaning	Brushing and/or Grinding
Interpass Cleaning	Brushing/Chipping
Multiple or Single Electrodes	Single/Multiple (See electrical table)
Multiple or Single Pass Per Side	Single/Multiple (See weld diagrams)
Contact Tube to Work Distance	7/8" - 1"
Electrode Spacing (2 Arcs)	3/4" - 7/8"
Angle of Electrode (SAW)	Lead Arc 0° - Trail Arc 10° to 15° Push
Peening	Prohibited
Oscillation for Automatic/Machine Welding	No

ELECTRICAL (QW-409)

Non-Waveform Controlled Welding

For Single V Groove Joints

Weld Pass(es)	Process	Filler Metal		Current and Polarity		Amps		Volts		Travel Speed (Ipm)	Heat Input (MAX)
		Class	Diameter	Lead	Trail	Lead	Trail	Lead	Trail		
1st Pass	SAW	EM14K	1/8"	DCEP	AC	450 - 550	350 - 450	26 - 28	27 - 29	30 - 34	95,000 J/In
Fill Passes	SAW	EM14K	1/8"	DCEP	AC	650 - 750	500 - 600	28 - 32	30 - 32	30 - 34	95,000 J/In
Cap Passes	SAW	EM14K	1/8"	DCEP	AC	500 - 600	400 - 500	29 - 32	32 - 35	30 - 34	95,000 J/In
*Dig Pass	SAW	EM14K	1/8"	DCEP	N/A	700 - 725	N/A	34 - 35	N/A	29 - 30	95,000 J/In

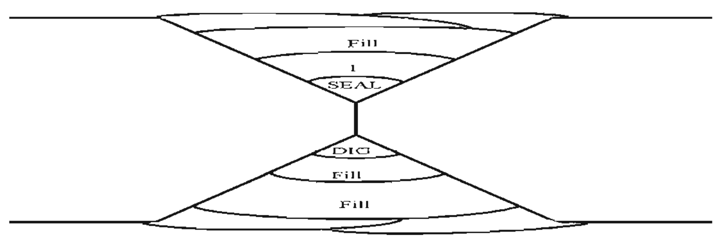
For Double V Groove Joints

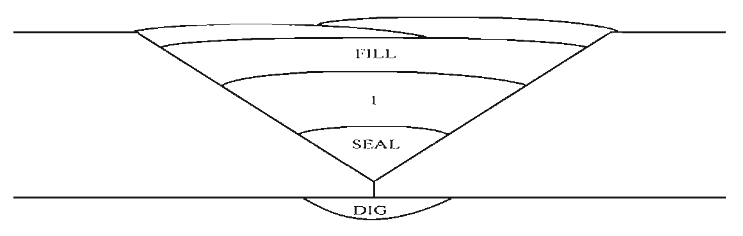
Weld Pass(es)	Process	Filler Metal		Current and Polarity		Amps		Volts		Travel Speed (Ipm)	Heat Input (MAX)
		Class	Diameter	Lead	Trail	Lead	Trail	Lead	Trail		
1st Pass	SAW	EM14K	1/8"	DCEP	AC	450 - 550	350 - 450	26 - 28	27 - 29	30 - 34	95,000 J/In
Fill Passes	SAW	EM14K	1/8"	DCEP	AC	675 - 800	550 - 650	28 - 32	30 - 32	30 - 34	95,000 J/In
Cap Passes	SAW	EM14K	1/8"	DCEP	AC	500 - 600	400 - 500	29 - 32	32 - 35	30 - 34	95,000 J/In
*Dig Pass	SAW	EM14K	1/8"	DCEP	AC	700 - 800	500 - 550	28 - 30	28 - 31	28 - 30	95,000 J/In

Use WPS P1-P1-GMAWP-A or P1-P1-GMAWP-STT-A for Seal Pass

*Dig Pass is the first SAW pass on opposite side of the seal pass, it shall consume the root face and seal pass

Use amps, volts, and travel speed to calculate heat input. Amps x Volts x 60 ÷ Travel Speed = Heat Input





This Weld Procedure Specification was prepared and accepted by Dan Durtschi on 12/15/2014

Accepted By ____________________ Plant 1 Denver, CO

Accepted By ____________________ Plant 2 Salt Lake City, UT

Accepted By ____________________ Plant 3 Pocatello, ID

AWS
Daniel Durtschi
CWI 11030421
QC1 EXP. 3/1/2017

All units referenced on WPS are in English (Standard, e.g. psi, inches, etc.) unless specifically noted.

Uncontrolled copy if not signed by plant representative

PROCEDURE QUALIFICATIOIN RECORD (ASME IX)
EATON METAL PRODUCTS COMPANY LLC

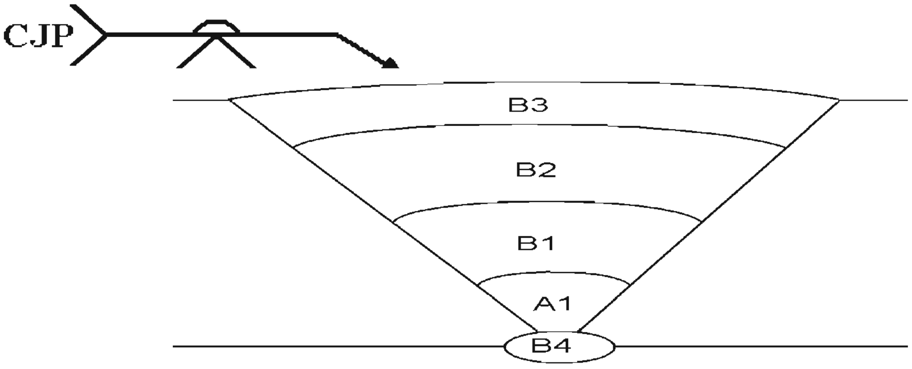
PQR No. P1G1-P1G2-EM14KT-A20U-1 **Date of Welding** 6/3/2014
Weld Process(es) (A) GMAWP (B) SAW **Type(s)** Semiautomatic/Machine

JOINT DETAILS (QW-402)

Joint Design	Butt Joint
Groove Type	Single V Groove
Root Spacing	0"
Root Face	1/8"
Backing	Yes
Backing Type	Base Metal/Weld Metal
Groove Angle	60°
Back gouged	No
Retainers	None

POSITION (QW-405)

Test Position	1G
Progression	N/A



BASE METALS (QW-403)

Material Spec (1) A-36 to (2) SA-516-70 P-No 1 Gr# 1 to P-No 1 Gr# 2
Type/Grade, or UNS Number N/A to N/A Heat Treated Condition Hot Rolled
Material Thickness (T) 1" Diameter of Test Coupon N/A

FILLER METALS (QW-404)

	(A)	(B)
SFA Specification	5.18	5.17
AWS Classification	ER70S-6	EM14k
F-No	6	6
A-No	1	1
Filler Metal Trade Name	Lincoln SuperArc L-59	ESAB SpoolArc 71
Filler Metal Product Form	Solid	Solid
Supplemental Filler Metal	None	None
Alloy Elements	N/A	N/A
Electrode Flux Class	N/A	F7A2-EM14K
Flux Trade Name	N/A	ESAB OK FLUX 10.71
Flux Type	N/A	Neutral
Alloy Flux	N/A	N/A
Recrushed Slag Used	N/A	No
Weld Metal Thickness (t)	1/4" Consumed by SAW	1"
Maximum Pass Thickness	1/4"	5/32"
ELECTRODE		
Electrode Spacing (2 Arcs)	N/A	3/4" Center to Center
Angle	N/A	Lead 0° Drag,Trail 12° Push
Contact Tube to Work	3/8"	1"

GAS (QW-408)

	Gases	Mixture (%)	Flow Rate (cfh)
Shielding	Ar/CO2	90/10	35
Trailing	None	None	None
Backing	None	None	None
Gas Cup Size	5/8"		

PREHEAT (QW-406)

Minimum Temperature	200
Preheat Maintenance	Prior/During

TECHNIQUE (QW-410)

Multipass or Single Pass (per side)	(A) Single, (B) Multiple
Single or Multiple Electrodes	(A) Single, (B) Multiple
Initial and Interpass Cleaning	Brushing/Grinding
Transfer Mode	(A) Pulsed-Spray, (B) N/A
Peening Performed	None
Maximum Pass Width	1"
Oscillation (Machine)	None

POST WELD HEAT TREATMENT (QW-407)

Temperature	None
Time	None

ELECTRICAL (QW-409)

Pass(es)	Process	Class	Diameter		Current and Polarity		Amps		Volts		Travel Speed (Ipm)	Heat Input (J/in)	Interpass Temp (°F)
			Lead	Trail	Lead	Trail	Lead	Trail	Lead	Trail			
A1	GMAWP	ER70S-6	.052"		DCEP		230		23.5		15	21,620	Preheat
B1	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	500	28	30	32	59,625	Preheat
B2	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	500	31	32	32	64,875	390°
B3	SAW	EM14K	1/8"	1/8"	DCEP	AC	600	550	33	33	30	75,900	474°
B4	SAW	EM14K	1/8"	1/8"	DCEP	AC	800	450	35	35	30	87,500	422°

Heat input calculated using QW-409.1 (a), No instantaneous energy readout.

PQR No. P1G1-P1G2-EM14KT-A20U-1 **Date** 6/3/2014

TENSILE TESTS (QW-150)

Specimen No	Width (in)	Thickness (in)	Diameter (in)	Area (in)	Ultimate Total Load (lbs)	Ultimate Stress (psi)	Location of Failure
1	0.746"	0.695"	N/A	0.5185"	38,171	73,500	Base Metal
2	0.745"	0.692"	N/A	0.5155"	38,041	74,000	Base Metal

GUIDED-BEND TESTS (QW-160)

Type and Figure No	Result	Type and Figure No	Result
Transverse Side Bend (QW-462.2)	Pass	Transverse Side Bend (QW-462.2)	Pass
Transverse Side Bend (QW-462.2)	Pass	Transverse Side Bend (QW-462.2)	Pass

TOUGHNESS TESTS (QW-170)

Specimen No	Notch Location	Specimen Size (in)	Notch Size (in)	Test Temp (F)	Impact Values (Ft LBS)	Shear %	Mils	Drop Weight Break
1	Weld Metal	.394x.394	0.315	-20	104	N/A	N/A	N/A
2	Weld Metal	.394x.395	0.315	-20	91	N/A	N/A	N/A
3	Weld Metal	.394x.395	0.315	-20	124	N/A	N/A	N/A
4	HAZ A-36	.394x.394	0.315	-20	83	N/A	N/A	N/A
5	HAZ A-36	.394x.395	0.315	-20	105	N/A	N/A	N/A
6	HAZ A-36	.394x.395	0.315	-20	106	N/A	N/A	N/A
7	HAZ SA-516	.394x.395	0.315	-20	111	N/A	N/A	N/A
8	HAZ SA-516	.394x.395	0.315	-20	82	N/A	N/A	N/A
9	HAZ SA-516	.394x.395	0.315	-20	75	N/A	N/A	N/A

Impact testing performed to ASME VIII

HARDNESS TEST - ROCKWELL B

Base Metal				Heat Affected Zone			Weld Metal		
A-36	75 Rb	77 Rb	77 Rb	81 Rb	80 Rb	81 Rb	90 Rb	91 Rb	91 Rb
SA-516	88 Rb	77 Rb	77 Rb	93 Rb	91 Rb	90 Rb			

DEPOSITED CHEMICAL ANALYSIS

C	Si	Mn	P	S	Al	V	Cr	Ni	Fe	Ce
0.100	0.590	1.410	0.015	0.013	N/A	N/A	0.051	0.059	N/A	N/A

Chemical Analysis Conforms to A# 1

MATERIAL TRACABILITY

Item Description A-36 Heat Number A2K326 Manufacturer SSAB
Item Description SA-516-70 Heat Number B2G551 Manufacturer SSAB

WELDING INFORMATION

Welding machine used (A) Lincoln 455m/STT w/ 25m Feeder box (B) Power Wave AC/DC 1000 w/ Lincoln Power Feed 10A Controller
Welder Name Richard Carter ID Number 28117 Stamp RC

TESTING INFORMATION

Tests Conducted By MSI Testing Inc. Laboratory Test Number 14-154 Date of Testing 6/5/2014
Preparation and welding of test coupon was witnessed by Jacob Mowat

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME IX.

This Procedure Qualification Record was prepared and accepted by Jake Mowat on 6/9/2014

Accepted By ____________________ Plant 1 Denver, CO
Accepted By ____________________ Plant 2 Salt Lake City, UT
Accepted By ____________________ Plant 3 Pocatello, ID

AWS
Jacob Mowat
CWI 13100541
QC1 EXP. 10/1/2016

All units referenced on PQR are in English (Standard, I.e. psi, inches, etc.) unless specifically noted.
Uncontrolled copy if not signed by plant representative

WELDING PROCEDURE SPECIFICATION (ASME)
EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P1-FCAW-AL Date 8/15/2014 Revision 3
Supporting PQR No(s) P1G1-P1G2-FCAW-A20L

BASE METAL (QW-403)
P # 1 Gr # - to P # 1 Gr # -
Thickness Range 0.1875 to 1.5
Backing YES
Backing Material BASE/WELD/TEMPORARY MATERIAL

JOINT (QW-402, QW-405)
Joint Type ANY/ALL Fillet ANY/ALL
Groove Type Any Fillet Weld Size ANY
Root Spacing 0" - 3/8" Groove Angle See Appendix
Position All Progression UPHILL

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range -
Time Range -
See appendix for service considerations

PREHEAT (F) (QW-406)
Minimum Temperature 50<1.25" - 200>1.25"
Maximum Interpass Temperature 400
Preheat Maintenance Maintain until welding is complete

PROCESS / TYPE	**FCAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	E71T-1	-
SFA# / AWS Specification	5.20	-
F #	6	-
A # or Chemical Composition	1	-
Filler Metal Trade Name	Lincoln Outershield 71 Elite	-
Filler Metal Diameter	0.045 / 1/16"	-
Maximum Weld Metal Thickness	1.5	-
SHIELDING (QW-408)		
Shielding Gas / CFH	100% CO2 - 30-50 CFH	-
Gas Cup Size	1/2 - 3/4	-
Trailing Gas / CFH	None	-
Backing Gas / CFH	None	-
ELECTRICAL (QW-410)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER - Each bead ≤ 5/8" wide	-
Passes per side	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	
Contact Tube to Work Distance	1/2" - 1"	
Peening	NONE	
Initial Cleaning	Grinding/Brushing	-
Interpass Cleaning	Chipping/Grinding	-

Daniel Durtschi
CWI 11030421
QC1 EXP. 3/1/2017

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY/ALL	FCAW	E71T-1	0.045	DCEP	200-250	22-26	4-8	-
ANY/ALL	FCAW	E71T-1	1/16	DCEP	200-250	22-26	4-8	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = - J/In

By

Accepted By PLANT 1 DEN

Accepted By PLANT 2 SLC

Accepted By PLANT 3 POC

Interpass cleaning not considered peening
Refer to Appendix WPS for all other variables.
Non Wave From Controlled Welding.
This WPS is only used for material which does not require notch-toughness testing.
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APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 4/28/2014 Revision: 9

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supersedes this document if a conflict exists.

QW-402

1 Customer Representative shall accept all weld joint designs on job specific drawings.
2 Retainers prohibited.
3 Root spacing shall be sufficient to allow for complete joint penetration.
4 Bevel angle for groove welds that can only be accessed from one side (i.e. no backgouge/grind) shall be 30° or greater.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-407 PWHT When Required

1 For vessels that are exposed to environments that could cause stress corrosion cracking; a minimum hold time of 1 hour at a minimum temperature of 1150°F shall be applied.
2 For welds that may be exposed to environments that could cause stress corrosion cracking the minimum PWHT hold time shall be one hour per inch for thicknesses exceeding one inch

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

UG-84

For weld procedures used when impact tests are required, production material must:
  a Be of the same P-Number and Group Number with the exception allowed by QW-403.5(c)
  b Be in the same heat treated condition
  c Meet the minimum notch toughness requirements

The brand specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)
A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ________________ PLANT 1 DENVER, CO

ACCEPTED BY ________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ________________ PLANT 3 POCATELLO, ID

Uncontrolled copy if actual signature not signed by plant representative.

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P1G1-P1G2-FCAW-A20L Date 11/11/2009 Revision 1

BASE METAL (QW-403)

Material Form PLATE Thickness* 0.75

Material Spec SA-36 P # 1 Gr # 1

Material Spec SA-516-70N P # 1 Gr # 2

* Weld thickness = to plate thickness

PREHEAT (F) (QW-406)

Minimum Temperature 50

Maximum Interpass Temperature 300

Preheat Maintenance PRIOR / DURING

JOINT (QW-402, QW-405)

Type DOUBLE BEVEL Groove Angle 40

Root Opening 0 Root Face 1/8

Backgouge YES Back Welded YES

Test Position 3G Vertical Progression UPHILL

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range -

Time Range -

PROCESS / TYPE	**FCAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	E71T-1	-
SFA# / AWS Specification	5.20	-
F #	6	-
A # or Chemical Composition	1	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	0.045	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100% CO2, 35CFH	-
Gas Cup Size	5/8"	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-409)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	1/2" - 1"	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ALL	FCAW	E71T-1	0.045	DCEP	210	24	6	50,400	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = 50,400 J/in $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)
EATON METAL PRODUCTS COMPANY LLC

PQR No P1G1-P1G2-FCAW-A20L Date 11/11/2009 Revision 1

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICK (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	LOCATION OF FAILURE
A	0.754	0.73	0.550	38,160	69,382	BASE METAL SA-36
B	0.746	0.721	0.538	37,040	68,848	BASE METAL SA-36
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
(4) QW-462.2 SIDE BEND	PASS	-	-
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
1	WELD	V-NOTCH	-20	63	40	0.051	NO
2	WELD	V-NOTCH	-20	65	40	0.055	NO
3	WELD	V-NOTCH	-20	89	60	0.071	NO
4	SA-36 HAZ	V-NOTCH	-20	16	20	0.014	NO
5	SA-36 HAZ	V-NOTCH	-20	29	20	0.03	NO
6	SA-36 HAZ	V-NOTCH	-20	22	20	0.026	NO
7	SA-516-70	V-NOTCH	-20	18	20	0.017	NO
8	SA-516-70	V-NOTCH	-20	22	20	0.023	NO
9	SA-516-70	V-NOTCH	-20	18	20	0.018	NO
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Brinell BHN

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
SA-36	130	127	-	172	159	-	190	165	-
SA-516-70	162	162	-	200	180	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4:
N5: Original PQR "CS-129-DS, 5-5-95"

Welder Name: V. NGUYEN Stamp: W ID Number: 218
Tests Conducted By: CMS, EMP Laboratory Test Number: C-45-259
PQR was done and welding of coupon was witnessed by: EATON METAL PRODUCTS COMPANY

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

BY

AWS
Daniel Durtschi
CWI 11030421
QC1 EXP. 3/1/2014

ACCEPTED BY PLANT 1 DENVER, CO

ACCEPTED BY PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ____________________ PLANT 1 DENVER, CO

ACCEPTED BY ____________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ____________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

WELDING PROCEDURE SPECIFICATION (ASME)

EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P1-GMAWP-AL Date 11/17/2011 Revision 5
Supporting PQR No(s) P1G1-P1G2-GMAWP-L59-A50L, P1G1-P1G2-GMAWP-L59-A50U

BASE METAL (QW-403)
P # 1 Gr # - to P # 1 Gr # -
Thickness Range 3/16 to 1 1/2
Backing YES Backing Material WELD / BASE METAL

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range None
Time Range None

JOINT (QW-402, QW-405)
Groove ALL Fillet ANY / ALL
Postion ANY Fillet Weld Size ALL
Progression UPHILL

PREHEAT (F) (QW-406)
Minimum Temperature 50<1.25" - 200>1.25"
Maximum Interpass Temperature 450
Preheat Maintenance PRIOR / DURING

PROCESS / TYPE	**GMAW-P**	-
FILLER METAL (QW-404)		
AWS Classification	ER70S-6	-
SFA# / AWS Specification	ASME SFA-5.18	-
F #	6	-
A # or Chemical Composition	1	-
Filler Metal Trade Name	LINCOLN SUPERARC L-59	-
Filler Metal Diameter	0.045" / 0.052"	-
Maximum Weld Metal Thickness	1.5"	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	90% Ar 10%CO2 / 35min	-
Gas Cup Size	1/2" - 3/4"	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-410)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	PULSED SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER - Each bead ≤ 5/8" wide	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	1/2 - 3/4"	-
Peening	NONE	
Interpass Cleaning	MANUAL / MECHANICAL	

AWS
Daniel Durtschi
CWI 11030421
QC1 EXP 3/1/2014

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY	GMAW-P	ER70S-6	0.045"	DCEP	Any	Any	Any	-
ANY	GMAW-P	ER70S-6	0.052"	DCEP	Any	Any	Any	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = ____ **J/in**

By

Accepted By PLANT 1 DEN

Accepted By PLANT 2 SLC

Accepted By PLANT 3 POC

Interpass cleaning not considered peening.
Refer to Appendix WPS for all other variables.
This WPS is only used for material that does not require notch-toughness testing
Lincoln Invertec V350 PRO, Pulsed MIG Steel 0.045, 237 SPD, 180 WFS -3.0 arc control
Uncontroled copy if actual signature not signed by plant representative.

APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 11/10/2011 Revision: 5

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers prohibited.
3 Root spacing shall be sufficient to allow for complete joint penetration.
4 Bevel angle for groove welds shall be 30° or greater.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-407 PWHT When Required

1 For vessels that are exposed to enviornments that could cause stress corrosion cracking; a minimum hold time of 1 hour at a minimum temperature of 1150°F shall be applied.

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

UG-84

For weld procedures used when impact tests are requried, production material must:

a Be of the same P-Number and Group Number with the exception allowed by QW-403.5(c)
b Be in the same heat treated condition
c Meet the minimum notch toughness requirements

The brand specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)

A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO

ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

PROCEDURE QUALIFICATION RECORD (ASME)
EATON METAL PRODUCTS COMPANY LLC

PQR No P1G1-P1G2-GMAWP-L59-A50L Date 4/12/2011 Revision 0

BASE METAL (QW-403)

Material Form PLATE Thickness* 3/8

Material Spec SA-516-70 P # 1 Gr # 2

Material Spec SA-36 P # 1 Gr # 1

*Weld thickness = to plate thickness

PREHEAT (F) (QW-406)

Minimum Temperature 50° F

Maximum Interpass Temperature 450° F

Preheat Maintenance NONE

JOINT (QW-402, QW-405)

Type SINGLE V Groove Angle 50

Root Opening 0 Root Face 1/16

Backgouge YES Back Welded YES

Test Position 3G Vertical Progression UPHILL

80° INCLINATION ANGLE

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range None

Time Range None

PROCESS / TYPE	**GMAW-P**	-
FILLER METAL (QW-404)		
AWS Classification	ER70S-6	-
SFA# / AWS Specification	ASME SFA-5.18	-
F #	6	-
A # or Chemical Composition	1	-
Filler Metal Trade Name	LINCOLN SUPERARC L-59	-
Filler Metal Diameter	0.045"	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	90% Ar 10%CO2 / 35min	-
Gas Cup Size	5/8"	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-409)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	PULSED SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	1/2-3/4	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ROOT	GMAWP	ER70S-6	.045	DCEP	150	18.5	8	20,813	-
FILL/COVER	GMAWP	ER70S-6	.045	DCEP	170	20.5	6.5	32,169	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = 32,169 J/in $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)
EATON METAL PRODUCTS COMPANY LLC

PQR No P1G1-P1G2-GMAWP-L59-A50L Date 4/12/2011 Revision 0

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICK (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	FAILURE LOCATION
1	0.753	0.352	0.2651	18,988	71,638	BASE METAL SA36
2	0.751	0.342	0.2568	18,961	73,824	BASE METAL SA36
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
(4) SIDE BEND, QW-462.2	ALL PASS	-	-
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
WELD 1	WELD	V-NOTCH	-55°	35	-	-	-
WELD 2	WELD	V-NOTCH	-55°	30	-	-	-
WELD 3	WELD	V-NOTCH	-55°	45	-	-	-
HAZ 36-1	HAZ	V-NOTCH	-55°	50	-	-	-
HAZ 36-2	HAZ	V-NOTCH	-55°	58	-	-	-
HAZ 36-3	HAZ	V-NOTCH	-55°	44	-	-	-
HAZ 516-1	HAZ	V-NOTCH	-55°	120	-	-	-
HAZ 516-2	HAZ	V-NOTCH	-55°	106	-	-	-
HAZ 516-3	HAZ	V-NOTCH	-55°	110	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Rockwell Hardness, B Scale

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
SA516-70	80.5	82.0	82.9	90.0	88.0	87.0	86.0	87.5	86.0
SA36	80.0	80.0	79.5	83.0	81.0	80.0	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4: Lincoln Invertec V350Pro: Pulsed MIG Steel 0.045, SPD=237, WFS=180
N5: Test Plate:SA516-70, Nucor Heat# 9106648; SA36, SSAB Heat# A0J024

Welder Name: Daniel Durtschi Stamp: DD ID Number: 1240
Tests Conducted By: MSI Testing, Inc. Laboratory Test Number: 11-089 #1
PQR was done and welding of coupon was witnessed by: Eaton Metal Products Company LLC

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

BY

Daniel Durtschi
CWI 11030421
QC1 EXP. 3/1/2014

ACCEPTED BY PLANT 1 DENVER, CO

ACCEPTED BY PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402
1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403
1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404
1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410
1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO

ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P1G1-P1G2-GMAWP-L59-A50U Date 4/12/2011 Revision 0

BASE METAL (QW-403)

Material Form PLATE Thickness* 3/4

Material Spec SA-516-70 P # 1 Gr # 2

Material Spec SA-36 P # 1 Gr # 1

*Weld thickness = to plate thickness

PREHEAT (F) (QW-406)

Minimum Temperature 50° F

Maximum Interpass Temperature 450° F

Preheat Maintenance NONE

JOINT (QW-402, QW-405)

Type SINGLE V Groove Angle 50

Root Opening 0 Root Face 1/16

Backgouge YES Back Welded YES

Test Position 3G Vertical Progression UPHILL

60° INCLINATION ANGLE

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range None

Time Range None

PROCESS / TYPE	**GMAW-P**	-
FILLER METAL (QW-404)		
AWS Classification	ER70S-6	-
SFA# / AWS Specification	ASME SFA-5.18	-
F #	6	-
A # or Chemical Composition	1	-
Filler Metal Trade Name	LINCOLN SUPERARC L-59	-
Filler Metal Diameter	0.045"	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	90% Ar 10%CO2 / 35min	-
Gas Cup Size	5/8	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-409)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	PULSED SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	1/2-3/4	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ROOT	GMAWP	ER70S-6	.045	DCEP	150	18.5	8	20,813	-
FILL	GMAWP	ER70S-6	.045	DCEP	170	20.5	6.5	32,169	-
COVER-	GMAWP	ER70S-6	.045	DCEP	150	18.5	8	20,813	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = 32,169 J/in $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)
EATON METAL PRODUCTS COMPANY LLC

PQR No P1G1-P1G2-GMAWP-L59-A50U Date 4/12/2011 Revision 0

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICK (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	FAILURE LOCATION
1	0.75	0.716	0.5370	40,496	75,412	BASE METAL SA36
2	0.752	0.72	0.5414	40,534	74,863	BASE METAL SA36
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
(4) SIDE BEND, QW-462.2	ALL PASS	-	-
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
WELD 1	WELD	V-NOTCH	-50°	94	-	-	-
WELD 2	WELD	V-NOTCH	-50°	82	-	-	-
WELD 3	WELD	V-NOTCH	-50°	90	-	-	-
HAZ 36-1	HAZ	V-NOTCH	-50°	20	-	-	-
HAZ 36-2	HAZ	V-NOTCH	-50°	60	-	-	-
HAZ 36-3	HAZ	V-NOTCH	-50°	98	-	-	-
HAZ 516-1	HAZ	V-NOTCH	-50°	180	-	-	-
HAZ 516-2	HAZ	V-NOTCH	-50°	146	-	-	-
HAZ 516-3	HAZ	V-NOTCH	-50°	140	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Rockwell Hardness, B Scale

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
SA516-70	82.0	82.0	80.5	90.0	89.0	91.0	91.0	92.0	94.5
SA36	80.5	80.5	81.0	94.5	94.0	95.0	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4: Lincoln Invertec V350Pro: Pulsed MIG Steel 0.045, SPD=237, WFS=180
N5: Test Plate:SA516-70, Ipsco Heat# B7L791 SA36, EVRAZ Heat# NT7695

Welder Name: Daniel Durtschi Stamp: DD ID Number: 1240
Tests Conducted By: MSI Testing, Inc. Laboratory Test Number: 11-089 #2
PQR was done and welding of coupon was witnessed by: Eaton Metal Products Company LLC

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

BY

AWS
Daniel Durtschi
CWI 11030421
QC1 EXP. 3/1/2014

ACCEPTED BY PLANT 1 DENVER, CO

ACCEPTED BY PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO

ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

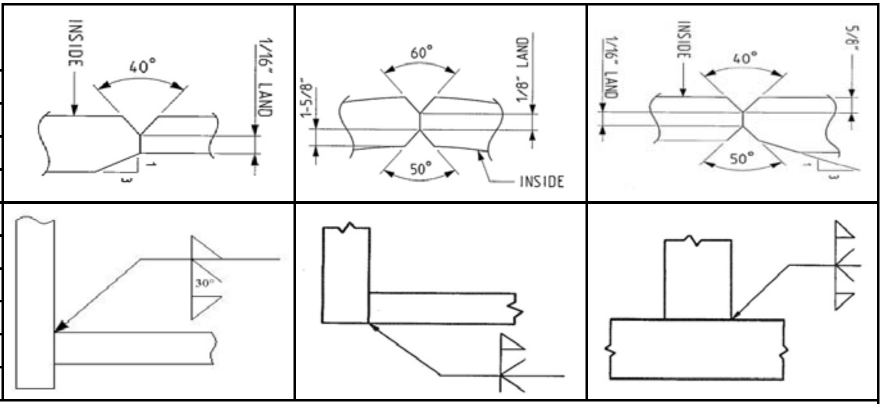
WELDING PROCEDURE SPECIFICATION (ASME IX)

EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P1-GMAWP-STT-A **Revision** 1 **Date** 5/17/2017
Supporting PQR No P1G1-P1G2-GMAWP-STT-A50U-1
Welding Process GMAW **Type** Semi-Automatic
Impact Qualified WPS No **to** N/A **at** N/A

JOINTS (QW-402)

Typical



Joint Design	All
Groove Type	Any
Root Spacing	0 - 3/8"
Fillet	Any
Root Face	0 - 1/8"
Backing	None
Backing Type	N/A
Groove Angle	See Typical Joint Details
Back gouge	When Applicable (Carbon Arc/Grind)
Retainers	None
Notes That Apply	1,2,3

Note 1: Customer representative shall accept all weld joint designs specified on job specific drawings.

Note 2: Root spacing for grooves that will only be welded from one side shall be sufficient to allow for cjp.

Note 3: Bevel angle for grooves that will only be welded from one side shall be 30° or greater.

BASE METALS (QW-403)

Thickness Qualified 3/4"
Thickness Range: Groove 3/16" to 1 - 1/2" Fillet No Min. to No Max
P-No 1 Group No N/A to P-No 1 Group No N/A
Maximum Pass Thickness 3/16"
Heat Treated Condition N/A

FILLER METALS (QW-404)

Process	(A) GMAW STT Short Arc		(B) GMAW Pulse-Spray	
AWS Classification	ER70S-6		ER70S-6	
SFA #/Specification	5.18		5.18	
F-No	6		6	
A-No	1		1	
Filler Metal Diameter	.045" - .052"		.045" - .052"	
Filler Metal Product Form	Solid		Solid	
Thickness Range:				
Groove	No Min. to	3/16"	No Min. to	1 - 1/2"
Fillet	N/A to	N/A	No Min.	No Max
Supplemental Filler	Prohibited		Prohibited	
Alloy Elements	N/A		N/A	
Consumable Inserts	Prohibited		Prohibited	

GAS (QW-408)

Process (A) GMAW STT Short Arc

	Gases	Mixture	Flow Rate
Shielding	Ar/C02	90-10	35
Trailing	N/A	N/A	N/A
Backing	N/A	N/A	N/A

Gas Cup Size 3/8" - 5/8" Backing Gas N/A

Process (B) GMAW Pulse-Spray

	Gases	Mixture	Flow Rate
Shielding	Ar/C02	90-10	35
Trailing	N/A	N/A	N/A
Backing	N/A	N/A	N/A

Gas Cup Size 3/8" - 5/8" Backing Gas N/A

PREHEAT (QW-406)

Minimum Preheat Temp	150°F
Maximum Interpass Temp	450°F
Preheat Maintenance	Maintain until welding is complete
Other	

POSITIONS (QW-405)

Position(s) of Groove	All
Welding Progression	(A) Root pass Downhill (B) Fill and Cap Uphill
Position(s) of Fillet	All
Other	

WPS No P1-P1-GMAWP-STT-A **Revision** 1 **Date** 5/17/2017
Supporting PQR No P1G1-P1G2-GMAWP-STT-A50U-1

POST WELD HEAT TREATMENT (QW-407)

Temperature Range None

Time at Temperature Range N/A

TECHNIQUE (QW-410)	**(A) GMAW STT Short Arc**	**(B) GMAW Pulse-Spray**
String or Weave Bead	String	String or Weave
Maximum Pass Width	5/16"	9/16"
Initial Cleaning	Brushing and/or Grinding	Brushing and/or Grinding
Interpass Cleaning	Brushing/Chipping	Brushing/Chipping
Multiple or Single Pass (Per Side)	Single	Multiple
Multiple or Single Electrodes	Single	Single
Contact Tube to Work Distance	1/4" - 1/2"	3/8" - 5/8"
Electrode Spacing (2 Arcs)	N/A	N/A
Angle of Electrode (SAW)	N/A	N/A
Peening	Prohibited	Prohibited

ELECTRICAL (QW-409) **Waveform Controlled Welding**

FLAT

Weld Pass(es)	**Process and Transfer Mode**	**Filler Metal**		**Current Type and**	**Amps**	**Volts**	**Travel Speed**	**Input (MAX)**
		Class	**Diameter**					
Root	GMAW Pulse-Short	ER70S-6	.045" - .052"	DCEP	120 - 160	12.5 - 14	9 - 14	15,083 J/In
Fill	GMAW Pulse-Spray	ER70S-6	.045" - .052"	DCEP	160 - 220	20 - 22	9 - 18	46,682 J/In
Cap	GMAW Pulse-Spray	ER70S-6	.045" - .052"	DCEP	160 - 200	21 - 22	8 - 18	46,682 J/In

OUT OF POSITION

Weld Pass(es)	**Process and Transfer Mode**	**Filler Metal**		**Current Type and**	**Amps**	**Volts**	**Travel Speed**	**Input (MAX)**
		Class	**Diameter**					
Root	GMAW Pulse-Short	ER70S-6	.045" - .052"	DCEP	120 - 160	12.5 - 14	9 - 14	15,083 J/In
Fill	GMAW Pulse-Spray	ER70S-6	.045" - .052"	DCEP	130 - 160	18 - 21.5	6 - 10	46,682 J/In
Cap	GMAW Pulse-Spray	ER70S-6	.045" - .052"	DCEP	120 - 150	18 - 21.5	5 - 12	46,682 J/In

Welding machine Lincoln V350 Pro and DC-600 use amps, volts, and travel speed to calculate heat input. Amps x Volts x 60 ÷ Travel Speed = Heat Input

Welding machines Lincoln 355 and 455 use instantaneous energy readout to calculate heat input. Total Joules ÷ Bead Length = Energy

This Weld Procedure Specification was prepared and accepted by on 5/17/17

Accepted By Plant 1 Denver, CO

Accepted By Plant 2 Salt Lake City, UT

Accepted By Plant 3 Pocatello, ID

All units referenced on WPS are in English (Standard, e.g. psi, inches, etc.) unless specifically noted.

Uncontrolled copy if not signed by plant representative

PROCEDURE QUALIFICATIOIN RECORD (ASME IX)
EATON METAL PRODUCTS COMPANY LLC

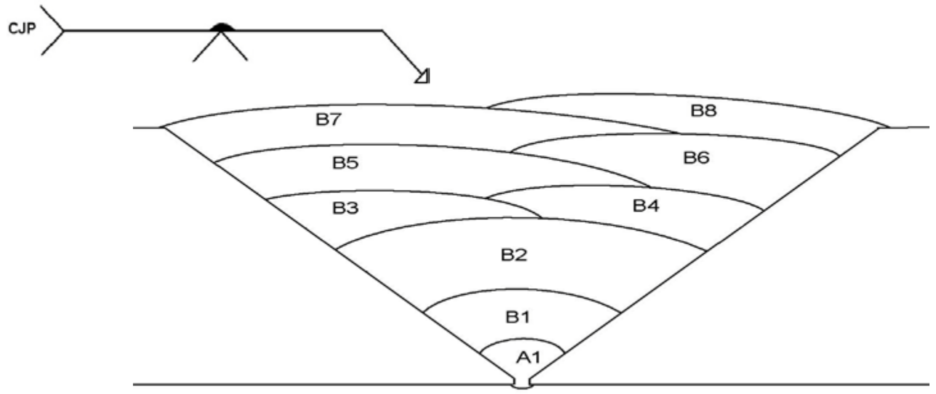
PQR No. P1G1-P1G2-GMAWP-STT-A50U-1 **Date of Welding** 5/12/2014
Weld Process(es) GMAW - GMAWP **Type(s)** Semi-Automatic

JOINT DETAILS (QW-402)

Joint Design	Butt Joint
Groove Type	Single V Groove
Root Spacing	3/32"
Root Face	1/32"
Backing	None
Backing Type	N/A
Groove Angle	70°
Back gouged	No
Retainers	None

POSITION (QW-405)

Test Position	3G
Progression	Root:Downhill Fill/Cap:Uhill



BASE METALS (QW-403)

Material Spec (1) A36 to (2) SA-516-70 P-No 1 Gr# 1 to P-No 1 Gr# 2
Type/Grade, or UNS Number N/A to N/A Heat Treated Condition Hot Rolled
Material Thickness (T) 3/4" Diameter of Test Coupon N/A

FILLER METALS (QW-404)	**(A)**	**(B)**
SFA Specification	5.18	5.18
AWS Classification	ER70S-6	ER70S-6
F-No	6	6
A-No	1	1
Filler Metal Trade Name	Lincoln Super Arc L-59	Lincoln Super Arc L-59
Filler Metal Product Form	Solid	Solid
Supplemental Filler Metal	None	None
Electrode Flux Class	N/A	N/A
Flux Trade Name	N/A	N/A
Flux Type	N/A	N/A
Recrushed Slag Used	N/A	N/A
Weld Metal Thickness (t)	3/16"	9/16"
Maximum Pass Thickness	3/16"	3/16"
ELECTRODE		
Tungsten Type/Size	N/A	N/A
Consumable Insert Used	N/A	N/A
Electrode Spacing (2 Arcs)	N/A	N/A
Angle	5° Drag	5° Push
Contact Tube to Work	3/8"	3/8"

GAS (QW-408)

	Gases	**Mixture (%)**	**Flow Rate (cfh)**
Shielding	Ar/CO2	90-10	35
Trailing	N/A	N/A	N/A
Backing	N/A	N/A	N/A
Gas Cup Size	1/2"		

PREHEAT (QW-406)

Minimum Temperature	150° F
Preheat Maintenance	Prior During

TECHNIQUE (QW-410)

Multipass or Single Pass (per side)	Multiple
Single or Multiple Electrodes	Single
Initial and Interpass Cleaning	Brushing/Grinding
Peening Performed	No
Maximum Pass Width	9/16"
Oscillation (Machine)	N/A
In Chamber Welding (GTAW)	N/A

POST WELD HEAT TREATMENT (QW-407)

Temperature	None
Time	N/A
Other	N/A

ELECTRICAL (QW-409)

Pass(es)	Process	Transfer Mode	Class	Diameter	Current & Polarity	Amps	Volts	Travel Speed (ipm)	Heat Input (J/in)	String or Weave	Interpass Temp (°F)
A1	GMAW	Pulse-Short	ER70S-6	.052"	DCEP	162	13.5	8.7	15,083	String	Preheat
B1	GMAW	Pulse-Spray	ER70S-6	.052"	DCEP	140	21.2	5.9	30,183	Weave	180°
B2	GMAW	Pulse-Spray	ER70S-6	.052"	DCEP	145	22	4.1	46,682	Weave	225°
B3	GMAW	Pulse-Spray	ER70S-6	.052"	DCEP	163	21.5	5.9	29,735	Weave	250°
B4	GMAW	Pulse-Spray	ER70S-6	.052"	DCEP	138	21.1	5.1	34,256	Weave	322°
B5	GMAW	Pulse-Spray	ER70S-6	.052"	DCEP	148	21.8	5.2	37,227	Weave	330°
B6	GMAW	Pulse-Spray	ER70S-6	.052"	DCEP	145	21.6	5.1	36,847	Weave	362°
B7	GMAW	Pulse-Spray	ER70S-6	.052"	DCEP	140	21.6	4.2	43,200	Weave	Preheat
B8	GMAW	Pulse-Spray	ER70S-6	.052"	DCEP	145	21.8	4.8	39,512	Weave	260°

Heat input calculated using QW-409.1 (a) Voltage X Amperage X 60 / by Travel Speed

PQR No. P1G1-P1G2-GMAWP-STT-A50U-1 **Date of Welding** 5/12/2014

TENSILE TESTS (QW-150)

Specimen No	Width (in)	Thickness (in)	Diameter (in)	Area (in)	Ultimate Total Load (lbs)	Ultimate Stress (psi)	Location of Failure
1	0.745	0.738		0.5498	40,022	72,793	Base Metal
2	0.749	0.742		0.5580	41,168	74,069	Base Metal

GUIDED-BEND TESTS (QW-160)

Type and Figure No	Result	Type and Figure No	Result
QW 462.2	Pass	QW 462.2	Pass
QW 462.2	Pass	QW 462.2	Pass

TOUGHNESS TESTS (QW-170)

Specimen No	Notch Location	Specimen Size (in)	Notch Size (in)	Test Temp (F)	Impact Values (Ft LBS)	Shear %	Mils	Drop Weight Break
Top 1	Weld Metal	.395 x .395	0.315	-50°	73	N/A	N/A	N/A
Top 2	Weld Metal	.394 x .395	0.314	-50°	43	N/A	N/A	N/A
Top 3	Weld Metal	.394 x .395	0.315	-50°	53	N/A	N/A	N/A
Bottom 1	Weld Metal	.395 x .395	0.315	-50°	65	N/A	N/A	N/A
Bottom 2	Weld Metal	.395 x .395	0.315	-50°	40	N/A	N/A	N/A
Bottom 3	Weld Metal	.394 x .395	0.314	-50°	63	N/A	N/A	N/A
HAZ 1	A36	.395 x .395	0.315	-50°	28	N/A	N/A	N/A
HAZ 2	A36	.394 x .395	0.315	-50°	27	N/A	N/A	N/A
HAZ 3	A36	.395 x .395	0.315	-50°	29	N/A	N/A	N/A
HAZ 1	SA-516-70	.395 x .394	0.315	-50°	31	N/A	N/A	N/A
HAZ 2	SA-516-70	.395 x .395	0.315	-50°	32	N/A	N/A	N/A
HAZ 3	SA-516-70	.395 x .395	0.314	-50°	28	N/A	N/A	N/A

Impact testing performed to ASME VIII

DEPOSITED CHEMICAL ANALYSIS

C	Si	Mn	P	S	Al	V	Cr	Ni	Fe	Ce
0.082	0.860	1.320	<.010	0.016	N/A	N/A	0.044	0.031	Rem	N/A

Chemical Analysis Conforms to A# 1

MATERIAL TRACABILITY

Item Description A36 Heat Number E3J357 Manufacturer SSAB

Item Description SA-516-70 Heat Number 516998 Manufacturer JSW

WELDING INFORMATION

Welding machine used Lincoln 455 STT W/ 25 M Feeder

Welder Name Clair Neff ID Number 28005 Stamp CN

TESTING INFORMATION

Tests Conducted By MSI Testing Inc. Laboratory Test Number 14-136 Date of Testing 5/21/2014

Preparation and welding of test coupon was witnessed by Jacob Mowat

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME IX.

This Procedure Qualification Record was prepared and accepted by Jake Mowat on 5/22/2014

Accepted By ______________________ Plant 1 Denver, CO

Accepted By ______________________ Plant 2 Salt Lake City, UT

Accepted By ______________________ Plant 3 Pocatello, ID

Jacob Mowat
CWI 13100541
QC1 EXP. 10/1/2016

All units referenced on PQR are in English (Standard, I.e. psi, inches, etc.) unless specifically noted.

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WELDING PROCEDURE SPECIFICATION (ASME)

EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P1-GTAW-AL Date 12/17/2009 Revision 2
Supporting PQR No(s) P1G1-P1G2-GTAW-A50L

BASE METAL (QW-403)
P # 1 Gr # - to P # 1 Gr # -
Thickness Range 1/16 to 0.56
Backing NO Backing Material -

JOINT (QW-402, QW-405)
Groove ANY Fillet ANY
Progression UPHILL Fillet Weld Size ANY

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range -
Time Range -

PREHEAT (F) (QW-406)
Minimum Temperature 50
Maximum Interpass Temperature 500
Preheat Maintenance PRIOR / DURING

PROCESS / TYPE	**GTAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	ER70S-6	-
SFA# / AWS Specification	5.18	-
F #	6	-
A # or Chemical Composition	1	-
Filler Metal Trade Name	LINCOLN ER70S-6	-
Filler Metal Diameter	3/32	-
Maximum Weld Metal Thickness	0.56	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100% ARGON - 30-60CFH	-
Gas Cup Size	ANY	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-410)		
Current	DCEN	-
GMAW, FCAW		
Transfer Mode	-	-
GTAW		
Electrode Type	EWLa-1.5, 1.5% Lanthana (GOLD)	-
Electrode Size	3/32	-
TECHNIQUE (QW-410)		
Beads	WEAVE	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	-	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY	GTAW	ER70S-6	3/32	DCEN	150max	15max	1min	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = - J/in

By

AWS
QC1
JASON J. HART
02030171
CWI

Accepted By PLANT 1 DEN

Accepted By PLANT 2 SLC

Accepted By PLANT 3 POC

Interpass cleaning not considered peening.
Refer to Appendix WPS for all other variables.
This WPS is only used for material which does not require notch-toughness testing.

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APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 4

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers prohibited.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

The brand specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)
A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO

ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

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PROCEDURE QUALIFICATION RECORD (ASME)
EATON METAL PRODUCTS COMPANY LLC

PQR No P1G1-P1G2-GTAW-A50L Date 12/16/2009 Revision 1

BASE METAL (QW-403)

Material Form PIPE Thickness* 0.28

Material Spec SA-106B P # 1 Gr # 1

Material Spec SA-106C P # 1 Gr # 2

* Weld thickness = to pipe thickness

PREHEAT (F) (QW-406)

Minimum Temperature 50

Maximum Interpass Temperature 500

Preheat Maintenance PRIOR / DURING

JOINT (QW-402, QW-405)

Type SINGLE BEVEL Groove Angle 60

Root Opening 1/8 Root Face 1/16

Backgouge NO Back Welded NO

Test Position 5G Verticle Progression UPHILL

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range -

Time Range -

PROCESS / TYPE	**GTAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	ER70S-6	-
SFA# / AWS Specification	5.18	-
F #	6	-
A # or Chemical Composition	1	-
Filler Metal Trade Name	LINCOLN ER70S-6	-
Filler Metal Diameter	3/32	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100% ARGON - 45 CFH	-
Gas Cup Size	5	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-409)		
Current	DCEN	-
GMAW, FCAW		
Transfer Mode	-	-
GTAW		
Electrode Type	EWTh-2, 2% THORIA	-
Electrode Size	3/32	-
TECHNIQUE (QW-410)		
Beads	WEAVE	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	-	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ANY	GTAW	ER70S-6	3/32	DCEN	110-150	10-15	1-3	135,000	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = 135,000 J/in $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)
EATON METAL PRODUCTS COMPANY LLC

PQR No P1G1-P1G2-GTAW-A50L Date 12/16/2009 Revision 1

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICK (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	LOCATION OF FAILURE
1	0.744	0.214	0.159	12,823	80,648	BASE METAL
2	0.748	0.211	0.158	12,670	80,190	BASE METAL
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
(2) QW-462.3a FACE BEND	PASS	(2) QW-462.3a ROOT BEND	PASS
-	-	-	-
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
WELD 1	WELD METAL	V-NOTCH	-50	13 (26)	-	-	NO
WELD 2	WELD METAL	V-NOTCH	-50	10 (20)	-	-	NO
WELD 3	WELD METAL	V-NOTCH	-50	18 (36)	-	-	NO
HAZ 1	HAZ	V-NOTCH	-50	33 (66)	-	-	NO
HAZ 2	HAZ	V-NOTCH	-50	36 (72)	-	-	NO
HAZ 3	HAZ	V-NOTCH	-50	29 (58)	-	-	NO
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Rockwell B Hardness

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4:
N5:
N6: Impact specimins: 1/2 size "Actual Values (Full Size Conversion)"
N7: Pipe Test: USS Heat# X84474 Dual Certified SA-106 B/C

Welder Name: CLAIR NEFF Stamp: C ID Number: 8005
Tests Conducted By: MSI TESTING, INC. Laboratory Test Number: 05-078
PQR was done and welding of coupon was witnessed by: EATON METAL PRODUCTS COMPANY LLC

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

BY

Daniel Durtschi
CWI 11030421
QC1 EXP. 3/1/2014

ACCEPTED BY PLANT 1 DENVER, CO

ACCEPTED BY PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ____________________ PLANT 1 DENVER, CO

ACCEPTED BY ____________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ____________________ PLANT 3 POCATELLO, ID

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WELDING PROCEDURE SPECIFICATION (ASME)

EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P8-FCAW-AL Date 11/12/2009 Revision 1
Supporting PQR No(s) P1-P8-FCAW-AL

BASE METAL (QW-403)
P # 8 Gr # - to P # 1 Gr # -
Thickness Range 0.1875 to 2.5
Backing YES Backing Material WELD/BASE METAL

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range -
Time Range -

JOINT (QW-402, QW-405)
Groove ALL Fillet ALL
Progression UPHILL Fillet Weld Size ANY

PREHEAT (F) (QW-406)
Minimum Temperature 50
Maximum Interpass Temperature 350
Preheat Maintenance -

PROCESS / TYPE	**FCAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	E309LT-1	-
SFA# / AWS Specification	5.22	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	0.045	-
Maximum Weld Metal Thickness	2.5	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100% CO2 - 35CFH	-
Gas Cup Size	1/2 - 3/4	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-410)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER - Each bead ≤ 5/8" wide	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	3/4 - 1 1/4	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY	FCAW	E309LT-1	0.045	DCEP	125-220	24-29	8-16	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = - J/in

By

AWS
QC1
JASON J. HART
02030171
CWI

Accepted By PLANT 1 DEN

Accepted By PLANT 2 SLC

Accepted By PLANT 3 POC

Interpass cleaning not considered peening.
Refer to Appendix WPS for all other variables.
This WPS is only used for material which does not require notch-toughness testing.

Uncontroled copy if actual signature not signed by plant representative.

APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 4

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers prohibited.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

The brand specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)
A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ____________________ PLANT 1 DENVER, CO

ACCEPTED BY ____________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ____________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P1-P8-FCAW-AL Date 11/12/2009 Revision 1

BASE METAL (QW-403)

Material Form	PLATE	Thickness*	1.25		
Material Spec	SA240-304	P #	8	Gr #	1
Material Spec	SA516-70	P #	1	Gr #	2

* Weld thickness = to plate thickness

PREHEAT (F) (QW-406)

Minimum Temperature	50
Maximum Interpass Temperature	350
Preheat Maintenance	PRIOR / DURING

JOINT (QW-402, QW-405)

Type	GROOVE	Groove Angle	60
Root Opening	-	Root Face	1/16
Backgouge	YES	Back Welded	YES
Test Position	1G	Vertical Progression	-

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range	-
Time Range	-

PROCESS / TYPE	**FCAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	E309LT-1	-
SFA# / AWS Specification	5.22	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	0.045	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100% CO2 - 35CFH	-
Gas Cup Size	3/4	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-409)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	3/4 - 1 1/4	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ALL	FCAW	E309LT-1	0.045	DCEP	150	27	12-20	20,250	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = 20,250 J/in $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P1-P8-FCAW-AL Date 11/12/2009 Revision 1

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICK (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	LOCATION OF FAILURE
A	0.751	1.252	0.940	72,000	76,575	BASE METAL
B	0.752	1.247	0.938	72,800	77,633	BASE METAL
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
QW-462.2 SIDE BEND	PASS	QW-462.2 SIDE BEND	PASS
QW-462.2 SIDE BEND	PASS	QW-462.2 SIDE BEND	PASS

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Brinell Hardness

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4:
N5: Original PQR - P1-P8-DS Rev 1 3/31/94

Welder Name: R. CARTER Stamp: 8 ID Number: 699
Tests Conducted By: CMS Laboratory Test Number: C-34-247
PQR was done and welding of coupon was witnessed by: EATON METAL PRODUCTS COMPANY

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

AWS
QC1
JASON J. HART
02030171
CWI

BY

ACCEPTED BY PLANT 1 DENVER, CO

ACCEPTED BY PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ____________________ PLANT 1 DENVER, CO

ACCEPTED BY ____________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ____________________ PLANT 3 POCATELLO, ID

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WELDING PROCEDURE SPECIFICATION (ASME)

EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P8-GMAWP-A Date 1/11/2017 Revision 2
Supporting PQR No(s) P1-P8-GMAWP-A

BASE METAL (QW-403)
P # 1 Gr # - to P # 8 Gr # -
Thickness Range 3/16 to 8
Backing YES Backing Material BASE/WELD METAL
Type: Semi-Automatic

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range -
Time Range -

JOINT (QW-402, QW-405)
Groove ALL + 3G≤60° Fillet ALL
Progression UPHILL Fillet Weld Size ANY
60-Degree Inclination Angle MAX

PREHEAT (F) (QW-406)
Minimum Temperature 50
Maximum Interpass Temperature 350
Preheat Maintenance PRIOR / DURING

PROCESS / TYPE	**GMAWP**	-
FILLER METAL (QW-404)		
AWS Classification	ER309L	-
SFA# / AWS Specification	5.9	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	0.045	-
Maximum Weld Metal Thickness	8	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	98% Ar - 2%CO2 / 35CFH min	-
Gas Cup Size	1/2 - 3/4	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-410)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	PULSED SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER - Each bead ≤ 5/8" wide	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	1/2 - 1	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY/ALL	GMAWP	ER309L	0.045	DCEP	170-210	24-28	4-12	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = - J/in
By
Accepted By PLANT 1 DEN
Accepted By PLANT 2 SLC
Accepted By PLANT 3 POC

Interpass cleaning not considered peening.
Refer to Appendix WPS for all other variables.
Only weld joint details accepted by the Company Representative shall be used
This WPS is only used for material which does not require notch-toughness testing.
Lincoln Invertec V-350Pro Pulsed MIG Stainless 0.045, 175WFS, 180SPD
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APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 4

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers prohibited.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

The brand-specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)
A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO

ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

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PROCEDURE QUALIFICATION RECORD (ASME)
EATON METAL PRODUCTS COMPANY LLC

PQR No P1-P8-GMAWP-A Date 11/13/2009 Revision 1

BASE METAL (QW-403)
Material Form PLATE Thickness* 1.5
Material Spec SA516-70 P # 1 Gr # 2
Material Spec SA240-304L P # 8 Gr # 1
* Weld thickness = to plate thickness

PREHEAT (F) (QW-406)
Minimum Temperature 50
Maximum Interpass Temperature 350
Preheat Maintenance PRIOR / DURING

JOINT (QW-402, QW-405)
Type V-GROOVE Groove Angle 50
Root Opening 0 Root Face 1/8
Backgouge YES Back Welded YES
Test Position 3G Vertical Progression UPHILL
45° INCLINATION ANGLE

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range -
Time Range -

PROCESS / TYPE	**GMAWP**	-
FILLER METAL (QW-404)		
AWS Classification	ER309LSi	-
SFA# / AWS Specification	5.9	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	Lincoln Murex 309LSi	-
Filler Metal Diameter	0.045	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	98% Ar - 2%CO2 / 35CFH min	-
Gas Cup Size	5/8	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-409)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	PULSED SPRAY	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	1/2 - 1	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ROOT	GMAWP	ER309L	0.045	DCEP	190	26	10	29,640	-
MID	GMAWP	ER309L	0.045	DCEP	190	26	7	42,343	-
CAP	GMAWP	ER309L	0.045	DCEP	190	26	5	59,280	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = **59,280** J/in $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P1-P8-GMAWP-A Date 11/13/2009 Revision 1

TENSILE TEST (QW-150)

SPECIMEN NO.	DIA (IN)		AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	LOCATION OF FAILURE
Top 1	0.504	-	0.200	17,118	85,803	BASE METAL 516-70
Top 2	0.507	-	0.202	16,289	80,684	BASE METAL 516-70
Bottom 1	0.506	-	0.201	16,388	81,496	BASE METAL 516-70
Bottom 2	0.504	-	0.200	16,818	84,299	BASE METAL 516-70
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
(4) QW-462.2 SIDE BEND	PASS	-	-
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Rockwell B

	BASE METAL			HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
SA516-70	48.0	48.5	49.0	71.0	76.5	72.5	76.0	73.9	77.8
SA240-304	61.0	56.5	56.5	73.5	72.5	72.1	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4:
N5: Test Plate: Jindal Stainless Corporation Heat #:1F0088 / Ipsco Heat #A4E165

Welder Name: Clair Neff Stamp: CN ID Number: 8005
Tests Conducted By: MSI Testing, Inc. Laboratory Test Number: 08-054
PQR was done and welding of coupon was witnessed by: Eaton Metal Products Company LLC

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

AWS QC1
JASON J. HART
02030171
CWI

BY

ACCEPTED BY PLANT 1 DENVER, CO

ACCEPTED BY PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY PLANT 3 POCATELLO, ID

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APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO
ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT
ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

WELDING PROCEDURE SPECIFICATION (ASME)

EATON METAL PRODUCTS COMPANY LLC

WPS No P1-P8-GTAW-AL Date 12/17/2009 Revision 1
Supporting PQR No(s) P1-P8-GTAW-AL

BASE METAL (QW-403)
P # 1 Gr # - to P # 8 Gr # -
Thickness Range 1/16 to 0.436
Backing NO Backing Material -

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range -
Time Range -

JOINT (QW-402, QW-405)
Groove ANY Fillet ALL
Progression UPHILL Fillet Weld Size ANY

PREHEAT (F) (QW-406)
Minimum Temperature 50
Maximum Interpass Temperature 350
Preheat Maintenance PRIOR / DURING

PROCESS / TYPE	**GTAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	ER309L	-
SFA# / AWS Specification	5.9	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	3/32	-
Maximum Weld Metal Thickness	0.436	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100%Argon / 30-60CFH	-
Gas Cup Size	ANY	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	100%Argon / 10-30CFH	-
ELECTRICAL (QW-410)		
Current	DCEN	-
GMAW, FCAW		
Transfer Mode	-	-
GTAW		
Electrode Type	EWLa-1.5, 1.5% Lanthana (GOLD)	-
Electrode Size	3/32	-
TECHNIQUE (QW-410)		
Beads	WEAVE	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	-	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY/ALL	GTAW	ER309L	3/32	DCEN	150max	15max	1min	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = - J/in

By

AWS
QC 1
JASON J. HART
02030171
CWI

Accepted By PLANT 1 DEN

Accepted By PLANT 2 SLC

Accepted By PLANT 3 POC

Interpass cleaning not considered peening.
Refer to Appendix WPS for all other variables.
This WPS is only used for material which does not require notch-toughness testing

Uncontroled copy if actual signature not signed by plant representative.

APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 4

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers prohibited.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

The brand specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)
A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO

ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P1-P8-GTAW-AL Date 12/16/2009 Revision 1

BASE METAL (QW-403)

Material Form PIPE Thickness* 0.218

Material Spec SA312-304L P # 8 Gr # 1

Material Spec SA53 Tp.E Gr.B P # 1 Gr # 1

*Weld thickness = to pipe thickness

PREHEAT (F) (QW-406)

Minimum Temperature 50

Maximum Interpass Temperature 350

Preheat Maintenance PRIOR / DURING

JOINT (QW-402, QW-405)

Type SINGLE BEVEL Groove Angle 60

Root Opening 3/32 Root Face 1/16

Backgouge NO Back Welded NO

Test Position 5G Vertical Progression UPHILL

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range -

Time Range -

PROCESS / TYPE	**GTAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	ER309L	-
SFA# / AWS Specification	5.9	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	3/32	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100%Argon / 45CFH	-
Gas Cup Size	5	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	100%Argon / 20CFH	-
ELECTRICAL (QW-409)		
Current	DCEN	-
GMAW, FCAW		
Transfer Mode	-	-
GTAW		
Electrode Type	EWTh-2, 2% THORIA	-
Electrode Size	3/32	-
TECHNIQUE (QW-410)		
Beads	WEAVE	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	-	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ALL	GTAW	ER309L	3/32	DCEN	110-150	10-15	1-3	135,000	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = 135,000 J/in $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)
EATON METAL PRODUCTS COMPANY LLC

PQR No P1-P8-GTAW-AL Date 12/16/2009 Revision 1

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICK (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	LOCATION OF FAILURE
1-1	0.75	0.193	0.145	9,188	63,475	BASE METAL - SA53
1-2	0.748	0.195	0.146	9,357	64,151	BASE METAL - SA53
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
(2) QW-462.3 FACE BENDS	PASS	(2) QW-462.3 ROOT BENDS	PASS
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Rockwell B

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4:
N5: Test Pipe: SA312-304L =TaChen Heat# 707585, SA53 Type E Grade B = Ipsco Heat# 267234

Welder Name: STAN NEFF Stamp: SN ID Number: 8002
Tests Conducted By: MSI TESTING, INC. Laboratory Test Number: 09-083
PQR was done and welding of coupon was witnessed by: EATON METAL PRODUCTS COMPANY LLC

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

BY

AWS
QC1
JASON J. HART
02030171
CWI

ACCEPTED BY PLANT 1 DENVER, CO
ACCEPTED BY PLANT 2 SALT LAKE CITY, UT
ACCEPTED BY PLANT 3 POCATELLO, ID

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APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO
ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT
ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

WELDING PROCEDURE SPECIFICATION (ASME)

EATON METAL PRODUCTS COMPANY LLC

WPS No P8-P8-GMAWP-A Date 10/16/2018 Revision 3
Supporting PQR No(s) P8-P8-GMAWP-A, P8-P8-GMAWP-A-1

BASE METAL (QW-403)
P # 8 Gr # N/A to P # 8 Gr # N/A
Thickness Range 3/16 to 8
Backing YES Backing Material BASE/WELD METAL

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range NONE
Time Range NONE

JOINT (QW-402, QW-405)
Groove ALL Fillet ALL
Position ANY Fillet Weld Size ANY
Progression UPHILL

PREHEAT (F) (QW-406)
Minimum Temperature 100
Maximum Interpass Temperature 400
Preheat Maintenance PRIOR / DURING

PROCESS / TYPE	**GMAWP**	**GMAWP**
FILLER METAL (QW-404)		-
AWS Classification	ER3XX	
SFA# / AWS Specification	5.9	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	N/A	-
Filler Metal Product Form	SOLID	-
Filler Metal Diameter	0.045	-
Maximum Weld Metal Thickness	8	-
SHIELDING (QW-408)		-
Electrode-Flux (Class)	N/A	
Flux Trade Name / Type	N/A	-
Shielding Gas / CFH	98% Ar - 2%CO2 / 35CFH min or	-
	98% Ar - 2% O2 / 35CFH min	-
Gas Cup Size	1/2 - 3/4	-
Trailing Gas / CFH	N/A	-
Backing Gas / CFH	N/A	-
ELECTRICAL (QW-410)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	PULSED SPRAY	-
GTAW		
Electrode Type	N/A	-
Electrode Size	N/A	-
TECHNIQUE (QW-410)		
Beads	STRINGER - Each bead ≤ 5/8" wide	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	N/A	-
Angle	N/A	-
Contact Tube to Work Distance	1/2 - 1	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY/ALL	GMAWP	ER3XX	0.045	DCEP	160-210	22-24	14-20	N/A
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = N/A **J/in**

By 10/16/18

Accepted By PLANT 1 DEN

Accepted By PLANT 2 SLC

Accepted By PLANT 3 POC

Interpass cleaning not considered peening.
Refer to Appendix WPS for all other variables.
Refer to Appendix SS for filler metal selection.
This WPS is only used for material which does not require notch-toughness testing.

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APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 12/12/2011 Revision: 6

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers prohibited.
3 Root spacing shall be sufficient to allow for complete joint penetration.
4 Bevel angle for groove welds that can only be accessed from one side (i.e. no backgouge/grind) shall be 30° or greater.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-407 PWHT When Required

1 For vessels that are exposed to enviornments that could cause stress corrosion cracking; a minimum hold time of 1 hour at a minimum temperature of 1150°F shall be applied.

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

UG-84

For weld procedures used when impact tests are requried, production material must:

a Be of the same P-Number and Group Number with the exception allowed by QW-403.5(c)
b Be in the same heat treated condition
c Meet the minimum notch toughness requirements

The brand specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)
A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ____________________ PLANT 1 DENVER, CO

ACCEPTED BY ____________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ____________________ PLANT 3 POCATELLO, ID

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APPENDIX SS

EATON METAL PRODUCTS COMPANY LLC

STAINLESS STEEL

BASE - FILLER METAL COMPATABILITY CHART

DATE 1/13/2005 **REVISION** 0

	BASE MATERIAL					
FILLER METAL	304	304 to 316	316	321	321 to 347	347
308	X					
316	X	X	X			
317		X	X			
321				X	X	X
347				X	X	X

When low Carbon content base material required use "L" grade filler metal.
ER3XX, Si grade filler metal may be used for better wetting and bead contour.

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P8-P8-GMAWP-A Date 2/22/2012 Revision 2

BASE METAL (QW-403)

Material Form PLATE Thickness* 1.5

Material Spec SA240-304L P # 8 Gr # 1

Material Spec SA240-304L P # 8 Gr # 1

* Weld thickness = to plate thickness

PREHEAT (F) (QW-406)

Minimum Temperature 200

Maximum Interpass Temperature 300

Preheat Maintenance PRIOR / DURING

JOINT (QW-402, QW-405)

Type V-GROOVE Groove Angle 50

Root Opening 0 Root Face 1/16"

Backgouge YES Back Welded YES

Test Position 1G Vertical Progression N/A

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range NONE

Time Range NONE

PROCESS / TYPE	**GMAWP**	**-**
FILLER METAL (QW-404)		
AWS Classification	ER316LSi	-
SFA# / AWS Specification	5.9	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	Lincoln Bluemax 316LSi	-
Filler Metal Product Form	SOLID	-
Filler Metal Diameter	0.045	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	N/A	-
Flux Trade Name / Type	N/A	-
Shielding Gas / CFH	98% Ar - 2%CO2 / 35CFH min	-
Gas Cup Size	5/8	-
Trailing Gas / CFH	N/A	-
Backing Gas / CFH	N/A	-
ELECTRICAL (QW-409)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	PULSED SPRAY	-
GTAW		
Electrode Type	N/A	-
Electrode Size	N/A	-
TECHNIQUE (QW-410)		
Beads	STRINGER	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	N/A	-
Angle	N/A	-
Contact Tube to Work Distance	1/2 - 1	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ROOT	GMAWP	ER308LSi	0.045	DCEP	200-210	23-24	18	16,800	-
MID	GMAWP	ER308LSi	0.045	DCEP	200-210	23-24	14-16	21,600	-
CAP	GMAWP	ER308LSi	0.045	DCEP	200-210	23-24	14-16	21,600	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = **21,600** **J/in** $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P8-P8-GMAWP-A Date 2/22/2012 Revision 2

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICKNESS (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	LOCATION OF FAILURE
1	0.750	0.750	0.5625	39,940	71,004	BASE METAL
2	0.750	0.750	0.5625	40,050	71,200	BASE METAL
3	0.750	0.750	0.5625	40,165	71,404	BASE METAL
4	0.750	0.750	0.5625	39,785	70,729	BASE METAL
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
(8) QW-462.2 SIDE BEND	PASS	-	-
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Rockwell B

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4:
N5: Test Plate: ENCORE METALS, HEAT #5RE5

Welder Name: Clair Neff Stamp: CN ID Number: 8005
Tests Conducted By: MSI Testing, Inc. Laboratory Test Number: EATON-12-001
PQR was done and welding of coupon was witnessed by: Eaton Metal Products Company LLC

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

BY Dan Durtschi 2/23/12

Daniel Durtschi
CWI 11030421
QC1 EXP. 3/1/2014

ACCEPTED BY ______ PLANT 1 DENVER, CO

ACCEPTED BY ______ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

PROCEDURE QUALIFICATIOIN RECORD (ASME IX)
EATON METAL PRODUCTS COMPANY LLC

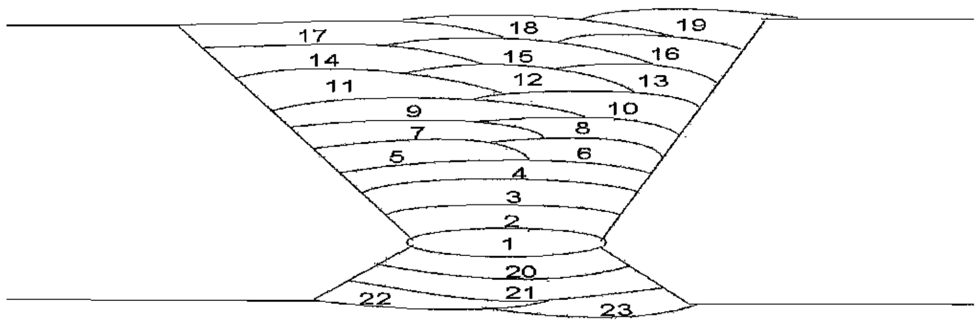
PQR No. P8-P8-GMAWP-A-1 **Date of Welding** 9/19/2018
Weld Process(es) GMAWP **Type(s)** Semiautomatic

JOINT DETAILS (QW-402)

Joint Design	Butt Joint
Groove Type	Single V
Root Spacing	0
Root Face	1/16"
Backing	Yes
Backing Type	Base Metal
Groove Angle	50°
Back gouged	Yes
Retainers	None

POSITION (QW-405)

Test Position	1G
Progression	



BASE METALS (QW-403)

Material Spec (1) SA-240 to (2) SA-240 P-No 8 Gr# 1 to P-No 8 Gr# 1
Type/Grade, or UNS Number 304/304L to 304/304L Heat Treated Condition None
Material Thickness (T) 1.5" Diameter of Test Coupon N/A

FILLER METALS (QW-404)

	(A)	(B)
SFA Specification	5.9	
AWS Classification	ER316LSi	
F-No	6	
A-No	8	
Filler Metal Trade Name	OK Autrod 316LSi	
Filler Metal Product Form	Solid	
Supplemental Filler Metal	N/A	
Alloy Elements	N/A	
Weld Metal Thickness (t)	3/16"	
Maximum Pass Thickness	3/16"	
ELECTRODE		
Tungsten Type	N/A	
Tungsten Size	N/A	
Consumable Insert Used	No	
Electrode Spacing (2 Arcs)	N/A	
Angle	N/A	
Contact Tube to Work	1/2" to 1"	

GAS (QW-408)

	Gases	Mixture (%)	Flow Rate (cfh)
Shielding	AR/O2	98/2	35
Trailing	None	None	None
Backing	None	None	None
Gas Cup Size	5/8"		

PREHEAT (QW-406)

Minimum Temperature	100
Preheat Maintenance	Prior/During

TECHNIQUE (QW-410)

Multipass or Single Pass (per side)	Multiple
Single or Multiple Electrodes	Single
Initial and Interpass Cleaning	Manual / Mechanical
Peening Performed	None
Maximum Pass Width	5/8"
Oscillation (Machine)	N/A
In Chamber Welding (GTAW)	N/A

POST WELD HEAT TREATMENT (QW-407)

Temperature	None
Time	N/A
Other	N/A

ELECTRICAL (QW-409)

Pass(es)	Process	Transfer Mode	Class	Diameter	Current & Polarity	Amps	Volts	Travel Speed (ipm)	Heat Input (J/in)	String or Weave	Interpass Temp (°F)
1	GMAWP	Pulse-Spray	ER316LSi	0.045"	DCEP	208	23	16	17,900	String	Preheat
2	GMAWP	Pulse-Spray	ER316LSi	0.045"	DCEP	201	23	16	17,300	Weave	228°
3-6	GMAWP	Pulse-Spray	ER316LSi	0.045"	DCEP	202	23	15	18,600	Weave	290° Max
7-10	GMAWP	Pulse-Spray	ER316LSi	0.045"	DCEP	209	23	14	20,600	Weave	280° Max
11-14	GMAWP	Pulse-Spray	ER316LSi	0.045"	DCEP	203	24	15	19,500	Weave	285° Max
15-19	GMAWP	Pulse-Spray	ER316LSi	0.045"	DCEP	205	23	15	18,900	Weave	275° Max
20-23	GMAWP	Pulse-Spray	ER316LSi	0.045"	DCEP	222	23	15	20,400	Weave	280° Max

Heat input calculated using QW-409.1 (c)1, Instantaneous energy readout.

PQR No. P8-P8-GMAWP-A-1 **Date of Welding** 9/6/2012

TENSILE TESTS (QW-150)

Specimen No	Width (in)	Thickness (in)	Diameter (in)	Area (in)	Ultimate Total Load (lbs)	Ultimate Stress (psi)	Location of Failure
Top -1	0.749	0.796	N/A	0.5962	56,046	94,000	WM
Top -2	0.745	0.791	N/A	0.5893	55,196	93,500	WM
Bottom -1	0.750	0.796	N/A	0.5970	56,008	94,000	WM
Bottom -2	0.749	0.795	N/A	0.5955	55,758	93,500	WM

GUIDED-BEND TESTS (QW-160)

Type and Figure No	Result	Type and Figure No	Result
QW-462.2 Side Bend	Pass	QW-462.2 Side Bend	Pass
QW-462.2 Side Bend	Pass	QW-462.2 Side Bend	Pass

TOUGHNESS TESTS (QW-170)

Specimen No	Notch Location	Specimen Size (in)	Notch Size (in)	Test Temp (F)	Impact Values (Ft LBS)	Shear %	Mils	Drop Weight Break

Impact testing performed to ASME VIII

HARDNESS TEST - ROCKWELL B

Base Metal				Heat Affected Zone			Weld Metal		

DEPOSITED CHEMICAL ANALYSIS

C	Si	Mn	P	S	Al	V	Cr	Ni	Fe	Ce	Mo

Chemical Analysis Conforms to A#

MATERIAL TRACABILITY

Item Description	SA-240 304/304L	Heat Number	M6N6	Manufacturer	North American Stainless
Item Description	SA-240 304/304L	Heat Number	M6N6	Manufacturer	North American Stainless

WELDING INFORMATION

Welding machine used Lincoln 455M/STT w /25m Feeder Box

Welder Name Richard Carter ID Number - Stamp RC

TESTING INFORMATION

Tests Conducted By MSI Laboratory Test Number 18-408 Date of Testing 9/24/2018

Preparation and welding of test coupon was witnessed by Sean Dunn

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME IX.

This Procedure Qualification Record was prepared and accepted by on 10 - 15 - 18

Accepted By Plant 1 Denver, CO

Accepted By Plant 2 Salt Lake City, UT

Accepted By Plant 3 Pocatello, ID

All units referenced on PQR are in English (Standard, I.e. psi, inches, etc.) unless specifically noted.

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APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO

ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

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WELDING PROCEDURE SPECIFICATION (ASME)
EATON METAL PRODUCTS COMPANY LLC

WPS No P8-P8-GTAW-AL Date 12/17/2009 Revision 4
Supporting PQR No(s) P8-P8-GTAW-AL

BASE METAL (QW-403)
P # 8 Gr # - to P # 8 Gr # -
Thickness Range 1/16 to 0.56
Backing NO Backing Material -

POST WELD HEAT TREATMENT (F) (QW-407)
Temperature Range -
Time Range -

JOINT (QW-402, QW-405)
Groove DOUBLE BEVEL Fillet ANY
Progression UPHILL Fillet Weld Size ANY

PREHEAT (F) (QW-406)
Minimum Temperature 50
Maximum Interpass Temperature 350
Preheat Maintenance PRIOR / DURING

PROCESS / TYPE	**GTAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	*ER3XX	-
SFA# / AWS Specification	5.9	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	1/16, 3/32, 1/8	-
Maximum Weld Metal Thickness	0.56"	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100% Ar, 50CFH Max	-
Gas Cup Size	ANY	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	100% Ar, 15-30CFH	-
ELECTRICAL (QW-410)		
Current	DCEN	-
GMAW, FCAW		
Transfer Mode	-	-
GTAW		
Electrode Type	EWLa-1.5, 1.5% Lanthana (GOLD)	-
Electrode Size	3/32	-
TECHNIQUE (QW-410)		
Beads	WEAVE	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	-	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY/ALL	GTAW	*ER3XX	1/16	DCEN	150max	15max	1min	-
ANY/ALL	GTAW	*ER3XX	3/32	DCEN	150max	15max	1min	-
ANY/ALL	GTAW	*ER3XX	1/8	DCEN	150max	15max	1min	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = - J/in

By

AWS
QC 1
JASON J. HART
02030171
CWI

Accepted By PLANT [illegible]EN

Accepted By PLANT 2 SLC

Accepted By PLANT 3 POC

Interpass cleaning not considered peening.
Refer to Appendix WPS for all other variables.
Refer to Appendix SS for filler metal selection.
This WPS is only used for material which does not require notch-toughness testing.
Uncontroled copy if actual signature not signed by plant representative.

APPENDIX SS

EATON METAL PRODUCTS COMPANY LLC

STAINLESS STEEL

BASE - FILLER METAL COMPATABILITY CHART

DATE 1/13/2005 REVISION 0

	BASE MATERIAL					
FILLER METAL	304	304 to 316	316	321	321 to 347	347
308	X					
316	X	X	X			
317		X	X			
321				X	X	X
347				X	X	X

When low Carbon content base material required use "L" grade filler metal.

ER3XX, Si grade filler metal may be used for better wetting and bead contour.

APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 4

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers prohibited.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

The brand specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)
A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ____________________ PLANT 1 DENVER, CO

ACCEPTED BY ____________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ____________________ PLANT 3 POCATELLO, ID

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PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P8-P8-GTAW-AL Date 12/16/2009 Revision 3

BASE METAL (QW-403)

Material Form PIPE Thickness* 0.28

Material Spec SA-312-TP304L P # 8 Gr # 1

Material Spec SA-312-TP304L P # 8 Gr # 1

*Weld thickness = to pipe thickness

PREHEAT (F) (QW-406)

Minimum Temperature 50

Maximum Interpass Temperature 350

Preheat Maintenance PRIOR / DURING

JOINT (QW-402, QW-405)

Type SINGLE BEVEL Groove Angle 60

Root Opening 1/8 Root Face 1/16

Backgouge YES Back Welded YES

Test Position 5G Vertical Progression UPHILL

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range -

Time Range -

PROCESS / TYPE	**GTAW**	**-**
FILLER METAL (QW-404)		
AWS Classification	ER308L	-
SFA# / AWS Specification	5.9	-
F #	6	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	3/32	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	100% Ar, 45CFH	-
Gas Cup Size	3 - 5	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	100% Ar, 30CFH	-
ELECTRICAL (QW-409)		
Current	DCEN	-
GMAW, FCAW		
Transfer Mode	-	-
GTAW		
Electrode Type	EWTh-2, 2% THORIA	-
Electrode Size	3/32	-
TECHNIQUE (QW-410)		
Beads	WEAVE	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	-	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ALL	GTAW	ER308L	3/32	DCEN	110-150	10-15	1-3	135,000	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = 135,000 J/in $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P8-P8-GTAW-AL Date 12/16/2009 Revision 3

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICK (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	LOCATION OF FAILURE
1	0.744	0.296	0.220	19,138	86,902	WELD METAL
2	0.746	0.297	0.222	18,775	84,739	WELD METAL
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
(2) QW-462.3(a) FACE BEND	PASS	(2) QW-462.3(a) ROOT BEND	PASS
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Brinell Hardness

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4:
N5:

Welder Name: ROBERT BLEVINS Stamp: B ID Number: 774
Tests Conducted By: MSI TESTING, INC. Laboratory Test Number: 03-318
PQR was done and welding of coupon was witnessed by: EATON METAL PRODUCTS COMPANY

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

BY

AWS
QC 1
JASON J. HART
02030171
CWI

ACCEPTED BY PLANT 1 DENVER, CO
ACCEPTED BY PLANT 2 SALT LAKE CITY, UT
ACCEPTED BY PLANT 3 POCATELLO, ID

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APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ____________________ PLANT 1 DENVER, CO

ACCEPTED BY ____________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ____________________ PLANT 3 POCATELLO, ID

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WELDING PROCEDURE SPECIFICATION (ASME)

EATON METAL PRODUCTS COMPANY LLC

WPS No P8-P8-SMAW-A Date 12/15/2009 Revision 4

Supporting PQR No(s) P8G1-P8G1-SMAW-A

BASE METAL (QW-403)

P # 8 Gr # - to P # 8 Gr # -

Thickness Range .1875 to 8

Backing YES Backing Material BASE/WELD METAL

JOINT (QW-402, QW-405)

Groove ANY Fillet ANY

Progression UPHILL Fillet Weld Size ALL

PREHEAT (F) (QW-406)

Minimum Temperature 50

Maximum Interpass Temperature 350

Preheat Maintenance PRIOR / DURING

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range -

Time Range -

PROCESS / TYPE	**SMAW**	-
FILLER METAL (QW-404)		
AWS Classification	E3XX	-
SFA# / AWS Specification	5.4	-
F #	5	-
A # or Chemical Composition	8	-
Filler Metal Trade Name	-	-
Filler Metal Diameter	ANY	-
Maximum Weld Metal Thickness	8	-
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	-	-
Gas Cup Size	-	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-410)		
Current	DCEP	-
GMAW, FCAW		
Transfer Mode	-	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER - Each bead ≤ 5/8" wide	-
Pass	MULTIPLE	-
Number of Electrodes	1	-
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	-	-
Peening	NONE	-
Interpass Cleaning	MANUAL / MECHANICAL	-

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)
ANY/ALL	SMAW	E3XXL	5/32	DCEP	90-140	26-32	7-12	-
ANY/ALL	SMAW	E3XXL	1/8	DCEP	60-120	20-25	4-8	-
ANY/ALL	SMAW	E3XXL	3/32	DCEP	40-100	19-24	3-8	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Maximum Heat Input for any Diameter = - **J/in**

By

JASON J. HART
02030171

Accepted By PLANT 1 DEN

Accepted By PLANT 2 SLC

Accepted By PLANT 3 POC

Interpass cleaning not considered peening.

Refer to appendix WPS for all other variables.

Refer to Appendix SS for filler metal selection.

This WPS is only used for material which does not require notch-toughness testing.

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APPENDIX SS

EATON METAL PRODUCTS COMPANY LLC

STAINLESS STEEL

BASE - FILLER METAL COMPATABILITY CHART

DATE 1/13/05 **REVISION** 0

	BASE MATERIAL					
FILLER METAL	**304**	**304 to 316**	**316**	**321**	**321 to 347**	**347**
308	X					
316	X	X	X			
317		X	X			
321				X	X	X
347				X	X	X

When low Carbon content base material required use "L" grade filler metal.
ER3XX, Si grade filler metal may be used for better wetting and bead contour.

APPENDIX WPS (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 4

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Welding Procedure Specification.

** Any information on actual WPS supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers prohibited.

QW-403

1 No pass greater than 1/2" allowed. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts prohibited. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

The brand specific filler and/or flux listed on the WPS shall not be substituted.

Applicable to WPS with Post Weld Heat Treatment (PWHT)
A specific PWHT procedure shall be developed for each job.

All units referenced on WPS are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO
ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT
ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P8G1-P8G1-SMAW-A Date 12/15/2009 Revision 3

BASE METAL (QW-403)

Material Form PLATE Thickness* 1 1/2 & 1/2

Material Spec SA-240, 304 & 316 P # 8 Gr # 1

Material Spec SA-240, 304 & 316 P # 8 Gr # 1

*Weld thickness = to plate thickness

PREHEAT (F) (QW-406)

Minimum Temperature 50

Maximum Interpass Temperature 350

Preheat Maintenance PRIOR / DURING

JOINT (QW-402, QW-405)

Type SINGLE BEVEL Groove Angle 50

Root Opening 1/16 Root Face 1/16

Backgouge YES Back Welded YES

Test Position 1G Verticle Progression -

POST WELD HEAT TREATMENT (F) (QW-407)

Temperature Range -

Time Range -

PROCESS / TYPE	**SMAW 304SS BASE**	**SMAW 316SS BASE**
FILLER METAL (QW-404)		
AWS Classification	E308L	E308L
SFA# / AWS Specification	5.4	5.4
F #	5	5
A # or Chemical Composition	8	8
Filler Metal Trade Name	-	-
Filler Metal Diameter	5/32	3/32, 1/8
SHIELDING (QW-408)		
Electrode-Flux (Class)	-	-
Flux Trade Name / Type	-	-
Shielding Gas / CFH	-	-
Gas Cup Size	-	-
Trailing Gas / CFH	-	-
Backing Gas / CFH	-	-
ELECTRICAL (QW-409)		
Current	DCEP	DCEP
GMAW, FCAW		
Transfer Mode	-	-
GTAW		
Electrode Type	-	-
Electrode Size	-	-
TECHNIQUE (QW-410)		
Beads	STRINGER / WEAVE	STRINGER / WEAVE
Pass	MULTIPLE	MULTIPLE
Number of Electrodes	1	1
ELECTRODE SPACING		
Longitudinal	-	-
Angle	-	-
Contact Tube to Work Distance	-	-
Peening	NONE	NONE
Interpass Cleaning	MANUAL / MECHANICAL	MANUAL / MECHANICAL

Pass or Weld Layer (s)	Process	Filler Metal Class	Filler Metal Diameter	Current Type & Polarity	Amps	Volts	Travel Speed (ipm)	Max Heat Input (J/in)	Remarks
ANY	SMAW	E308L	5/32	DCEP	130	30	7-12	-	-
ANY	SMAW	E316L	1/8	DCEP	120	22	4-8	-	-
ANY	SMAW	E316L	3/32	DCEP	90	22	3-8	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

MAXIMUM HEAT INPUT FOR ANY DIAMETER = - **J/in** $= \frac{\text{Amps x Volts x 60}}{\text{Travel Speed}}$

PROCEDURE QUALIFICATION RECORD (ASME)

EATON METAL PRODUCTS COMPANY LLC

PQR No P8G1-P8G1-SMAW-A Date 12/15/2009 Revision 3

TENSILE TEST (QW-150)

SPECIMEN NO.	WIDTH (IN)	THICK (IN)	AREA (SQIN)	ULTIMATE TOTAL LOAD	ULTIMATE STRESS (PSI)	LOCATION OF FAILURE
1	0.754	1.508	1.137	103,000	90,587	WELD METAL
2	0.753	1.508	1.136	102,900	90,619	WELD METAL
T-1	1.014	0.506	0.513	46,400	90,434	BASE METAL
T-2	0.995	0.507	0.504	45,000	89,203	BASE METAL
-	-	-	-	-	-	-
-	-	-	-	-	-	-

GUIDED BEND TEST (QW-160)

FIGURE NO AND TYPE	RESULTS	FIGURE NO AND TYPE	RESULTS
4 @ QW-462.2 SIDE BEND	PASS	2 @ QW-462.3(a) FACE BEND	PASS
-	-	2 @ QW-462.3(a) ROOT BEND	PASS
-	-	-	-

TOUGHNESS TEST (QW-170)

SPECIMEN NO.	NOTCH LOCATION	NOTCH TYPE	TEST TEMP (F)	IMPACT VALUES (FT-LBS)	LATERAL EXP.		DROP WEIGHT BREAK
					SHEAR %	MILS	
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

HARDNESS TEST - Brinell Hardness

BASE METAL				HEAT AFFECTED ZONE			WELD METAL		
	1	2	3	1	2	3	1	2	3
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N1: Interpass cleaning not considered peening.
N2: Refer to Appendix PQR for all other variables.
N3:
N4:
N5:
N6:
N7: Original PQR's: SS-115 1994, SS-106 1982

Welder Name: R. CARTER, BILL DERY Stamp: 8, D ID Number: 699, 236
Tests Conducted By: CMS, COMERCIAL TESTING LAB. Laboratory Test Number: C-14-4, SS-106-D-82
PQR was done and welding of coupon was witnessed by: EATON METAL PRODUCTS COMPANY

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of ASME Section IX.

AWS QC1
JASON J. HART
02030171
CWI

BY

ACCEPTED BY PLANT 1 DENVER, CO
ACCEPTED BY PLANT 2 SALT LAKE CITY, UT
ACCEPTED BY PLANT 3 POCATELLO, ID

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APPENDIX PQR (ASME)

EATON METAL PRODUCTS COMPANY LLC

Date: 6/3/2009 Revision: 3

* This appendix addresses any Essential, Supplementary Essential, and Nonessential variables not mentioned on the Procedure Qualification Test Record.

** Any information on actual PQR supercedes this document if a conflict exists.

QW-402

1 Approved joints shall be on detailed drawings for individual jobs.
2 Retainers not used for weld test.

QW-403

1 No pass greater than 1/2" used in weld test. (FCAW, GMAW, SAW, SMAW)

QW-404

1 Consumable inserts not used for weld test. (GTAW)
2 Filler metal used with weld test. (GTAW)
3 Supplemental filler material not used in weld test. (FCAW, GMAW, SAW)
4 Recrushed slag not used in weld test. (SAW)
5 Flux not used in weld test. (FCAW, GMAW)

QW-410

1 Backgouge performed with air carbon arc, plasma, and/or grinder.
2 Oscillation not used with automatic or machine welding. (FCAW, GMAW, GTAW, SAW)
3 Out of chamber welding only. (GTAW)
4 a FCAW - semiautomatic
  b SMAW - manual
  c SAW - machine
  d GTAW - manual

Full size impact test specimins used. (10mm x 10mm)

All units referenced on PQR are in English (Standard, i.e. psi, inches, etc.) unless specifically noted.

ACCEPTED BY ______________________ PLANT 1 DENVER, CO

ACCEPTED BY ______________________ PLANT 2 SALT LAKE CITY, UT

ACCEPTED BY ______________________ PLANT 3 POCATELLO, ID

Uncontroled copy if actual signature not signed by plant representative.

Eaton Metal Products Company LLC
ENGINEERS DESIGNERS FABRICATORS
PETROLEUM EQUIPMENT
(303) 296-4800 FAX: (303) 296-5736

EATON METAL PRODUCTS CO LLC
MANUFACTURER DATA REPORT
5361-1

Inspection Records

EATON METAL PRODUCTS COMPANY LLC

INSPECTION TEST PLAN

Job No.	Customer	PO No.	Serial No.	Tag No.	National Board No.	Rev No. / Date
5361-1	Anadarko	4500100246	TBD	V-1000	TBD	Rev 0 11/27/18

INSPECTION ITEM	SIGN / DATE			REMARKS
	EMP QC	*AI	CUSTOMER	
PRE-FABRICATION				
AI HOLD POINT	H-SLC 3-15-19	H-SLC 3/15/19	3/15/19	*EITHER HEAD/SHELL FITUP
APPROVED ITP	H – SLC 11-27-18	11/28/18	3/15/19	ITP shall be completed for inspection points prior to opening job with the AI
APPROVED DRAWINGS	IP – SLC 11-27-18	W - SLC 11/28/18	H – SLC 3/15/19	Drawings shall be approved by customer prior to opening job with the AI. The drawings shall be identified on the Drawing Summary Sheet. Rev A
APPROVED CALCULATIONS	H - SLC 11-27-18	W - SLC 11/28/18	H – SLC By APC	Calculations shall be approved by the customer prior to opening job with the AI. Hydro Summary Sheet shall accompany the calcs for the AI review. Nameplate sketch (no serial or NB numbers) shall accompany the calcs for the AI review.
APPROVED WELDING PROCEDURES	W - SLC 11-27-18	W -SLC 11/28/18	IP - SLC By APC 3/15/19	Weld Procedures used shall be listed on approved drawings.
WELDER QUALIFICATIONS	W – SLC 11-27-18		IP – SLC By MOM 3/11/19	Available for review in each shop of fabrication.
NDE PROCEDURES	IP – SLC 11-27-18		IP - SLC MOM 3/15/69	NDE Procedures shall be reviewed and accepted by EMP QC TEAM

PREPLANNING MEETING	H – SLC 11-27-18	H - SLC 11/28/18	3/15/19	Meeting with EMP QC and AI to start job and establish hold points during fabrication. **Job summary at the end of this ITP shall describe the approximate fabrication scope for each vessel in each plant**

EATON METAL PRODUCTS COMPANY LLC

INSPECTION TEST PLAN

INSPECTION ITEM	SIGN / DATE			REMARKS
	EMP QC	*AI	CUSTOMER	
INPROCESS FABRICATION				
VISUAL INSPECTION (INTERNAL COMPLETED VESSEL)	H – POC 5.1.19 J. Mount	H – POC 5/1/19	H – POC 7/24/2019	All surfaces and welds shall be visually examined during fabrication by QC All surfaces and welds shall be visually examined during fabrication by the AI after all welding is completed. Inspection shall take place prior to Hydro test.
VISUAL INSPECTION (EXTERNAL) COMPLETED VESSEL	H – POC 5.15.19 J. Mount	H – POC 5/15/19	H – POC 5/15/19	All surfaces and welds shall be visually examined during fabrication by QC All surfaces and welds shall be visually examined during fabrication by the AI after all welding is completed.
COMPONENT FITUP	IP – SLC 3-29-19		IP - SLC 3/29-19	All fit-up shall be within the tolerances specified in EMP Vessel Fabrication Tolerance specification
NONDESTRUCTIVE EXAMINATION				**Acceptance per ASME Section VIII, Division 1 code.**
RT/PAUT	H - SLC 4-19-19	W - SLC 4/19/19	IP - SLC 6/12/19	100% All Long Seams Spot All Girth Seams
RT/PAUT	H - POC 5.1.19 J. Mount	W - POC 5/1/19	IP - POC 6/26/19	Spot Closing Seam H&H
FINAL DIMENSIONAL	H – POC 5.15.19 J. Mount		IP - POC 5-15-19	All dimensions of finished vessel shall conform to the approved drawings within the tolerance of EMP Vessel Fabrication Tolerance specification
HYDRO TEST Water Boot	H – POC 4/23/19 J. Mount	H – POC 4/23/19	W - POC 4/27/19	Test shall be performed at **325 psig** Temperature shall be **40°F min** Hold time shall be **1 hour** Test shall be recorded with a chart recorder The chart shall be signed by the operator and the serial number of the chart recorder and/or gauge used shall be noted on chart.
Main Vessel	5.15.19 J. Mount	5/15/19	5/15/19	

EATON METAL PRODUCTS COMPANY LLC

INSPECTION TEST PLAN

INSPECTION ITEM	SIGN / DATE			REMARKS
	EMP QC	*AI	CUSTOMER	
PAINT	H – POC 5.17.19		7/24/2019	Surface preparation and paint shall be verified AND DOCUMENTED in accordance with P-Sheet from Engineering
FINAL CLEAN	H – POC 5.17.19		7/24/2019	The ID of the vessel shall be swept out and free of blast media
SHIPPING PREPARATION	H – POC 5.17.19		7/24/2019	Vessel prepared to ship with the following items All flange faces protected with covers ✓ Extra studs, nuts, and gaskets supplied with vessel ✓ All manway covers with davits secured ✓ All cribbing and supports ready for loading ✓
DOCUMENTATION				
MATERIAL TEST REPORTS (MTR)	H – SLC 4-19-19	W - SLC 4/19/19	4/19/19	All pressure boundary and attachments to pressure boundary shall have an MTR or C of C.
WELD MAP DESCRIPTION (SLC SCOPE)	H – SLC 4-19-19	H – SLC 4/19/19		All pressure boundary and attachments to pressure boundary welds shall have welder ID and WPS used documented
WELD MAP DESCRIPTION (POC SCOPE)	H – POC ~~5.19.19~~ 5.15.19	H – POC 5/15/19	5/19/19	All pressure boundary and attachments to pressure boundary welds shall have welder ID and WPS used documented
DOCUMENT INDEX LOG	H – POC 5.15.19	H – POC 5/15/19		Document Index Log Initialed by QAM and AI
NDE REPORTS	H – SLC/POC ~~5.19.19~~ 5.15.19		5/19/17	All NDE performed on the vessel shall have a report documenting acceptance.
NONCONFORMANCE REPORTS (NCR) NONE	H – SLC/POC 5.15.19	H – SLC/POC 5/15/19	N/A	All NCRs cleared for vessel
NAME PLATE	H – POC 5.15.19	H – POC 5/15/19	5/19/19	Stamped and a picture taken for records

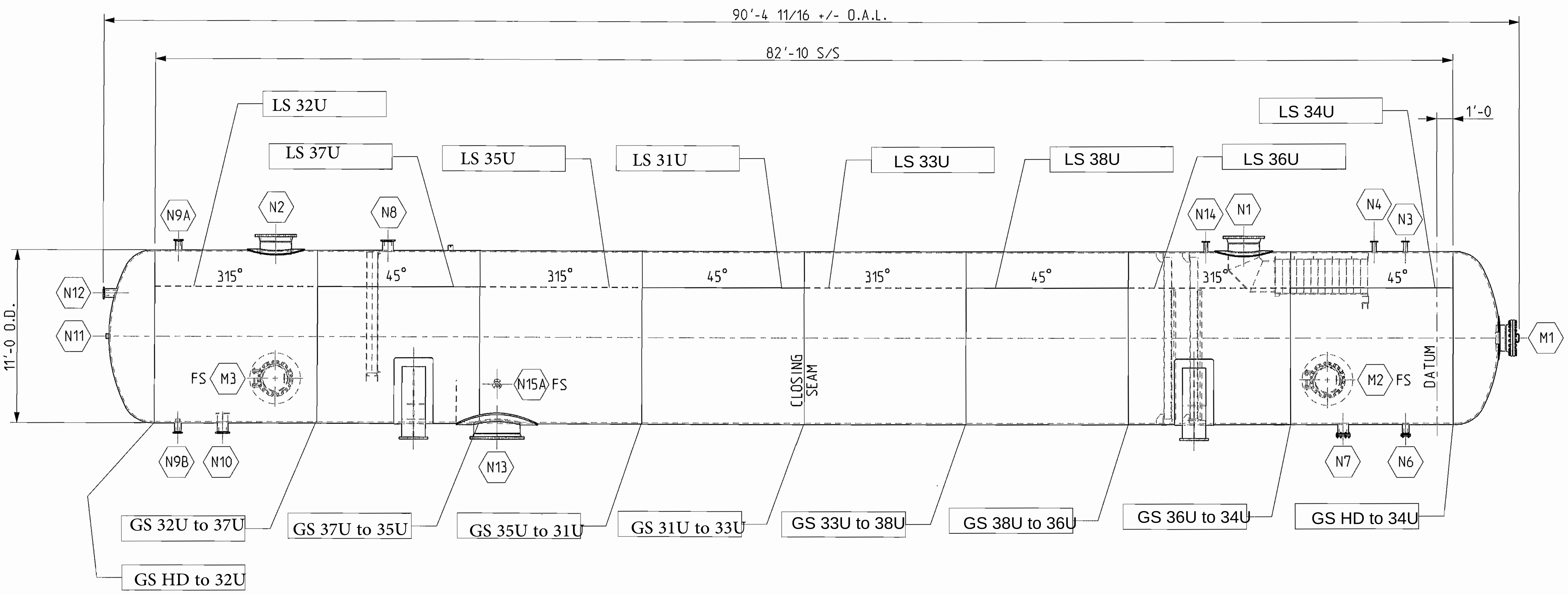
EATON METAL PRODUCTS COMPANY LLC

INSPECTION TEST PLAN

INSPECTION ITEM	SIGN / DATE			REMARKS
	EMP QC	*AI	CUSTOMER	
ASME CODE DATA SHEET	H – POC 5.15.19	H – POC 5/15/19	5/15/18	Completed and signed by AI U1A
FINAL DOCUMENT PACKAGE	H – POC 5.17.19		7/24/2019	Final document package to include: Document Index Log ✓ Manufacturers Data Report (U-1A) ✓ Nameplate Picture ✓ Manufacturers Drawings ✓ Design Calculations ✓ MTRs ✓ WPS/PQR ✓ NDE Records ✓ Completed ITP ✓ Weld Map Description ✓ Hydro Test Record ✓ NCRs N/A
COMPLETED ITP	H – POC 5.17.19		7/24/2019	All items requiring above shall be initialed by EMP QC and any items noted shall be initialed by the AI and Customer.
RELEASE FOR SHIPMENT	H – POC 5.17.19		7/24/2019	Documentation for the customer allowing the vessel to ship to job site. To be stored, recommend pre ship inspection as well by customer

SUMMARY

PLANT 2 (SLC) SCOPE: (SLC, UT)	**PLANT 3 (POC) SCOPE: (Pocatello, ID)**	**Inspection Legend:**
Fabricate 2 Halves	Closing Seam Hydro Vessel Paint Vessel	H = Hold Point IP = In Process Inspection W = Witness Point * = AI to set Hold points at beginning of job



Nozzle	Qty	Size	Rating	Flange Face	Flange Type		Service	Remarks
M3	1	20"	150#	RF	WN		MANWAY	w/ HINGE
M2	1	20"	150#	RF	WN		MANWAY	w/ HINGE
M1	1	20"	150#	RF	WN		MANWAY	w/ HINGE
N18	1	3"	150#	RF	LWN		DRAIN (IN BOOT)	
N17A/B	2	3"	150#	RF	LWN		SPARE LEVEL (IN BOOT)	
N16	1	4"	150#	RF	WN		WATER OUTLET (IN BOOT)	w/ INT PIPE
N15B/C	2	3"	150#	RF	LWN		LEVEL GAUGE (IN BOOT)	
N15A	1	3"	150#	RF	WN		LEVEL (BOOT INTERFACE)	
N14	1	2"	150#	RF	LWN		HP DRAIN RECYCLE	
N13	1	36"	150#	RF	WN		BOOT	SERIES "B"
N12	1	4"	150#	RF	LWN		LAHH	
N11	1	2"	6000#	FNPT	CPLG		SPARE	
N10	1	6"	150#	RF	LWN		LIQUID OUTLET (OIL)	w/ V.B.
N9A/B	2	3"	150#	RF	LWN		BRIDLE	w/ STINGER (N9B)
N8	1	6"	150#	RF	LWN		PSV	
N7	1	6"	150#	RF	LWN		DRAIN	w/ BLIND
N6	1	3"	150#	RF	LWN		DRAIN	w/ BLIND
N4	1	2"	150#	RF	LWN		PUMP RECYCLE	
N3	1	2"	150#	RF	LWN		VRU RECYCLE	
N2	1	24"	150#	RF	WN		OUTLET	
N1	1	24"	150#	RF	WN		INLET	w/ OIFFUSER

NOZZLE SCHEDULE

APPROVED
FOR CONSTRUCTION
DATE 11/8/18 BY

No.	Date	By	Chk'd	Revision Description

EATON METAL PRODUCTS CO LLC
DENVER -- SALT LAKE CITY

WELD MAP
132" OD x 82'-10" S/S INLET SLUG CATCHER
P.O. # 4500100246 - TAG # V-1000
Loc: JOHNSTOWN COMPRESSOR STATION, COLORADO
Cust: ANADARKO E&P ONSHORE LLC

Drawn By: RT
Date: 10/23/2018
Chk'd By:
Date: 11/8/18

EMP Job No. 5361-S01
Dwg. No. D-5361-1WM
REV

EATON METAL PRODUCTS COMPANY LLC

IN-PROCESS INSPECTION RECORD AND WELD MAP DESCRIPTION

JOB NUMBER 5361-1

VESSEL SERIAL NUMBER ______________

DESCRIPTION	FIT-UP	WELDER ID & PROCEDURE KEY		VISUAL ACCEPT	NDE ACCEPT/TYPE		
Weld GS HD /32U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Girth Seam	RS	LK II	LK II		Spot		
MK 1-1 to 1-3				Lead RK			
Head to Shell	DG			QC DG	SD		
Weld LS 32U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Long Seam	BS	RC II	RC II		100%		
MK 1-3				Lead RK			
Shell	DG			QC DG	SD		
Weld GS 32U/37U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Girth Seam	RS	LK II	LK II		Spot		
MK 1-3 to 1-2				Lead RK			
Shell to Shell	DG			QC DG	SD		
Weld LS 37U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Long Seam	BS	RC II	RC II		100%		
MK 1-2				Lead RK			
Shell	DG			QC DG	SD		
Weld GS 37U/35U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Girth Seam	RS	CC II	LK II		Spot		
MK 1-2 to 1-2				Lead RK			
Shell to Shell	DG			QC DG	SD		
Weld LS 35U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Long Seam	BS	RC II	RC II		100%		
MK 1-2				Lead RK			
Shell	DG			QC DG	SD		
Weld GS 35U/31U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Girth Seam	RS	CC II	CC II		Spot		
MK 1-2 to 1-3				Lead RK			
Shell to Shell	DG			QC DG	SD		
Weld LS 31U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Long Seam	BS	RC II	RC II		100%		
MK 1-3				Lead RK			
Shell	DG			QC DG	SD		
Weld GS 31U/33U	POC #3	INSIDE	OUTSIDE	POC #3	RT		
Girth Seam	JS	JS I	FZ I		Spot		
MK 1-3 to 1-3	BA	NS I	GG I	Lead SA	JM		
Shell to Shell CS	AD			QC AD	AD		
Weld LS 33U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Long Seam	BS	RC II	RC II		100%		
MK 1-3				Lead RK			
Shell	DG			QC DG	SD		
Weld GS 33U/38U	SLC #2	INSIDE	OUTSIDE	POC #3	RT		
Girth Seam	RS	FZ III	FZ III		Spot		
MK 1-3 to 1-2				Lead SA	JM		
Shell to Shell	DG			QC AD	AD		
Weld LS 38U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Long Seam	BS	RC II	RC II		100%		
MK 1-2				Lead RK			
Shell	DG			QC DG	SD		
Weld GS 38U/36U	SLC #2	INSIDE	OUTSIDE	POC #3	RT		
Girth Seam	RS	JF III	JF III		Spot		
MK 1-2 to 1-2		FZ III	FZ III	Lead SA	JM		
Shell to Shell	DG			QC AD	AD		
Weld LS 36U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Long Seam	BS	RC II	RC II		100%		
MK 1-2				Lead RK			
Shell	DG			QC DG	SD		
Weld GS 36U/34U	SLC #2	INSIDE	OUTSIDE	POC #3	RT		
Girth Seam	RS	JF III	JF III		Spot		
MK 1-2 to 1-3				Lead SA	JM		
Shell to Shell	DG			QC AD	AD		
Weld LS 34U	SLC #2	INSIDE	OUTSIDE	SLC #2	RT		
Long Seam	BS	RC II	RC II		100%		
MK 1-3				Lead RK			
Shell	DG			QC DG	SD		

EATON METAL PRODUCTS COMPANY LLC

IN-PROCESS INSPECTION RECORD AND WELD MAP DESCRIPTION

JOB NUMBER 5361-1

VESSEL SERIAL NUMBER ____________

DESCRIPTION	FIT-UP	WELDER ID & PROCEDURE KEY		VISUAL ACCEPT	NDE ACCEPT/TYPE		
Weld GS 34U/HD Girth Seam MK 1-3 to 1-1 Shell to Head	SLC #2 CC DG	INSIDE FZ III	OUTSIDE JF III FZ III	POC #3 Lead SA QC AD	RT Spot JM AD		
Nozzle N1 RFWN to Pipe 1D-9 to 1D-2	SLC #2 JW DG	INSIDE JW IV	OUTSIDE JW IV	SLC #2 Lead RK QC DG			
Nozzle N1 Pipe to Shell 1D-9 to 1-2	POC #3 JS AD	INSIDE NS I	OUTSIDE JS I	POC #3 Lead SA QC AD			
Nozzle N1 Pipe to Repad 1D-9 to 1D-14	POC #3 JS AD		OUTSIDE NF I	POC #3 Lead SA QC AD			
Nozzle N1 Repad to Shell 1D-14 to 1-2	POC #3 JS AD	INSIDE CD I NS I	OUTSIDE JS I	POC #3 Lead SA QC AD		POC #3 Air Test AD	
Nozzle N1 Pipe to Pipe 1G-4 to 1D-9	POC #3 CD BA AD	INSIDE CD IX	OUTSIDE CD IX	POC #3 Lead SA QC AD			
Nozzle N2 RFWN to Pipe 1D-9 to 1D-2	SLC #2 JW DG	INSIDE JW IV	OUTSIDE JW IV	SLC #2 Lead RK QC DG			
Nozzle N2 Pipe to Shell 1D-9 to 1-3	SLC #2 RS RK DG	INSIDE SW I JE I	OUTSIDE SW I	SLC #2 Lead RK QC DG			
Nozzle N2 Pipe to Repad 1D-9 to 1D-14	SLC #2 RS RK DG		OUTSIDE SW I	SLC #2 Lead RK QC DG			
Nozzle N2 Repad to Shell 1D-14 to 1-3	SLC #2 RS DG		OUTSIDE JE I	SLC #2 Lead RK QC DG		SLC #2 Air Test DG	
Nozzle N3 RFLWN to Shell 1D-7 to 1-3	POC #3 JS AD	INSIDE CD I	OUTSIDE JS I	POC #3 Lead SA QC AD			
Nozzle N4 RFLWN to Shell 1D-7 to 1-3	POC #3 JS AD	INSIDE CD I	OUTSIDE JS I	POC #3 Lead SA QC AD			
Nozzle N6 RFLWN to Shell 1D-5 to 1-3	POC #3 BA AD	INSIDE JF I	OUTSIDE JS I NF I	POC #3 Lead SA QC AD			
Nozzle N7 RFLWN to Shell 1D-3 to 1-3	POC #3 BA AD	INSIDE JF I	OUTSIDE JS I NF I	POC #3 Lead SA QC AD			
Nozzle N8 RFLWN to Shell 1D-3 to 1-2	SLC #2 CC SW DG	INSIDE JE I	OUTSIDE RS I	SLC #2 Lead RK QC DG			
Nozzle N9A RFLWN to Shell 1D-5 to 1-3	SLC #2 CC SW DG	INSIDE SW I	OUTSIDE RS I	SLC #2 Lead RK QC DG			

EATON METAL PRODUCTS COMPANY LLC

IN-PROCESS INSPECTION RECORD AND WELD MAP DESCRIPTION

JOB NUMBER 5361-1

VESSEL SERIAL NUMBER ________________

DESCRIPTION	FIT-UP	WELDER ID & PROCEDURE KEY		VISUAL ACCEPT	NDE ACCEPT/TYPE		
Nozzle N9B RFLWN to Shell 1D-5 to 1-3	SLC #2 CC SW DG	INSIDE JE I	OUTSIDE RS I	SLC #2 Lead RK QC DG			
Nozzle N9B Pipe to RFLWN 1D-11 to 1D-5	SLC #2 RK DG		OUTSIDE JW I	SLC #2 Lead RK QC DG			
Nozzle N10 RFLWN to Shell 1D-3 to 1-3	SLC #2 RK DG	INSIDE JE I	OUTSIDE SW I	SLC #2 Lead RK QC DG			
Nozzle N10 Plate to RFLWN 1D-16 to 1D-3	SLC #2 SW DG		OUTSIDE SW I	SLC #2 Lead RK QC DG			
Nozzle N10 Plate to RFLWN 1D-17 to 1D-3	SLC #2 SW DG		OUTSIDE SW I	SLC #2 Lead RK QC DG			
Nozzle N11 Coupling to Head 1D-8 to 1-1	SLC #2 RS DG	INSIDE RS I	OUTSIDE RS I	SLC #2 Lead RK QC DG			
Nozzle N12 RFLWN to Head 1D-4 to 1-1	SLC #2 RS DG	INSIDE RS I	OUTSIDE RS I	SLC #2 Lead RK QC DG			
Nozzle N13 RFWN to Pipe 1D-1 to 1D-12	SLC #2 JW DG	INSIDE JW IV	OUTSIDE JW IV	SLC #2 Lead RK QC DG			
Nozzle N13 Pipe to Shell 1D-12 to 1-2	SLC #2 RS RK DG	INSIDE JE I SW I	OUTSIDE RS I CC I SW I	SLC #2 Lead RK QC DG			
Nozzle N13 Pipe to Repad 1D-12 to 1D-13	SLC #2 RS RK DG		OUTSIDE RS I CC I SW I	SLC #2 Lead RK QC DG			
Nozzle N13 Repad to Shell 1D-13 to 1-2	SLC #2 RS SW DG		OUTSIDE RS I CC I SW I	SLC #2 Lead RK QC DG		SLC #2 Air Test DG	
Boot Long Seam MK# 1H-2	SLC #2 BS DG	INSIDE JW IV	OUTSIDE JW IV	SLC #2 Lead RK QC DG			
Boot RFWN to Plate 1H-1 to 1H-2	SLC #2 JW DG	INSIDE JW III	OUTSIDE JW III	SLC #2 Lead RK QC DG			
Boot Plate to Head 1H-2 to 1H-3	SLC #2 JW DG	INSIDE JW IV	OUTSIDE JW III	SLC #2 Lead RK QC DG			
Nozzle N14 RFLWN to Shell 1D-7 to 1-2	POC #3 JS AD	INSIDE CD I	OUTSIDE NS I	POC #3 Lead SA QC AD			
Nozzle N15A RFWN to Pipe 1D-6 to 1D-10	SLC #2 RK DG	INSIDE JW VI	OUTSIDE JW VI	SLC #2 Lead RK QC DG			

EATON METAL PRODUCTS COMPANY LLC

IN-PROCESS INSPECTION RECORD AND WELD MAP DESCRIPTION

JOB NUMBER 5361-1

VESSEL SERIAL NUMBER ____________

DESCRIPTION	FIT-UP	WELDER ID & PROCEDURE KEY		VISUAL ACCEPT	NDE ACCEPT/TYPE		
Nozzle N15A Pipe to Shell 1D-10 to 1-2	SLC #2 RS DG	INSIDE SW I	OUTSIDE JE I	SLC #2 Lead RK QC DG			
Nozzle N15B RFLWN to Boot 1H-5 to 1H-2	SLC #2 RK DG	INSIDE JW IV	OUTSIDE JW IV	SLC #2 Lead RK QC DG			
Nozzle N15C RFLWN to Boot 1H-5 to 1H-2	SLC #2 RK DG	INSIDE JW IV	OUTSIDE JW IV	SLC #2 Lead RK QC DG			
Nozzle N16 RFWN to Pipe 1H-4 to 1H-6	SLC #2 JW DG	INSIDE JW III	OUTSIDE JW III	SLC #2 Lead RK QC DG			
Nozzle N16 Pipe to Pipe 1H-6 to 1H-7	SLC #2 JW DG	INSIDE JW III	OUTSIDE JW III	SLC #2 Lead RK QC DG			
Nozzle N16 Pipe to Boot 1H-6 to 1H-2	SLC #2 JW DG	INSIDE KE IV	OUTSIDE KE IV	SLC #2 Lead RK QC DG			
Nozzle N17A RFLWN to Boot 1H-5 to 1H-2	SLC #2 RK DG	INSIDE KE IV	OUTSIDE KE IV	SLC #2 Lead RK QC DG			
Nozzle N17B RFLWN to Boot 1H-5 to 1H-2	SLC #2 RK DG	INSIDE KE IV	OUTSIDE JW IV	SLC #2 Lead RK QC DG			
Nozzle N18 RFLWN to Head 1H-5 to 1H-3	SLC #2 RK KE DG	INSIDE JW IV	OUTSIDE JW IV	SLC #2 Lead RK QC DG			
Nozzle M1 RFWN to Pipe 1C-1 to 1C-13	SLC #2 JW DG	INSIDE JW III	OUTSIDE JW III	SLC #2 Lead RK QC DG			
Nozzle M1 Pipe to Head 1C-13 to 1-1	SLC #2 JW JE DG	INSIDE JE I	OUTSIDE JE I	SLC #2 Lead RK QC DG			
Nozzle M1 Pipe to Repad 1C-13 to 1C-14	SLC #2 JE JE DG		OUTSIDE JE I	SLC #2 Lead RK QC DG			
Nozzle M1 Repad to Head 1C-14 to 1-1	SLC #2 JE JE DG		OUTSIDE JE I	SLC #2 Lead RK QC DG		SLC #2 Air Test DG	
Nozzle M1 Plate to RFWN 1C-6 to 1C-1	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Nozzle M1 Plate to RFWN 1C-5 to 1C-1	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Nozzle M1 Plate to Blind 1C-4 to 1C-2 x2	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			

EATON METAL PRODUCTS COMPANY LLC

IN-PROCESS INSPECTION RECORD AND WELD MAP DESCRIPTION

JOB NUMBER 5361-1

VESSEL SERIAL NUMBER ____________

DESCRIPTION	FIT-UP	WELDER ID & PROCEDURE KEY		VISUAL ACCEPT	NDE ACCEPT/TYPE		
Nozzle M1 Rod to Blind 1C-8 to 1C-2	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Nozzle M2 RFWN to Pipe 1J-1 to 1J-13	SLC #2 JW DG	INSIDE JW III	OUTSIDE JW III	SLC #2 Lead RK QC DG			
Nozzle M2 Pipe to Shell 1J-13 to 1-3	POC #3 JS AD	INSIDE CD I	OUTSIDE NS I	POC #3 Lead SA QC AD			
Nozzle M2 Pipe to Repad 1J-13 to 1J-14	POC #3 JS AD		OUTSIDE CD I	POC #3 Lead SA QC AD			
Nozzle M2 Repad to Shell 1J-14 to 1-3	POC #3 JS AD		OUTSIDE JS I	POC #3 Lead SA QC AD		POC #3 Air Test AD	
Nozzle M2 Plate to RFWN 1J-5 to 1J-1	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Nozzle M2 Plate to RFWN 1J-6 to 1J-1	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Nozzle M2 Plate to Blind 1J-4 to 1J-2	POC #3 JB AD		OUTSIDE JB	POC #3 Lead SA QC AD			
Nozzle M2 Rod to Blind 1J-8 to 1J-3	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Nozzle M3 RFWN to Pipe 1J-1 to 1J-13	SLC #2 JW DG	INSIDE JW III	OUTSIDE JW III	SLC #2 Lead RK QC DG			
Nozzle M3 Pipe to Shell 1J-13 to 1-3	SLC #2 RS DG	INSIDE SW I	OUTSIDE RS I SW I	SLC #2 Lead RK QC DG			
Nozzle M3 Pipe to Repad 1J-13 to 1J-14	SLC #2 RS DG		OUTSIDE SW I	SLC #2 Lead RK QC DG			
Nozzle M3 Repad to Shell 1J-14 to 1-3	SLC #2 RS DG		OUTSIDE SW I RS I	SLC #2 Lead RK QC DG		SLC #2 Air Test DG	
Nozzle M3 Plate to RFWN 1J-5 to 1J-1	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Nozzle M3 Plate to RFWN 1J-6 to 1J-1	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Nozzle M3 Plate to Blind 1J-4 to 1J-2	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			

EATON METAL PRODUCTS COMPANY LLC

IN-PROCESS INSPECTION RECORD AND WELD MAP DESCRIPTION

JOB NUMBER 5361-1

VESSEL SERIAL NUMBER ____________

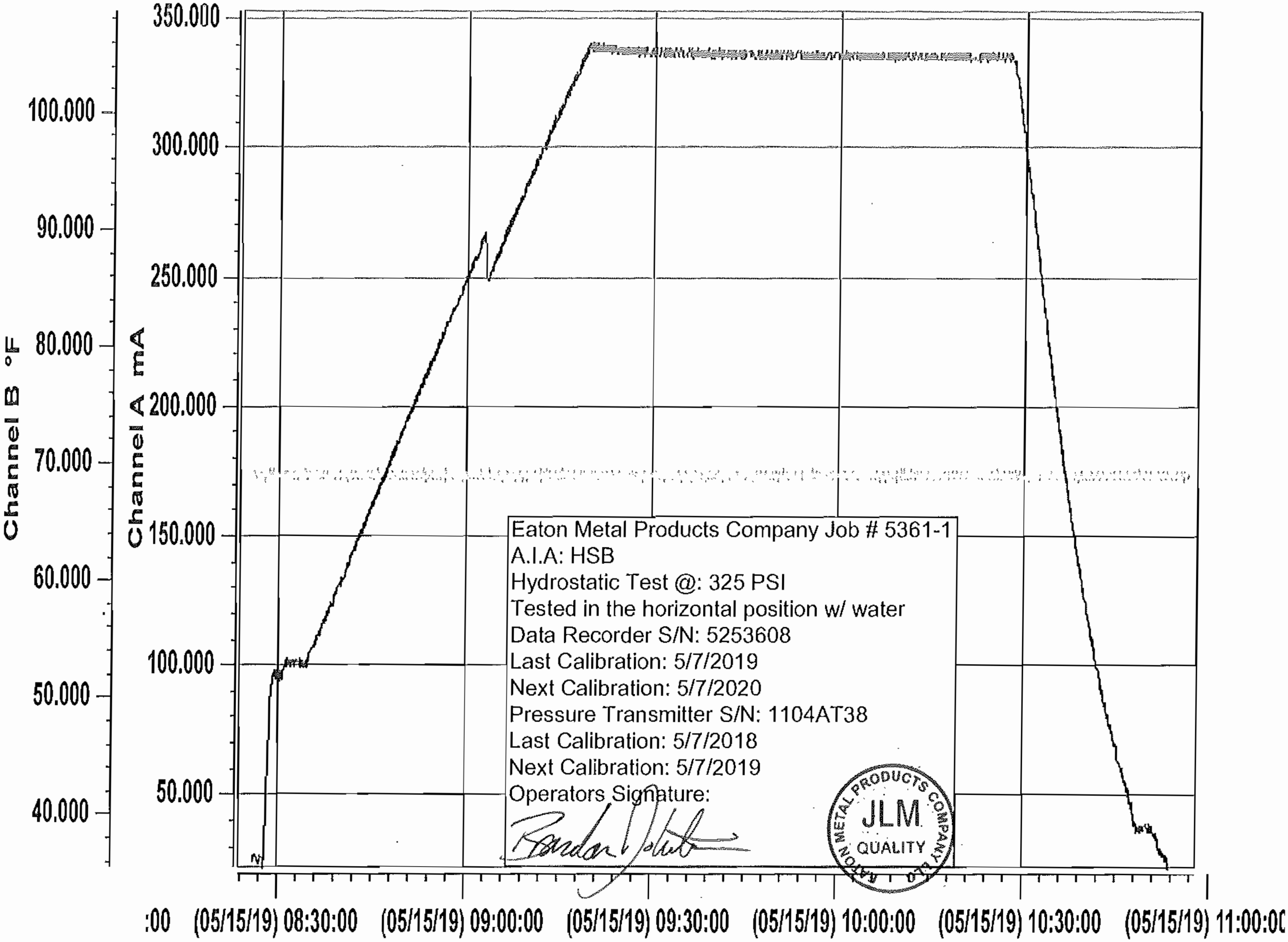
DESCRIPTION	FIT-UP	WELDER ID & PROCEDURE KEY		VISUAL ACCEPT	NDE ACCEPT/TYPE		
Nozzle M3 Rod to Blind 1J-8 to 1J-2	POC #3 JB AD		OUTSIDE JB I	POC #3 Lead SA QC AD			
Internals Weir Plate Plate to Shell 1E-3 to 1-2	SLC #2 JW DG		OUTSIDE CC I RS I	SLC #2 Lead RK QC DG			
Internals Vane Pack Plate to Shell 1E-1 to 1-2	SLC #2 JW DG		OUTSIDE CC I RP I	SLC #2 Lead RK QC DG			
Internals Plate Plate to Shell 1F-1 to 1-2	POC #3 BA AD		OUTSIDE CD IX NS IX	POC #3 Lead SA QC AD			
Internals Plate Plate to Shell 1F-3 to 1-2	POC #3 BA AD		OUTSIDE CD IX NS IX	POC #3 Lead SA QC AD			
Internals Plate Plate to Shell 1F-4 to 1-2	POC #3 BA AD		OUTSIDE CD IX NS IX	POC #3 Lead SA QC AD			
Internals Plate Plate to Shell 1G-7 to 1-2-3 x2	POC #3 BA AD		OUTSIDE CD IX NS IX	POC #3 Lead SA QC AD			
Internals Plate Plate to Shell 1G-8 to 1-3 x2	POC #3 BA AD		OUTSIDE CD IX NS IX	POC #3 Lead SA QC AD			
Internals Plate Plate to Shell 1G-9 to 1-3 x2	POC #3 BA AD		OUTSIDE CD IX NS IX	POC #3 Lead SA QC AD			
Internals Plate Plate to Shell 1G-10 to 1-3	POC #3 BA AD		OUTSIDE GG IX	POC #3 Lead SA QC AD			
Name Plate Plate to Head 1-4 to 1-1	POC #3 JS AD		OUTSIDE JS I	POC #3 Lead SA QC AD			
Saddle Pad Plate to Shell 1B-8 to 1-2 Left	POC #3 JS AD		OUTSIDE CD I	POC #3 Lead SA QC AD			
Saddle Pad Plate to Shell 1B-8 to 1-2 Right	POC #3 JS AD	INSIDE	OUTSIDE CD I	POC #3 Lead SA QC AD			

WELD PROCEDURE KEY:

I = P1-P1-GMAWP-AL
II = P1-P1-EM14KT-A
III = P1-P1-EM14K1-A
IV = P1-P1-EM14K2-A
V= P1-P1-FCAW-AL

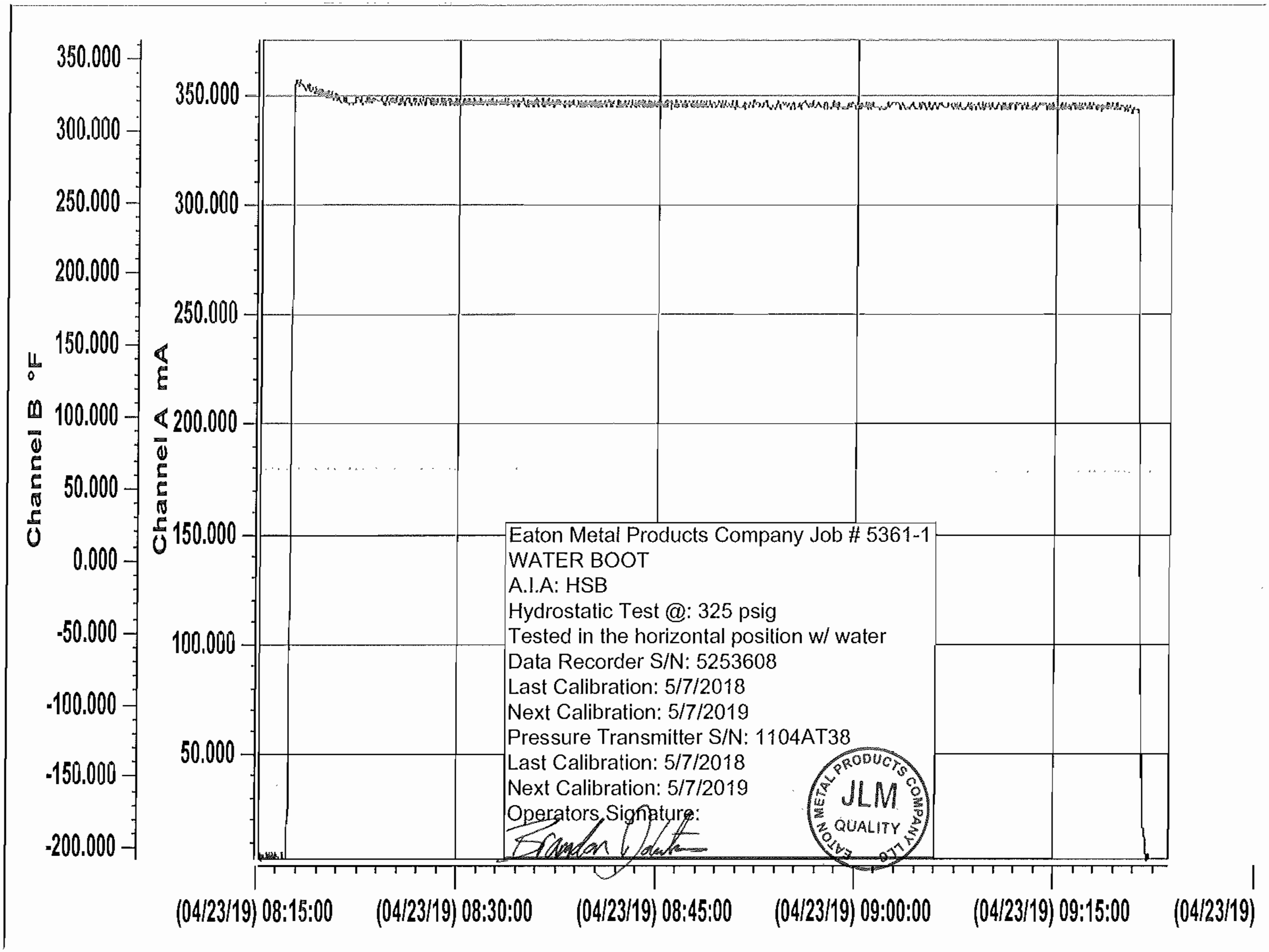
VI = P1-P1-GTAW-AL
VII = P1-P1-GMAWP-STT-A
VIII = P1-P8-FCAW-AL
IX= P1-P8-GMAWP-A
X= P1-P8-GTAW-AL

XI = P8-P8-GMAWP-A
XII = P8-P8-GTAW-AL
XIII= P8-P8-SMAW-A
XIV=
XV=



Eaton Metal Products Company Job # 5361-1
A.I.A: HSB
Hydrostatic Test @: 325 PSI
Tested in the horizontal position w/ water
Data Recorder S/N: 5253608
Last Calibration: 5/7/2019
Next Calibration: 5/7/2020
Pressure Transmitter S/N: 1104AT38
Last Calibration: 5/7/2018
Next Calibration: 5/7/2019
Operators Signature:

JLM
QUALITY



Eaton Metal Products Company Job # 5361-1
WATER BOOT
A.I.A: HSB
Hydrostatic Test @: 325 psig
Tested in the horizontal position w/ water
Data Recorder S/N: 5253608
Last Calibration: 5/7/2018
Next Calibration: 5/7/2019
Pressure Transmitter S/N: 1104AT38
Last Calibration: 5/7/2018
Next Calibration: 5/7/2019
Operators Signature:

JLM
QUALITY

Eaton Metal Products CO, LLC
Daily Coating Inspection Report

Date:	5-13-19	M T W [✓ Th] F S Su	Page 1 of 4
Job #:	5361-1		Attachments
Inspector:	Jake Mowat		☒ DFT Sheet ☐ NCR ☐ ☐

Customer:	ANADARKO		
Location:	Pocatello, ID		
Description:	132" ID Inlet Slug Ca.		
Requirements:	See paint sheet		
Contractor:	Airless	Spec. #	5361-PS1

Notes

SSPC-SP5 White Metal Blast(Green Diamond Media)

~~Finish Coat: 15.0 - 30.0 mils (INTERIOR COATING)~~

~~Sherwin-Williams Nova-Plate UHS Epoxy Novolac Tank~~

~~Lining~~

~~Light Gray~~

40 mil MAX DFT in areas that have been stripe coated.

SSPC 6 commercial blast

primer 5-10 mils

Sherwin Williams Macropoxy 646 Epoxy

Carlsbad Canyon tan

Hold Point Inspections Performed

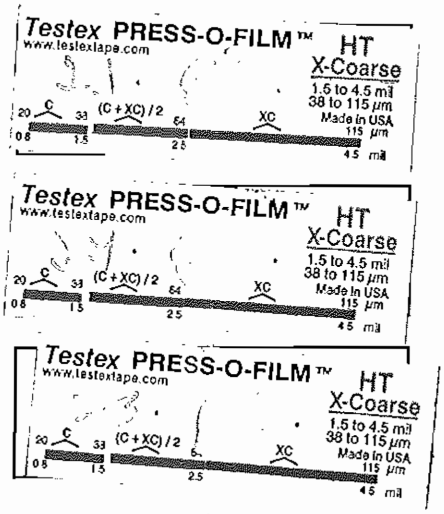
- ☐ 1. Pre Surface Prep/Condition & Cleanliness
- ☐ 2. Surface Preparation Monitoring
- ☒ 3. Post surface Preparation/Cleanliness & Profile
- ☐ 4. Pre Application Prep/Surface Cleanliness
- ☐ 5. Application Monitoring/Wet Film Thickness (WFT)
- ☒ 6. Post Application/Application Defects
- ☒ 7. Post Cure/Dry Film Thickness (DFT)
- ☐ 8. Nonconformance/corrective Actions Follow-up
- ☐ 9. Holiday Testing Per 1.5.5 of APC Spec.
- ☐ 10. Final Inspection

Approved By: J Mowat

Ambient Conditions

Time (am or pm)	5:30 AM			
Dry Bulb Temp° (C/F) or Ambient	69.8			
Wet Bulb Temp° (C/F)	53.2			
% Relative Humidity	21.9			
Surface Temp° (C/F) Min/Max				
Dew Point Temp° (C/F)	36.8			
Wind Direction / Speed (mph)	W-15 mph	mph	mph	mph
Weather Conditions	cloudy			

Testex Tape



Average Profile in mils:________mils

Start Time Finish Time Est. Sq/ft.

☐ Primer ☐ Intermediate ☐ Topcoat ☐ Touch-up

Generic Type:	Qty Mixed: 30 gal.
Manuf.: Sherwin William	Mix Ratio: 1 to 1
Prod. Name: Macropoxy 646	Mix Method: Drill
Prod. #: B58 W600	Strain/Screen: 60 mesh.
Color: Carlsbad canyon Tan	Material Temp: 74 °F
Kit Sz/Cond.: 10 gal.	Sweat-in Time 30 [✓ Min]/Hrs
Shelf Life 24 mo.	Pot Life: 4 Min/[✓ Hrs]
Batch #'s	Reducer #: n/a
(A) XM 0729CVL	Qty Added: NA Pt/Qt/Gal
(B) VM 347826	% by Vol: NA %
(C)	Specific WFT Avg: 10-12 Mils
Reducer:	Achieved WFT Avg: 10-12 Mils

☒ Airless/Conv. Spray ☐ Brush ☐ Roller

☐ Other: __________

☐ Air Cleanliness Check ☒ Oil Seperator Check

☒ Filter Check / Replace ☐ Agitator Check

PSI (A) 3500

PSI (B)

Surface Cleanliness & Profile Measurement

☒ SSPC/NACE-SP- 6

☐ SSPC/NACE Spec/Vis Stds: ________

☐ Specified ______ mils avg./Achieved______mils

	5/13-19
Painter's Signature	Date

		J Mowat	5.13.19
Customer's Inspector / Representative	Date	Inspector's Signature	Date

Eaton Metal Products CO, LLC

DFT Measurement Worksheet

Date: 5-17-19 [✓ M] T W Th F S Su

Page 2 of 4

Job #: 5361-1

Description: 132" ID Inlet Slug Ca.

Customer: ANADARKO

Inspector: Jake Mowat

Location: Pocatello, ID

0

Contractor: Airless

Spec.# 5361-PS1

Item:							
Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
	A	7.7	8.4	9.3	25.4	4.0	8.4
0	B	8.0	8.7	9.0	25.7	4.0	8.5
0	C	6.1	5.8	5.7	17.6	4.0	5.8
0	D	5.9	6.4	8.0	20.3	4.0	6.7
0	E	8.3	8.4	9.2	25.9	4.0	8.6
Approx. Sq/Ft	3600				114.9		7.6
	Specified DFT 5-10		mils/µm		Total DFT 5-10		mils/µm
Reference Inspection Report Page#							

Item:							0
Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	8.4	10.1	8.3	26.8	4.0	8.9
0	B	8.9	9.2	8.7	26.8	4.0	8.9
0	C	8.6	9.8	8.4	27.8	4.0	9.2
0	D	8.1	9.7	8.4	26.2	4.0	8.7
0	E	8.3	10.2	8.8	27.3	4.0	9.1
Approx. Sq/Ft	3600				134.9		8.9
	Specified DFT 5-10		mils/µm		Total DFT 5-10		mils/µm
Reference Inspection Report Page#							

Item:							0
Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	10.6	7.9	7.8	26.3	4.0	8.7
0	B	10.2	9.3	9.1	28.6	4.0	9.5
0	C	8.0	9.4	9.4	26.8	4.0	8.9
0	D	8.3	7.7	8.0	24	4.0	8.0
0	E	7.4	8.3	6.1	21.8	4.0	7.2
Approx. Sq/Ft	3600				127.5		8.5
	Specified DFT 5-10		mils/µm		Total DFT 5-10		mils/µm
Reference Inspection Report Page#							

Item:							0
Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	6.4	8.0	8.4	22.4	4.0	7.6
0	B	8.2	7.6	8.1	23.9	4.0	7.9
0	C	7.0	7.3	8.0	22.3	4.0	7.4
0	D	10.6	8.7	9.3	28.6	4.0	9.5
0	E	9.1	9.4	5.9	24.4	4.0	8.1
Approx. Sq/Ft	3600				121.6		8.1
	Specified DFT 5-10		mils/µm		Total DFT 5-10		mils/µm
Reference Inspection Report Page#							

Item:							0
Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	6.7	6.3	7.4	20.4	4.0	6.8
0	B	8.0	8.9	9.5	26.4	4.0	8.8
0	C	10.1	8.6	6.0	24.7	4.0	8.2
0	D	6.2	6.4	7.3	19.9	4.0	6.6
0	E	8.0	8.1	8.1	24.2	4.0	8.0
Approx. Sq/Ft	3600				115.6		7.7
	Specified DFT 5-10		mils/µm		Total DFT 5-10		mils/µm
Reference Inspection Report Page#							

Item:							0
Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	8.6	9.2	8.7	26.5	4.0	8.8
0	B	5.8	8.0	8.4	22.2	4.0	7.4
0	C	5.6	5.9	7.2	18.7	4.0	6.2
0	D	6.4	6.9	6.7	20.0	4.0	6.6
0	E	8.1	8.4	8.7	25.4	4.0	8.4
Approx. Sq/Ft	3600				112.8		7.5
	Specified DFT 5-10		mils/µm		Total DFT 5-10		mils/µm
Reference Inspection Report Page#							

DFT GAGE CALIBRATION RECORD

Gage Type Model	Gage S/N	Plate Shim mils	BMR	Adjust +/-	Spec. Avg DFT	DFT Last Coat	DFT This Coat
Positector 6000	635619	80	0.17				

Comments:

5-17-19

Contractor's Signature Date

Customer's Inspector / Representative Date

J Mowat 5.17.19

Inspector's Signature Date

Eaton Metal Products CO, LLC
Daily Coating Inspection Report

Date:	5-6-19	M T W [✓ Th] F S Su	Page 3 of 4
Job #:	5361-1		Attachments
Inspector:	Jake Mowat		☒ DFT Sheet ☐ NCR ☐ ☐

Customer:	ANADARKO	
Location:	Pocatello, ID	
Description:	132" ID Inlet Slug Ca.	
Requirements:	See paint sheet	
Contractor:	Airless	Spec. # 5361-PS1

Notes

SSPC-SP6 Commercial Blast Cleaning

~~Primer Coat: 5.0 - 10.0 mils~~

~~Sherwin-Williams Macropoxy 646 Fast Cure Epoxy~~

~~Carlsbad Canyon Tan~~

sspc 5 white metal Blast

Nova plate uHS Epoxy novolac

lining

light gray

40 mil MAX DFT in areas that

have been strip coated

Hold Point Inspections Performed

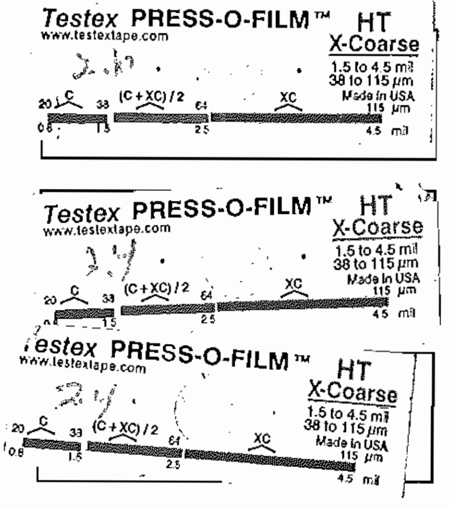
- ☐ 1. Pre Surface Prep/Condition & Cleanliness
- ☐ 2. Surface Preparation Monitoring
- ☒ 3. Post surface Preparation/Cleanliness & Profile
- ☐ 4. Pre Application Prep/Surface Cleanliness
- ☐ 5. Application Monitoring/Wet Film Thickness (WFT)
- ☒ 6. Post Application/Application Defects
- ☐ 7. Post Cure/Dry Film Thickness (DFT)
- ☐ 8. Nonconformance/corrective Actions Follow-up
- ☒ 9. Holiday Testing Per 1.5.5 of APC Spec.
- ☒ 10. Final Inspection

Approved By: J. Mowat

Ambient Conditions

Time (am or pm)	9:20			
Dry Bulb Temp° (C/F) or Ambient	75.3			
Wet Bulb Temp° (C/F)	55.2			
% Relative Humidity	26.5			
Surface Temp° (C/F) Min/Max				
Dew Point Temp° (C/F)	38.3			
Wind Direction / Speed (mph)	none mph c-told.	mph	mph	mph
Weather Conditions	p-cloud.			

Testex Tape



Average Profile in mils:__________mils

Start Time	Finish Time	Est. Sq/ft.	
☒ Primer	☐ Intermediate	☐ Topcoat	☐ Touch-up

Generic Type:	Qty Mixed: 45 gal.
Manuf.: Sherwin williams	Mix Ratio: 4 to 1
Prod. Name: Nova plate uHS	Mix Method: Drill
Prod. #: B62A220	Strain/Screen: 60 mesh
Color: light gray	Material Temp: 78.4 °F
Kit Sz/Cond.: 5 gal.	Sweat-in Time 30 [✓ Min]/Hrs
Shelf Life 24 mo	Pot Life: 4 Min/[✓ Hrs]
Batch #'s	Reducer #: n/a
(A) XM0589 1/A	Qty Added: n/a Pt/Qt/Gal
(B) XM07492A	% by Vol: n/A %
(C)	Specific WFT Avg: [illegible] Mils
Reducer:	Achieved WFT Avg: [illegible] Mils

☒ Airless/Conv. Spray ☐ Brush ☐ Roller

☐ Other: __________

Surface Cleanliness & Profile Measurement

☒ SSPC/NACE-SP- 5 white metal

☐ SSPC/NACE Spec/Vis Stds: __________

☐ Specified ________ mils avg./Achieved________mils

☒ Air Cleanliness Check ☒ Oil Seperator Check

☒ Filter Check / Replace ☒ Agitator Check

PSI (A) 3500

PSI (B)

5-6-19

Painter's Signature Date

Customer's Inspector / Representative Date

J. Mowat 5-6-19

Inspector's Signature Date

Eaton Metal Products CO, LLC

DFT Measurement Worksheet

Date: 5-8-19 | M T W Th F S Su | Page 4 of 4

Job #: 5361-1
Description: 132" ID Inlet Slug Ca.
Customer: ANADARKO
Inspector: Jake Mowat
Location: Pocatello, ID
0
Contractor: Airless
Spec.# 5361-PS1

Item:

Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
	A	17.7	15.2	16.0	48.9	12.0	16.3
0	B	16.3	14.8	15.7	46.8	12.0	15.6
0	C	15.9	16.6	16.8	49.3	12.0	16.4
0	D	15.3	15.1	15.1	45.4	12.0	15.1
0	E	14.7	15.0	14.6	44.3	12.0	14.7
Approx. Sq/Ft				3400	234.7		15.6
	Specified DFT 15-35 mils/µm				Total DFT 15-35 mils/µm		

Reference Inspection Report Page#

Item: 0

Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	16.7	17.9	21.8	56.4	12.0	18.8
0	B	14.6	17.0	18.9	50.5	12.0	16.8
0	C	20.1	16.6	16.5	53.2	12.0	17.7
0	D	15.4	14.3	15.9	45.6	12.0	15.2
0	E	17.0	14.6	15.5	47.1	12.0	15.7
Approx. Sq/Ft				3400	252.8		16.8
	Specified DFT 15-35 mils/µm				Total DFT 15-35 mils/µm		

Reference Inspection Report Page#

Item: 0

Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	17.1	17.9	18.4	53.4	12.0	17.8
0	B	18.9	16.6	15.3	50.2	12.0	16.7
0	C	15.1	14.1	15.6	43.8	12.0	14.6
0	D	15.7	16.7	17.2	50.3	12.0	16.7
0	E	15.4	15.9	15.6	46.9	12.0	15.6
Approx. Sq/Ft				3400	244.6		16.3
	Specified DFT 15-35 mils/µm				Total DFT 15-35 mils/µm		

Reference Inspection Report Page#

Item: 0

Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	14.0	15.6	14.9	44.5	12.0	14.8
0	B	15.3	15.9	16.0	47.2	12.0	15.7
0	C	16.5	16.7	17.0	50.2	12.0	16.7
0	D	16.3	15.4	15.9	47.6	12.0	15.8
0	E	14.7	14.7	14.9	44.3	12.0	14.7
Approx. Sq/Ft				3400	233.8		15.5
	Specified DFT 15-35 mils/µm				Total DFT 15-35 mils/µm		

Reference Inspection Report Page#

Item: 0

Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	15.0	15.6	17.9	48.5	12.0	16.1
0	B	21.4	17.6	24.1	63.1	12.0	21
0	C	15.6	16.1	19.8	51.5	12.0	17.1
0	D	17.7	20.4	21.6	59.7	12.0	19.9
0	E	19.6	19.0	17.3	55.9	12.0	18.6
Approx. Sq/Ft				3400	278.7		18.5
	Specified DFT 15-35 mils/µm				Total DFT 15-35 mils/µm		

Reference Inspection Report Page#

Item: 0

Location:	Area	Spot Readings					
		1	2	3	Total	% Min	Avg.
0	A	26.1	20.4	19.4	65.9	12.0	21.9
0	B	17.7	15.9	16.3	49.9	12.0	16.6
0	C	15.9	15.0	16.9	47.8	12.0	15.9
0	D	17.9	18.4	17.3	53.6	12.0	17.8
0	E	19.6	19.9	20.5	59.8	12.0	19.9
Approx. Sq/Ft				3400	277		18.4
	Specified DFT 15-35 mils/µm				Total DFT 15-35 mils/µm		

Reference Inspection Report Page#

DFT GAGE CALIBRATION RECORD

Gage Type Model	Gage S/N	Plate Shim mils	BMR	Adjust +/-	Spec. Avg DFT	DFT Last Coat	DFT This Coat
Positector 6000	635619	14.0	0.79				

Comments:

5-8-19

Contractor's Signature Date

Customer's Inspector / Representative Date

J. Mowat

Inspector's Signature Date