P.O. BOX 677 - KATY, TEXAS 77492 - (281) 392-7747 - FAX (281) 392-7727

Manufacturer Data Book

Marathon Oil Company

Carlsbad, New Mexico

PO# 4500261551

Vertical 2 Phase Separator

Job #18165 Serial #18165-9



Katy: 1435 Katy Flewellen

Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

TABLE OF CONTENTS

Serial# 18165-9

- 1) ASME Code Data Reports
- 2) Name Plate Facsimile
- 3) ASME Code Traveler
- 4) Receiving Inspection Report W/MTR's and Heat Map
- 5) NDE Reports / NDE Tech Certifications
- 6) ASME Code Calculations
- 7) Hydrostatic Traveler w/Chart
- 8) Weld Map
- 9) WPS / PQR's
- 10) Welder Qualification Records
- 11) Inspection and Test Plan
- 12) Coating Report
- 13) Post Weld Heat Treating Report w/Chart
- 14) As-Builts
- **15) Non-Conformation Reports**



Katy: 1435 Katy Flewellen

Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East

Baytown, Tx 77523

SECTION 1 ASME CODE DATA REPORT

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

1.	Manufact	ured a	nd ce	ertified	d by			Moore (Control S	System	s, Inc., 1	435 k	Katy Flew	vellen, Ka	ty, TX	77494		
2.	Manufact	ured fo	or					M		Oil Co	., Carlsb	ad, N	f Manufacti lew Mexi					
							ħ.	Marathon (address of onita St			w Mexico	882	20		
3. 1	Location	of insta	allatio	on —					J., O G., 2		Name and			TV IVICAICO	0022			
4.	Гуре	Ve	rtical			18165-	9 rial number)				165-XXX				19			2018
	(Ho	rizontal c	or verti	cal, tani	k) (Manu	facturer's se	rial number)	(CRN)	,	(Drawing r	numbei	r)	(National	Board r	iumber)		(Year built)
5. /	ASME Co	de, Sed	ction	VIII, [Div. 1 _	[Edition on	2017 Edition of Addenda, if a		4-11		10.1		1)			10		
			SΔ-	516-70	Λ	(Edition an	.375"	ррисавіе (па	0"		(Code		umber) -0" O.D.			Specia	•	r UG-120(d)]
6. 3	Shell	(Materi			er, grade)	(No	minal thickness) (Corr. allow	v.)			er diameter	r)			20'-0" S	
								Body FI	anges on	Shells								
						į.										Bolting		
No.	Туре	ID	(DD F	lange Thk	Min Hub Th	ik Mater	ial	How Atta	iched	Location	Nur	m & Size	Bolting M	eterial		asher ID, thk)	Washer Material
			+-															
-			+-	-			+			-								
7.	Seams _			ype 1	garan			00%		0.119.11	T D i s		Туре			Spot	100%	ć 2
	[Long. (we	elded,	dbl., sn	gl., lap, but	t)] [R.T. (sp		ff., %) (H.T. temp.	.) (Tim	ne, hr) [G	irth (we	elded, dbl.,	sngl., lap, b	utt)]	(R.T. (spo	t (Eff., %	(No. of courses)
8.	Heads: (a) Mate	rial _		······		\-516-70N			(b)	Materia	al				-516-70N		
	Location	on (Top,		Minim	Num I	Corrosion	c. no., grade)	- Kanadia		T			T		T	o., grade)		
		n, Ends)		Thickr	- 1	Allowance	Crown Radius	Knuckle Radius	Ellipti Rat		Conic Apex An		Hemisp Rac	herical dius		Flat meter		to Pressure x or Concave)
(a)	E	nd		.312	:5"	0"			2:	:1								Concave
(b)	E	nd		.312	5"	0"			2:	1						+1		Concave
								Body	Flanges o	on Head	s							
																Bolting		
	Location	Туре		ID	OD	Flange Thk	Min Hub Thk	Mater	rial	How A	Attached	Num	& Size	Bolting M	aterial		asher ID, thk)	Washer Material
(a)		ļ	\perp															
(b)				201							·							
9.	MAWP _		250 (Interi				(External)		at ma	x. tem	р		150 ° (Internal)				(Extern	,
	Min. desig	gn meta	al ten	np	-20 ° F	: at	250 PSI	Hvo	dro and	OU O.F.	comb. t	est ni				Hydro @	325 PSI	ai,
	Proof test									 ,		001 p	000010					
	Nozzles, i				afety val	ve openir	ac.											
	Purpose	Парсскі	1011, 0	1110 30	nety var	ve opeiiii												
(In	let, Outlet, rain, etc.)		No.	Diame or Si	. 1	Туре	Nozzle	laterial	lange		zzle Thickn	orr.	Reinford Mate			chment D		Location
	nway w/Cvr		1	18" 1:		RFSO	SA-106B		A-105	_		0"	SA-51		Weld		lange Velded	(Insp. Open.) Shell
	Inlet		1	6" 15		REWN	SA-106B		A-105			0"	0,1.01		Weld		Velded	Shell
V	/ater Outlet		1	3" 30	00# (CPLG	SA-105			37	75" (ט"			Weld			Shell
	auge Glass	-	_	1/2" 60		CPLG	SA-105			.3	3" (ס"			Weld	ed		Shell
	Supply Gas		1	1/2" 60		CPLG	SA-105					0"			Weld			Head
	Drain	-	1	2" 300	00# 0	CPLG	See Note 1	_		.3	3" ()"			Welde	ed		Head
	**																	
11. 3	Supports:	Skirt _	Ye	es .	Lugs _	/Bl 1	Legs (Nur	Otl	her				_ Attach	ned		Welde	ed to Hea	
12. F	Remarks:	Manufa	o est. acture	er's Pa	artial Da	(Number) ta Report	Nur) s properly ic	nper) dentified a	and siar	^{D)} ned bv	escribe) Commi	ssion	ed Inspe	ctors ha	ve bee	Whe) en furni	re and how shed for) the following
	tems of th						Shell, Seria											
							ame of part, iter											
-							See U4 att	acned.	No Charp	y Impac	t Testig p	er UG	-20(t)					
(07/1	7)																	

		FORM U	-1A		Page 2 of 2
Manufactured by	V	Moore Control Systems, Inc.,	1435 Katy Flewelle	en, Katy, Tx 77494	
Manufacturer's Serial No	18165-9	CRN	Natio	nal Board No	19
		CERTIFICATE OF SHOP/FI	ELD COMPLIANCE		
We certify that the statements me conform to the ASME BOILER AND expires May 9, 2019	PRESSURE VE	SSEL CODE, Section VIII, Divi	ision 1. "U" Certifica	ate of Authorization	number 45443
Date 6-4-18 Co. name	M	loore Control Systems, Inc. (Manufacturer)	Signed	Kennet	Hwither (Representative)
		CERTIFICATE OF SHOP/FI	IELD INSPECTION		
Vessel constructed by	Moore Co	introl Systems, Inc.	at	1435 Katy Flewe	llen, Katy, Tx 77494
l, the undersigned, holding a v Authorized Ins					
Authorized Inshall have inspected the component of to the best of my knowledge and VESSEL CODE, Section VIII, Divisional half he liable in any manner for a shall he liable in any manner for a shall he liable in any manner for the second section.	escribed in this belief, the Man sion 1. By signi e vessel describ	s Manufacturer's Data Reporturer has constructed the one this certificate neither the ped in this Manufacturer's D	nis pressure vessel ne Inspector nor his Data Report. Furthe	in accordance with s/her employer ma rmore, neither the	ASME BOILER AND PRESSURE kes any warranty, expressed or Inspector nor his/her employer

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

Manufactured ar	nd certified by	Moore Control Systems, Inc., 1435	Katy Flewellen, Katy, Tx 77494	
		(Name and address o		
2. Manufactured fo	r	Marathon Oil Co., Carlsbad, N		
		(Name and address of Purch Marathon Oil Co., 2423 Bonita St., Carl		
3. Location of insta	llation	(Name and address		
	Vertical	Vertical 2 Phase Separator	1816	5-9
4. Type	(Horizontal, vertical, or sphere)	(Tank, separator, heat exch., etc.)	(Manufacturer's	
	·	18165-XXXX Rev. 1	19	2018
(CRN)		(Drawing number)	(National Board number)	(Year built)
Data Report				
Item Number		Remarks		
10,	Elbow-1-SA-234-WPB, S/	80, 90° LR / Pipe-1-SA-106B, S/80		
	* (QTY 16 Ea) 1 1/8" Dia.	x 6 1/4" Lg. SA-193-B7 Studs w/ (2 Ea) SA-194-2H He	eavy Hex Nuts	
	, , ,			4
	(1) Gas Outlet Nozzle: 6"	150# RFWN, Flange-1-SA-105, S/80 / Pipe-1-SA-106B,	S/80 432" Thk / Renad-1-SA-516-70	375" Thi
			0700 1402 TIIK., 7 Nepad-1-5A-510-70,	.575 THK.
	U Corr. Allow., Nozzie / Fi	lange Attachment: Welded, Welded in Head	, , , , , , , , , , , , , , , , , , ,	
	(1) Safety Head Nozzle: 2	" 3000# CPLG-1-SA-105, .3125" Thk., 0" Corr. Allow., N	Nozzle / Flange Attachment: Welded, We	Ided in Head
·	(1) PI Nozzle: 1/2" 6000#	CPLG-1-SA-105, .33 Thk., 0" Corr: Allow., Nozzle / Flar	nge Attachment: Welded, Welded in Shel	I
	(1) Water LLC Nozzle: 2" 3	3000# CPLG-1-SA-105,, .3125" Thk., 0" Corr. Allow., No	ozzle / Flange Attachment: Welded, Weld	ded in Shell
	-15			
	(1) Relief Nozzle: 2" 3000#	# CPLG-1-SA-105,, .3125" Thk., 0" Corr. Allow., Nozzle	/ Flange Attachment: Welded, Welded in	Shell
	(1) Water Level Low Nozzi	le: 3/4" 6000# CPLG-1-SA-105,, .35" Thk., 0" Corr. Allo	w., Nozzle / Flange Attachment: Welded,	Welded in Shell
			W-99	
	(1) Oil Level High Nozzle:	3/4" 6000# CPLG-1-SA-105,, .35" Thk., 0" Corr. Allow.,	Nozzle / Flange Attachment: Welded, W	/elded in Shell
		2		
· · · · · · · · · · · · · · · · · · ·				
Certificate of Authoriz	ation: TypeU	No Expi	res May 9, 201	19
				1-10
Date 6-4-18	Name	Moore Control Systems, Inc. (Manufacturer)	Signed Kennett (Repres	velher tentative)
Date 55UNI8	1/	t m	Inepres	
Date <u> </u>	Name / / / / / / / / / / / / / / / / / / /	commissi		
	(Ai	uthorized Inspector)		or Commission number)

Page 1	of	2	
--------	----	---	--

FORM U-2A MANUFACTURER'S PARTIAL DATA REPORT (ALTERNATIVE FORM) A Part of a Pressure Vessel Fabricated by One Manufacturer for Another Manufacturer As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Ma	anufactu	red an	d certifie	d by:				Bise V	Velding	& fa	bricati	ng, In	c. 19	000 De So	to H	ouston,	Texas	7091				
2. Ma	ınufactu	red for	:					MCSI	More C	Contr		tems.	Inc.	ddress of Ma 14827 I-1	0 Ea	st Byto	own. Tx	77523				
3 100	cation o	f inetal	lation	-								(Name	and a	ddress of Pu	rchase	er)	,					
J. LU	cation o	HISLAH	alion	-										Inknown and address	5)							
4. Ty	pe:	againtian	of vocani as	Cy	linder	e head, tube	t. //		_					ough L								
	īpe	scription	oi vessei pa	ır. (sneir,	two piece	e nead, tube	pundle)])	İ			(Mani	ufacture	ers se	rial number)						CRN) 2018		
E 0.00	(National					(Drawing nu				(Drawing prepared by)									ear buil	t)		
5. ASI	VIE Coa	e Secti	on VIII D	1V 1	[Edition	n and Adder	2017 da, if app		date)]	_		(Co	de Ca	se number)				íSner	rial San	ice ner	UG-120('dVI
6. She	ell (a) N	umber	of cours	e (s):			1				(ico pei	00-120(,u))
		urse(s)			Mater	ial		Thickness							,	10'-0 Circum. Joint (Cat. A, B & C)						
	T	2.00(0)		1	Material		1111	THICKIESS			Long.	JOHIL (Cal. A	1	Cir	cum. Joi	nt (Cat. A	, B & C)	-	Heat Tr	reatment
No.		neter	Length	Spec		or Type	Nom.			уре	Full, S	Spot, N	lone	Eff.	Ту	pe Fu	ıll, Spot, I	None	Eff.	٦	emp.	Time
1	48	'OD	10'-0"		SA 516	5-70	.375'	-		1		Full								-		
												-										
	T	T				T			Body	Fla	nges d	on Sh	ell		-				Boltino			
No.	Тур	e	ID C	D F	lange Thk	Min Hu Thk	b	Mate	arial		ow Atta	abod		Lagation	ľ	Num	1	Bolting	V	Vashe		Washer
-110.	.,,,,,		.5		17110	THE		Mate	ila:		OW Alla	Cileu	11	Location		Síze		Materia	_	ID, ti	1K)	Material
						1																
7. Hea	ds: (a)		(Material	spec, nu	mber, gr	ade or type)	(H.T tin	ne and t	emp)		(b)	-	(N	latoris	i saec no	mber, grad	le or type	a) /山 T	timo a	nd lomo	
Г	Loool	inn			1									(14	i cici ic	11 3,266, 110	miber, grad	ie or typi	e) (n. i.	- ume a	nu temp)	· · · · · · · · · · · · · · · · · · ·
	Locat (To	o, L	Thick	ness		Radius			Coni	cal					8	Side to Pr	ressure			Categ	ory A	
	Botto End		Min.	Corr	Cro	own Knu		lliptical Ratio	Ape Ang			ispheri Radius	- 1	Flat Diameter	Co	nvex	Concave	Typ	_	Full, S Nor	pot,	Eff.
(a)									7 1119		u, i	uuiuo		Diameter		IIVEX	Concave	1 1 1 1 1		IVOI	ie	EII.
(b)																						
	1					1	1		Body I	Flan	ges o	n Hea	ds						Bolting			
	10	cation	Tyr		ID	00	Flang		n Hub				١			Num 8	1	Bolting	V	/asher		Washer
(a)	LO	cauon	Tyr	e	ID	OD	Thk		Thk		Material		H	ow Attached		Size	1	1aterial	+	ID, th	k)	Material
(b)															\top				+			:
8. MA	WP _					_ at ma	x temp							Min.	desi	gn meta	al temp.			at		
		(interna	31)	(Exte	rnal)				(Interna	l)	(Externa	al)									
9. Imp	act Tes	t		In	dicate ye	es or no and	No.	onent(s)	impact te	ested				at test	temp	perature	of _					_
10. Hyd	dro on	ou or	eemb. te				•				roof Te	et te										
-			on, and s	•						- ' '	.001 10											
	pose					7	Mate	rial		- N	lozzle T	hiokno					A.W	A F	D = 4 = 11 =			
(inlet,	Outlet,	No.	Diam or Si	eter ze	Type	Nozz			nge	1	Nom.	Co		Reinforc Mate		nt 📙	Nozzle	nment [Jetalis Flar	100		ocation o. open.)
Dian	i, e(c)	ė:								-	li .	11					1102210		1 101		(,
																						7
12. Ider	ntificatio	n of pa	ert (s)																			
		Name of	Part			Quantity	Line	No.	Mfr's le	denti	fication	No.		Mfr's Draw	ing N	No.	CRI	V	Nation	al Boa	rd No.	Year Built
						/A																1
10.0																	L					
13. Sup	port: S	kirt	Yes or no	Lug	gs(Number)	Legs	S	Number)	_	Othe	r		Describe		_ Attacl	hed	/\/	Vhere 2	nd how)		
4. Ren	narks		PO# 18	165605	58A		esing B	-	-		For	ned li	ı Acc	cordance V	Vith	UG 79.	UG 80	•				
		No H	ydro Pre	formed																		

FORM U-2A

lanufacturer's Serial No.	7967 A - L	CRN	National Board No.	

2 of 2

		CER	TIFICATE OF S	HOP/FIEI	D COMPL	IANCE	
V	Ve certify that the pres	statements made ssure vessel part o	in this report are correct	t and that all d piler and press	etails of materia sure Vessel Code	I, construction e, Section VII	n and workmanship of this II, Division 1.
"[" Certificate of Auth	orization Number	30,911	Expires		January 30, 20	020
Date	3.8.18	Name	Bise Welding & fabric	ating	Signed		(Representative)
l, t	ne undersigned, hol OneCIS Insurance	ding a valid commis	RTIFICATE OF		and Pressure Ves		
to AN an ne	ve inspected the pre the best of my kno ID PRESSURE VI y warranty, expres ither the Inspector	ssure vessel part de pwledge and belie ESSEL CODE, Se ssed or implied, co	ection VIII, Division 1. By oncerning the pressure v oyer shall be liable in an	constructed the signing this coversel part des	t on 3 nis pressure vest certificate neither scribed in this M	sel part in acc r the Inspecto anufacturer's	and state that, cordance with ASME BOILER or nor his/her employer makes Data Report. Furthermore, y damage or a loss of any
Date	3-8-18	Signed \$7	(Authorized Inspector)	Y	Commissions	NB 14513 A	sl ultrarized Inspector Commission number)

(07/17)



Katy: 1435 Katy Flewellen

Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East

Baytown, Tx 77523

SECTION 2 NAME PLATE FACSIMILE





Katy: 1435 Katy Flewellen

Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East

Baytown, Tx 77523

SECTION 3 ASME CODE TRAVELER



EXHIBIT B REV 0 Page 1 of 5

Moore Control Syste	ems, inc.
JOB TRAVEL	ER
Customer: Marathon Oil Company	Date: 2/26/2018
Job Number: 18165 Vertical 2 Phase Separa	tor
Tag Number: Later	•
Drawing # 18165-XXX SHT 1	
Serial No.: 18165-9	National Board# At time of hydro
WPS - Long Seams Bise welded long seams WPS #	BW-04L
WPS - Girth Seams MCS-SAW-2-P1, MCS-GM&FC-	P1
WPS - Nozzle Attach MCS-GM&FC-P1	
Design Requirements	
Design Press Int. 250 PSI	
Design Press Ext.	
Design Temperature 150°F	MDMT -20°F
Design for special service (L, UB, LT) Yes	No X
LT Received Yes No X	
Calculations	
Reviewed by A.I.	Date 28HEBH9
QC Reviewed	Date <u>03-03-18</u>
Como 1	1.0

18/45-9

JOB TRAVELER

18165-9

Material Inspection

					A.I.	A.I.	A.I.
	Shop	Date	Q.C.	Date	Hold	Check	Date
Examine MTR's and compare to heat number							
1) Heads			N ex	3-2-13	₩		
2) Shell			11/	3-9-18			
Check thickness, surface and tolerance							
1) Heads			Nive	3-2-18			
2) Shell (plate) (pipe)			1v	3-4-18			
Examine cut edges (bevel) of							
1) Heads			JV, vy	3-2-18		 	
2) Shell (plate) (pipe)		ĵ _o	J.V.	3-9-18			
Record mill stamping and transfers					· · · · · · · · · · · · · · · · · · ·		
1) Heads			NIVY	3-2-18			
2) Shell (plate) (pipe)			N	3-9-18			
Verify flange ratings and pipe thickness							
1) Nozzles			44	3-20-18			
2) Flanges			~~	3-20-19			
3) Pipe			44	3-10-19			

Welding							
					A.I.	A.I.	A.I.
	Shop	Date	Q.C.	Date	Hold	Check	Date
1) Welding Procedure Specifications			1	3-2-18			
2) Welder Performance Qualifications			DV .	4-1958			

JOB TRAVELER

1810571	JO	BIRAV	ELEK				
					1816:	5-9	
Fabrication							
					A.I.	A.I.	A.I.
	Shop	Date	Q.C.	Date	Hold	Check	Date
Fabrication Inspection							
Examine cut edges on cylinder	cuf	5-11-18	JV	4-16-18			
2) Shell course fitup			JV	4-16-18			
3) Shell layout	Cent	5-4-18	FW	5-3-18			
4) Head layout	Cerf	5-10-18	70	4-26-18			
5) Nozzle fitup	Cust	5-418	Kw	5-4-18			
6) Internal check	cerA	57818	Kw	5-18-18	¥	ens	1801AY
		<u> </u>					
Check weld groove preparation		T -					T
1) Long seam			NIA	D. J. Omise	,	 	
2) Girth seams	Centro	100 5-11-18	N	BY OTHER	>	 	
3) Nozzle attachments	cust 1	1025-1118 8-4-18	Ku	5-4-18		+	
BISE CUT IL				5-4-10			
			-	7		<u> </u>	1
Cutting, fitting and alignment				T			
1) Long seams			MA	BYOTHER	<i>i</i>	 	
2) Girth seams	cust	25-11-18	JV	4-16-18		 	
3) Nozzle attachments	cert	5-4-18	Kui	5A-18		 	
RISE ROLLED /WELDED							
Check back chip surface	1	T	Т				
1) Long seams		 	11-0				
2) Girth seams			NIA	BYOTHER	5		<u> </u>
	+	<u> </u>	see	BeLow		ļ.	
3) Nozzle attachments	0 1	0.00	1 01			 	
BISE WELDED	Root	Pass.	Left	INTACT	NO BI	ACK Gou	NO.

JOB TRAVELER

10165	10	BIRAVI	ELEK				
					1810	65-9	
Non-destructive testing					, ,		
					A.I.	A.I.	A.I.
	Shop	Date	Q.C.	Date	Hold	Check	Date
Radiography						1	
1) Long seam			KW	*	*		
2) Girth seams			Cw	5-16-18	*		
3) Nozzle attachments					-		
* BT AT BISE							
Ultrasonics						T : T	
1) Long seam			NA			+	
2) Girth seams			N/D			1	
3) Nozzle attachments			N/A				
			<u> </u>				
Test reinforcement pads							
1) Nozzle attachments			NA				
							- Tu
Final inspection							
1) Weld appearance and reinforcement	tern	5-18-18	Rev	5-18-18	?		
2) Check fillet weld sizes	CerA	5-18-18	kew	5-18-18			
3) Out of roundness			Kew	5-18-18	7		
4) Final dimension	Cust	3-18-18	Kew	5-18-18	•		
5) Check stamping on nameplate			Key	5-12-4	24		-
6) Name plate attached			N	0-15-12	· Jr		
						1	
						+	
			 			+	

JOB TRAVELER 18165-9 Post fabrication A.I. A.I. A.I. Shop Date Q.C. Date Hold Check Date Post weld heat treatment 1) Review and approve procedure 2) Type (furnace or local) 3) Thermocouples attached to item 4) Charts reviewed and signed 5) Verify up, hold and down periods Hydrostatic test 1) Pressure test verified 2) Gauge SIN 3) Code Stamp P Preparation for shipment 1) Data Report checked 2) Sandblast 3) Paint

6-15-18

Final Acceptance

Remarks



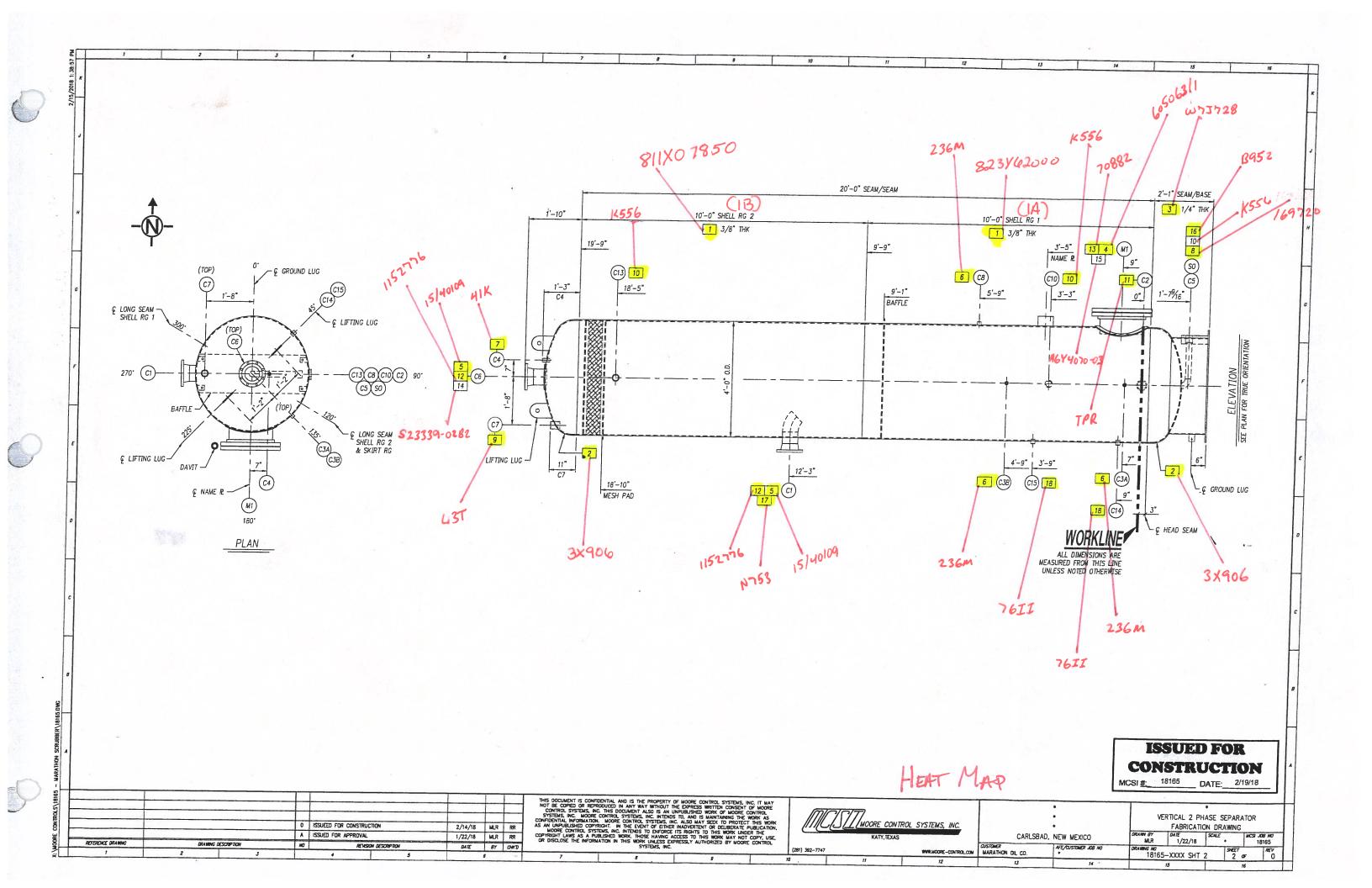
Katy: 1435 Katy Flewellen

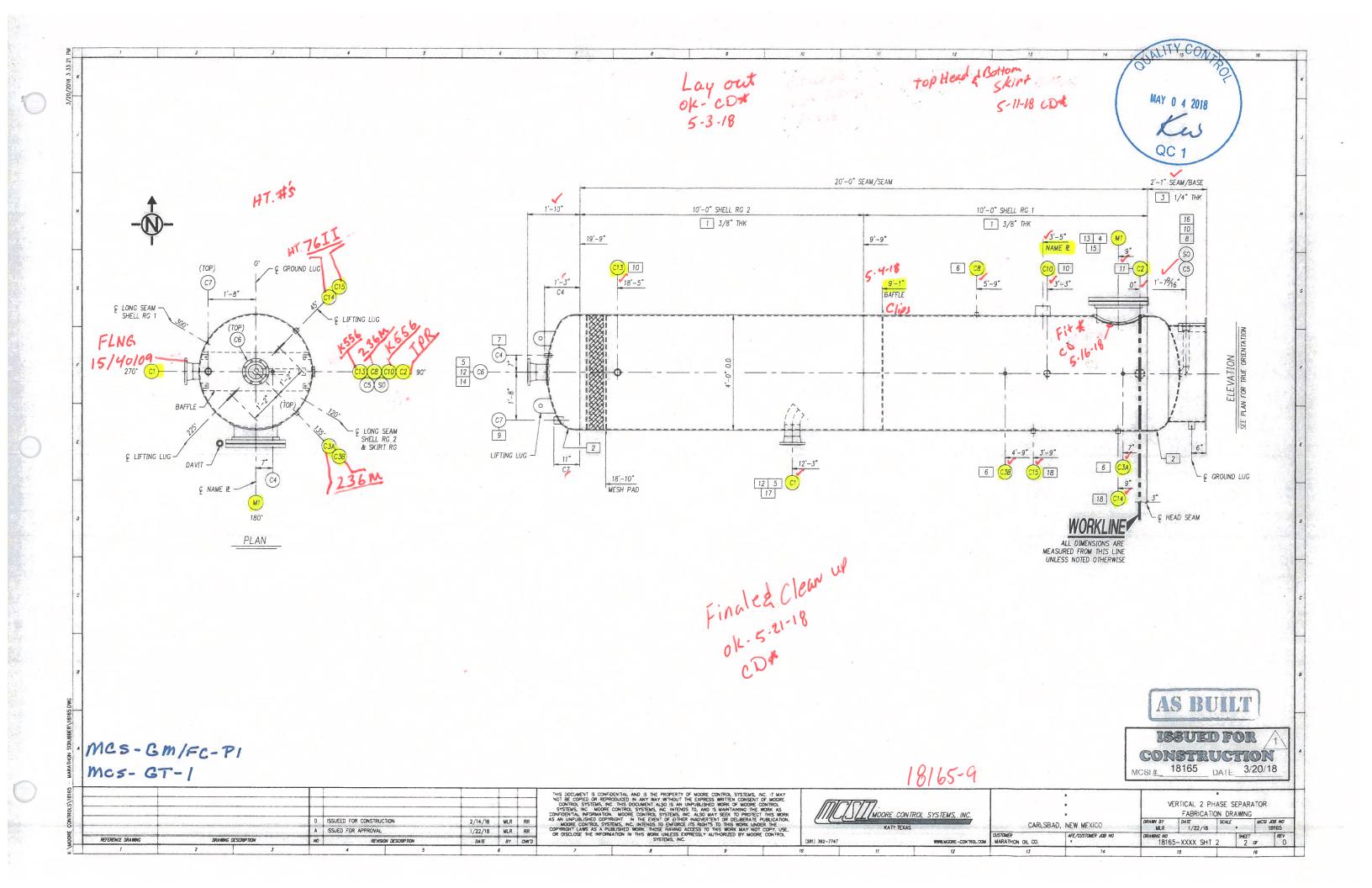
Katy, Tx 77494

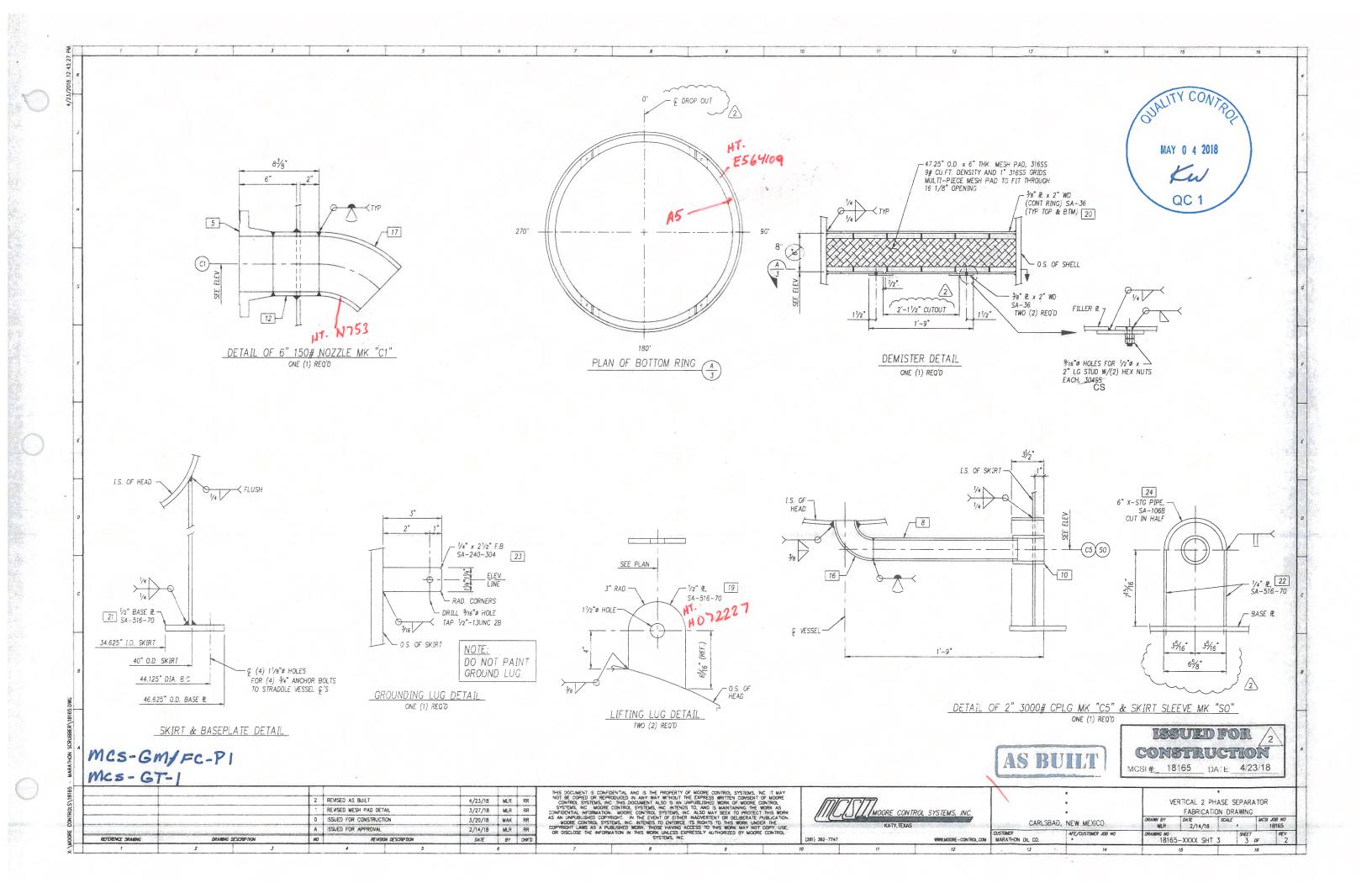
Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East

Baytown, Tx 77523

SECTION 4 RECEIVING INSPECTION REPORT W/MTR's AND HEAT MAP







					(L)	
PLATE					(L)	
SPEC. NO.	SAGF	ADET1			(T1) $(T2)$	- 1
		DT2			2	
		Т				
MFG. BY		т	4			
M.T.R. NO		L			(T3) $(T4)$	
HARDNESS	TEST IF RE	QDW			(W)	
CONFORMS	TO CODE	YES N	10			
HEADS SPEC.NO. SA	AGR/	ADET1		- (TI	- th
		T2		_ T 4	T2	(L) I.D.R
IEAT NO		Тз		_ \ \	//	
NFG. BY		T4		_	T3	
I.T.R.NO		PG/UG-79				± '
		_ =	¥		1	
ARDNESS 7	EST IF RE	QDL.I	K.R	_ THICKNE	SS MEASURED AT ST	RAIGHT FLANGE
O. OF IDEN	FICAL HEAD	OS1.D	.R	_		
		YES NO				
		7967E				
		GRADE_70T1_		<u>.</u>		L)
N. THICKNE	SS REQD_	,375 T2	The second name of the second	-		↑
EAT NO 8	-		:380	- //	T1	
FG.BY_Arc.	The state of the s		,377	. //		
		#046096 L	120	. T 4	T2	
T.R.NO/\/	The second second second	- 11/n O	0 48	. \\	, J	
RDNESS T	STIFREQ	D_N/A			T3	
NFORMS T	O CODE	YES NO				1
ITINGS			(#)			y
55	OUDI INGO .	- NOZZLES - COMP	ONENTO	001170-	110 TO 000	
	: EIITGO -	IIVELLES - CUMPI	CIAEIA I 2	CONFOR	MS TO CODE	
O. SIZE	P.S.I.	DESCRIPTION	MEC DV	MADICINE	8 (8)	YES NO
	1	DESCRIPTION	MFG.BY	MARKING	OTHER INFORM	A
	12					
	-	'				
	-		-			
1	1	1	1 2 2			
	 		<u> </u>	ļ I		



Stamp Rubbing 18/65-9A

PO#	
Paint Stick	Welder Symbol:
Cylinder: 3/8 x 48 ab x 120 Lg	Material: SA 5 W - 70
SN: 7967-E	Heat:
U Steel Stamp	Slab: Hot 6096
Part Certified By Bise SN:	MFG:

02/13/2018 From: AMERICAN ALLOY STEEL, INC.

To: BISE WELDING & FABRICATING

P.O.#: 6768

Item:

(M55) MFST REF#:7

2 (1 PC) 3/8" X 120" X 480"

S.O.#: 593368 AA PL#: 5191981

ArcelorMittal Burns Harbor Plate REPORT OF TEST AND ANAYLSES
DATE SHIPPED US HWY 12 Burns Harbor, Indiana SHIPMENT NO 803-00575 08-28-17 AMERICAN COMMERCIAL AMERICAN ALLOY STEEL INC PAGE AMERICAN ALLOY STEEL INC PO BOX 40469 C/O FREIGHT MANAGEMENT & LOGISTICS HOUSTON TX 77240-0469 INBESA TERMINAL-PORT OF HOUSTON 16335 PENINSULA BLVD HOUSTON TX 77015 PAT NO. SERIAL NUMBER HEAT NUMBER TENSII F THICKNESS WIDTH OR DIA LENGTH WEIGHT POINT ELONG. INCHES INCHES INCHES POUNDS QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A. PSI PSI IN PLATES - ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU. 15 MAX KLD FINE GRAIN PRAC, ASME SA516 GR 70 PVQ 2015 EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT --- MILL TEST PCS NORM 1625/1675F FOR 30MIN/IN 30MINS/MIN --- TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN 10204:2004 TYPE 3.1 NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S) CO# 112625 GH 354-5712F H047429 823X70130 3 .375 120 480 18378 53200 78600 8 51300 73500 8 (M55) MFST REF#:7 25 -> H046096 823Y62000 3 .375

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

480

18378

51100

53600

79500 8

75900 8

24

120

ENERGYE'T LBS | SHEAR(%) PAT NO. HEAT NUMBER DIR TEST THICKNESS INCHES LAT. FXP MILS TEMP. 2 3

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

HEAT NUMBER						GHEMICAL	ANAI VRI	R			J.	- 11	116	120	רו	
	С	Mn	Þ	8	SI CU	Mi	Cr	Mo	v	77	Al					MQUAID GRAIN
823X70130 823Y62000	.17	1.11	.008	.003	.327.023	.01	.12	.079	.002	2.00	2.03	8.0002	003	N 004		
823Y62000	.18	1.11	.011	.003	.349.017	.01	.12	.083	.002	.002	2.032	2.0002	.002	.000	5.002	

t certify that the above results are a true and correct copy of actual results contained in records maintained by ArcelorAlitial Burns Harbor and are in full complian requirements of the specification cited above. This test report connot be altered and must be transmitted intact with any subsquard third party test reports, if no

SUPV. QUALITY ASSURANCE

SPANGLER II LSS AMERICAN ALI

			(L)		
PLATE			(L)		
SPEC. NO. SAT1T1			(T1) (T2)		
MIN. THICKNESS REQDT2			3		
HEAT NOT3_				1	
MFG. BYT4_					
M.T.R. NOL			(T3) (T4)		
HARDNESS TEST IF REQDW			(W)		
CONFORMS TO CODE YES NO					
HEADS SPEC.NO. SAGRADET1		T4	T1 T2 T3	(L) <u>1.</u>	D.R
IARDNESS TEST IF REQD L.K.I IO. OF IDENTICAL HEADS I.D.R CONFORMS TO CODE YES NO	R	_ THICKNE	SS MEASURED AT STF	RAIGHT FLA	NGE
PEC.NO.SA 5/6 GRADE 70 T1	380			,	
	375		(L	.)	—
EAT NO 8///07850 T3	382				
	380		T1 \		
FG.IDENTIFICATION E063345 L	120 "	+ T4	T2		(0
.T.R.NO <i>N/A</i> *	48"	\ \	, 12 / /		
ARDNESS TEST IF REQD			Т3		
ONFORMS TO CODE YES NO					
TTINGS	= 180				<u>_</u>
ANGES – COUPLINGS – NOZZLES – COMPOI	151170				
ANGLS - COUPLINGS - NOZZLES - COMPOR	NENIS	CONFOR	MS TO CODE		
O. SIZE P.S.I. DESCRIPTION	1450 DV		8	YES	NO
O. SIZE P.S.I. DESCRIPTION	MFG.BY	MARKING	OTHER INFORMA	4	
		1		1 1	



Stamp Rubbing 18165-98

PO# 181651005	
Paint Stick	Welder Symbol:
Cylinder: 3/8 x 1860 x 120 Lg	Material: Sa. Sug. 70
SN:	Heat:
U Steel Stamp	Slab: <u>E063345</u>
Part Certified By Bise SN:	MFG:

02/13/2018 From: AMERICAN ALLOY STEEL, INC.

To: BISE WELDING & FABRICATING

P.O.#: 6768

Item:

2 (1 PC) 3/8" X 120" X 480"

S.O.#: 593368

AA PL#: 5187223

			Arce	IorMittal B	urns Harbo	or Plate			US	HWY 12	Burns Harbor, F
803-2114	2			SHIPPED 6-20-17	CSS - CH			000 0			
PO BO HOUST	CAN ALLOY 57 X 40469 ON TX 77240		INC		S BNSF	TCAN A TR# 7 N HOU	LLOY 8 226 M STON R	TEEL I	4 LN SE	-	-
	AT HEAT NUMBER	NO. PCS.	THICKNESS	WIDTH OR		NGTH	WEIGHT	YIELD	TENSILE STRENGTH	AF FR	
	STEEL MELTE - ASTM A516- CU.15 MAX 1 SA516 GR 7 TST AS ROLI PC HEAT TRI NORM 1625/1 30MINS/MIN PREPARED IN OUTLINED IN NO WELD REP	06 (KLD PV LED- EATM L675	MANUFA FINE G Q 2015 ADD'L FF FOR TEST (CORD W) 10204:	CTURED IN VQ MOD C. RAIN PRACE EDITION, FENSION POMILL TE SOMMIN/IN CERTS ARE LTH PROCE	THE U. 20 MAK 20 MAK 21 ASME FIRST ER TST ST PCS DURES E 3.1	nches S. A. Plate (POUN	DS PSI	: PSI	II	1 & &
	80 GH 354-55	70C		inte Orthanso (N PEHON	PLIATE (5)				
E063344 (M55) MFST	811X07850 REF#:5	3	.375	120	480		L8378	51500 51200	76500 73800	-	24 26
E063345	811X07850	3	.375	120	480	1	.8378	51300	76400	-	25
(M55) MFST	REF#:5							51200	73700	8	26
E063347	822X37710	1	.375	120	480		6126	52700 53300	78400	-	26
(M55) MFST	REF#:5							J3300	76300	ď	26

8ERIAL	PAT	HEAT	HARD	T						-	CHA	RPY MP	ACT				-
NUMBER	NO.	NUMBER	BHN	BEND	INCHES	TYPE	SIZE	DIR TENT	ENERGY	et .	LBS		SHEAR	%)	LAT, EXP	MIL	8
									1	2	3	1	2	3	1	2	3

T-TEMPER TEMPERATURE

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

N-NORMALIZE TEMPERATURE

HEAT NUMBER Si Cu NI Cr Mo 811X07850 .17 1.07 .010 .004 .319.020 .01 .11.078.001.002.031.0002 .002.006.003 822X37710 .18 1.16 .012 .004 .344.022 .01 .13.086.002.002.033.0002 .002.004.003

I cartify that the above results are a fine and correct copy of ectuel results contained in records maintained is requirements of the specification cited above. This test report connot be altered and must be transmitted in SPANGLER II AMERICAN ALL

Q-QUENCH TEMPERATURE

				(L)		
PLATE	NDE T4					
SPEC. NO. SAGRA				(T1) (T2)		
MIN. THICKNESS REQD.						
HEAT NO			-	7,0		
MFG. BY			-	(T2) (T4)		
M.T.R. NO HARDNESS TEST IF REC			-	(T3) (T4)		
			-	(W)		
CONFORMS TO CODE	YES NO					
HEADS					78-1	B
SPEC.NO. SA <u>5/6</u> GRA	DE 70 T1 .34	,2		rı		w
		^		\ \	-	.3
MIN. THICKNESS REQD_	13125 T2 ,391	8	_ 1 T4	T2	(L) L.	D.R
HEAT NO 3 × 90	6/504247 T3	355		//		
MFG. BY Nucor	T4_	,367		r3 /		
M.T.R.NO.					↓	
L 49-1/8			_			
HARDNESS TEST IF REC	D None L.K.	.R. ,	THICKNES	SS MEASURED AT ST	RAIGHT FLA	ANGE
NO. OF IDENTICAL HEAD	24.55	. 9 9/				TITOL
10. OF IDENTICAL HEAL	/S <u></u>	R. 41 - 1/	16			
CONFORMS TO CODE		R. <u>41-7/</u>	6			
CONFORMS TO CODE		R. <u>41 - 9</u> ,	16			
CONFORMS TO CODE	YES NO	· · · · · · · · · · · · · · · · · · ·	,-		L)	
CONFORMS TO CODE	YES NO GRADET1_	267	,-		L)	
CONFORMS TO CODE PIPE SPEC.NO.SA MN. THICKNESS REQD	YES NO GRADE T1 T2	167 348	,-		<u>L)</u>	<u> </u>
CONFORMS TO CODE PIPE SPEC.NO.SA	YES NO GRADET1	1 (7 , 5 = 5 , 5 = 8	,-	TI	L)	1
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO	YES NO GRADE	1 (7 , 5 = 5 , 5 = 8		TI	<u>L)</u>	
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD_ HEAT NO MFG.BY MFG.IDENTIFICATION	YES NO GRADE	1 (7 , 5 = 5 , 5 = 8	,-		L)	
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY	YES NO GRADE	1 (7 , 5 = 5 , 5 = 8		TI	L)	
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO IARDNESS TEST IF REQ	YES NO GRADE	1 (7 , 5 = 5 , 5 = 8		T1 T2	<u>L)</u>	
CONFORMS TO CODE PIPE SPEC.NO.SA MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO	YES NO GRADE	1 (7 , 5 = 5 , 5 = 8		T1 T2	L)	
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO HARDNESS TEST IF REQ	YES NO GRADE	1 (7 , 5 = 5 , 5 = 8		T1 T2	<u>L)</u>	
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO HARDNESS TEST IF REQ CONFORMS TO CODE	YES NO GRADE	2 G C	T4	T1 T2	L)	
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO HARDNESS TEST IF REQ CONFORMS TO CODE	YES NO GRADE	2 G C	T4	T1 T2 T3		NO
CONFORMS TO CODE PIPE SPEC.NO.SA MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO IARDNESS TEST IF REQ CONFORMS TO CODE SITTINGS LANGES – COUPLINGS	YES NO GRADE	2 G C	T4	T1 T2 T3 MS TO CODE	YES	NO
CONFORMS TO CODE PIPE SPEC.NO.SA MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO IARDNESS TEST IF REQ CONFORMS TO CODE SITTINGS LANGES – COUPLINGS	YES NO GRADET1T2T3T4L D YES NO - NOZZLES - COMPO	DNENTS	CONFOR	T1 T2 T3	YES	NO
CONFORMS TO CODE PIPE SPEC.NO.SA MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO IARDNESS TEST IF REQ CONFORMS TO CODE SITTINGS LANGES – COUPLINGS	YES NO GRADET1T2T3T4L D YES NO - NOZZLES - COMPO	DNENTS	CONFOR	T1 T2 T3 MS TO CODE	YES	NO
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO HARDNESS TEST IF REQ CONFORMS TO CODE EITTINGS LANGES – COUPLINGS	YES NO GRADET1T2T3T4L D YES NO - NOZZLES - COMPO	DNENTS	CONFOR	T1 T2 T3 MS TO CODE	YES	NO
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO HARDNESS TEST IF REQ CONFORMS TO CODE EITTINGS LANGES – COUPLINGS	YES NO GRADET1T2T3T4L D YES NO - NOZZLES - COMPO	DNENTS	CONFOR	T1 T2 T3 MS TO CODE	YES	NO
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO HARDNESS TEST IF REQ CONFORMS TO CODE EITTINGS LANGES – COUPLINGS	YES NO GRADET1T2T3T4L D YES NO - NOZZLES - COMPO	DNENTS	CONFOR	T1 T2 T3 MS TO CODE	YES	NO
CONFORMS TO CODE PIPE SPEC.NO.SAC MN. THICKNESS REQD HEAT NO MFG.BY MFG.IDENTIFICATION M.T.R.NO HARDNESS TEST IF REQ CONFORMS TO CODE EITTINGS LANGES – COUPLINGS	YES NO GRADET1T2T3T4L D YES NO - NOZZLES - COMPO	DNENTS	CONFOR	T1 T2 T3 MS TO CODE	YES	NO

ode

RECEIVING INSPECTION REPORT

SPEC. NO. SA	DLATE				(L)	
MIN. THICKNESS REQD T2 HEAT NO. T3 MFG. BY T4 HARDNESS TEST IF REQD. W (W) CONFORMS TO CODE YES NO HEADS SPEC.NO. SA SIGRADE 70 T1.3 55 MIN. THICKNESS REQD T2.357 HEAT NO. SA SIGRADE T4.360 MIN. THICKNESS REQD T4.360 MIN. THICKNESS TEST IF REQD L.K.R. THICKNESS MEASURED AT STRAIGHT FLANG MO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MIN. THICKNESS REQD T2 MIN. THICKNESS TEST IF REQD T3 MIN. THICKNESS TEST IF REQD T4 MIN. THICKNESS TEST IF REQD T5 CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO	PLATE SPEC NO SA GRAI	DE T1			(T1) (T2)	
### HEAT NO	MIN THICKNESS REOD	T2			(11) (12)	
MFG. BY	_					
M.T.R. NO. L (W) CONFORMS TO CODE YES NO HEADS SPEC.NO. SA 5 GRADE 70 T1 3 5 5 MIN. THICKNESS REQD T2 3 5 7 HEAT NO. 3 4 90 6 50 42 47 T3.2 5 5 HEAT NO. PG/UG-79 L 77 - 15 6 HARDNESS TEST IF REQD L.K.R. THICKNESS MEASURED AT STRAIGHT FLANG NO. OF IDENTICAL HEADS I.D.R. 47 - 5 16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 MSPEG.BY T4 MFG.BY T4 MFG.BORNEST TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO				_		
HARDNESS TEST IF REQD				_	(T3) (T4)	
HEADS SPEC.NO. SA SIGRADE 70 T1 3 55 MIN. THICKNESS REQD T2 357 HEAT NO 3 490 6/5042 47 T3,2 75 MFG. BY T4.360 M.T.R.NO. PG/UG-79 L 77 - 15/16 HARDNESS TEST IF REQD L.K.R. THICKNESS MEASURED AT STRAIGHT FLANG NO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS MEASURED AT STRAIGHT FLANG MFG.BY T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD T2 CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO TEST OF THE TOTAL AND TO THE TOTAL AND T				-		
SPEC.NO. SA SIGRADE 70 T1 3 5 5 MIN. THICKNESS REQD T2 3 5 7 HEAT NO 3 × 90 6/50 + 2 + 7 T3, 2 + 5 MFG. BY T4 3 6 0 M.T.R.NO. PG/UG-79 L 77 - 15/16 NO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.BY T5 MFG.BY T6 MFG.BY T6 MFG.BY T7 MFG.B		•		-	()	
SPEC.NO. SA SIGRADE 70 T1 3 5 5 MIN. THICKNESS REQD T2 3 5 7 HEAT NO 3 × 90 6/50 + 2 + 7 T3, 2 + 5 MFG. BY T4 3 6 0 M.T.R.NO. PG/UG-79 L 77 - 15/16 NO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.BY T5 MFG.BY T6 MFG.BY T6 MFG.BY T7 MFG.B	115.450				†	47-15/16
MIN. THICKNESS REQD T2 .357 HEAT NO 3 × 90 6/504247 T3,235 MFG. BY T4 .360 M.T.R.NO. PG/UG-79 L 47 - 15/16 HARDNESS TEST IF REQD L.K.R. THICKNESS MEASURED AT STRAIGHT FLANGE NO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO TA T2 T1 T2 T3 T1 T4 T2 T1 T4 T2 T3 T3 T1 T4 T4 T2 T3 T1 T4 T2 T3 T1 T4 T2 T3 T3 T1 T4 T2 T3 T1 T4 T2 T3 T1 T4 T2 T3 T3 T1 T4 T4 T2 T3 T1 T4 T2 T3 T3 T4 T4 T2 T3 T1 T4 T2 T1 T1 T1 T1 T1 T1 T1 T1 T1	HEADS	DE 70 T1 35			+ \	1
HEAT NO 3 4 90 6 5042 47 T3,23 5 MFG. BY T4.360 M.T.R.NO. PG/UG-79 L 77-5/6 HARDNESS TEST IF REQD L.K.R. THICKNESS MEASURED AT STRAIGHT FLANG CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO FITTINGS	SPEC.NO. SA O / GRAL)E/()_ 1 <u></u> 5	-	- / /	T1 \	1
HEAT NO 3 4 90 6 5042 47 T3,23 5 MFG. BY T4.360 M.T.R.NO. PG/UG-79 L 77-5/6 HARDNESS TEST IF REQD L.K.R. THICKNESS MEASURED AT STRAIGHT FLANG CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO FITTINGS	MIN. THICKNESS REOD	T2 .35	7		ma	
MFG. BY T4.360 M.T.R.NO. PG/UG-79 L. 77-15/16 HARDNESS TEST IF REQD L.K.R. THICKNESS MEASURED AT STRAIGHT FLANG CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO TABLE OF THE COMPONENTS TO CONFORMS TO CODE YES NO TABLE OF THE COMPONENTS TO CONFORMS TO CODE YES NO TEST NOTES OF THE COMPONENTS	HEAT NO 3 X 907	1504247 Ta	3 5 5	.	12]	(L) <u>I.D.R</u>
M.T.R.NO. PG/UG-79 L 7 - 15/6 HARDNESS TEST IF REQD L.K.R. THICKNESS MEASURED AT STRAIGHT FLANGE NO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO	MFG. BY	T4.	360	. // .	гз //	
HARDNESS TEST IF REQD L.K.R. HO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO MFG.BY MFG.BY MT.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO TI TI TI TI TI TI TI TI TI T			700		+//	↓
HARDNESS TEST IF REQD NO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L MT.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS THICKNESS MEASURED AT STRAIGHT FLANG (L) T1 T1 T1 T2 T1 T4 T2 T1 T4 T2 T3 T1 T4 T2 T1 T4 T2 T3 CONFORMS TO CODE YES NO TITTINGS					+	
NO. OF IDENTICAL HEADS I.D.R. 47 - 5/16 CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L MT.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO YES NO	HARDNESS TEST IF REQU	D L.K.	.R.	THICKNES	SS MEASURED AT ST	TRAIGHT EI ANGS
CONFORMS TO CODE YES NO PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES NO YES NO	NO. OF IDENTICAL HEAD	SI.D.I	R. 47 - 5/1	6	TO MERCONED AT O	TIAIGITI FLANGE
PIPE SPEC.NO.SA GRADE T1 MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES – COUPLINGS – NOZZLES – COMPONENTS CONFORMS TO CODE YES NO YES N						
SPEC.NO.SA GRADE T1 (L) MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES – COUPLINGS – NOZZLES – COMPONENTS CONFORMS TO CODE YES N		TES NO			**	
MN. THICKNESS REQD T2 HEAT NO T3 MFG.BY T4 MFG.IDENTIFICATION L M.T.R.NO. HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES – COUPLINGS – NOZZLES – COMPONENTS CONFORMS TO CODE YES NO YES N		DADE ~-				
HEAT NOT3						(L)
MFG.BYT4		12				Ţ
MFG.IDENTIFICATIONL M.T.R.NO HARDNESS TEST IF REQD CONFORMS TO CODE YES NO FITTINGS FLANGES – COUPLINGS – NOZZLES – COMPONENTS CONFORMS TO CODE YES N					T1 \	
M.T.R.NO))	
CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES N				T14	T2	- }
CONFORMS TO CODE YES NO FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES N)		//	тз //	
FITTINGS FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES N						
FLANGES - COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE YES N	CONFORMS TO CODE	YES NO				
YES N	FITTINGS))			
YES N	FLANGES – COUPLINGS –	NOZZLES - COMPO	DNENTS	CONFOR	MS TO CODE	
						YES NO
	NO. SIZE P.S.I.	DESCRIPTION	MFG.BY	MARKING	OTHER INFORI	
				1		
		1	 	 		
				1		1 1

Tank Head Manufacturing Complex 10703 Sheldon Road Houston, TX 77044

UNI-FORM COMPONENTS CO.

(281) 456-9310

(800) 231-3272 toll-free

(281) 456-0245 fax

PL-89830	MOCOSY
Packlist 15.	Customer II

MATERIAL CERTIFICATION

UCC Lot No. Date C∈ t. Originated 181656056A 135218 2/23/2018

Sold To: MOORE CONTROL SYSTEMS 1435 KATY FLEWELLEN

Ship To: MCSI - BAYTOWN 14827 I-10 EAST

KAT Ln O		TX Ship 2: B	77494 /O Qsy Part De	escript on	BAYT			7523
1	20	20	0 HEAD	2:1 ELLIP, 48 OI of Measure: EA				.3125" MIN
Code:	3X906	HEAT/SLAB:	504247 / 07	GRADE:	SA516-70	Size:	.375 X 120 X 480	MILL: NUCOR
Code:	3Y160	HEAT/SLAB:	7500851-07	GRADE:	SA516-70	Size:	.375 X 120 X 480	MILL: NUCOR
Code:	3Y525	HEAT/SLAB:	7504249 / 02	GRADE:	. SA516-70	Size:	.375 X 120 X 480	MILL: NUCOR

MILL TEST REPORTS ATTACHED

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

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

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

Stephen C Quality Control



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

Mill Test Report

1505 River Rd Cofield, NC 27922 (252) 356-3700



isuing Date:

06/22/2017

B/L No.: 475576

Load No.: 485124

Our Order No.: 148421/1

Cust, Order No.: 14111

ehicle No: pecification:

NOKL 725198

0.3750" x 120.000" x 480.000"

Sold To:

RANGER STEEL SERVICES LP 1225 NORTH LOOP W STE 650 Ship To:

WATCO TRANSLOADING CLINTON

HOUSTON,TX 77008

9640 CLINTON DR HOUSTON,TX 77245

ASTM A516 70-10(2015)/ASME SA516 70 PVQ 2013/2015 Cu .15 Max, Sn .020 Max Normalized Test Coupons at 1650 F NACE MR0175 Annex

2.1.2. MR0103 (2010) Section 2.1.2 (2015) 13.1.1, 13.1.2)Compliant

Warking:

Heat No	С	Mn	Р	S	Si	Cu	Ni	Cr	Mo	Al(tot)	٧	Nb	Ti	N	Ca	В	Sn	Ceq	Pcm	
504247 504248	0.19 0.19	1.09 1.05	0.010 0.009	0.002 0.001	0.19 0.20	0.13 0.12	0.13 0.13	0.07 0.06	0.03 0,03	0.025 0.025	0.006 0.005	0.002 0.002	0.002 0.002		0.0033 0.0031	0.0001 0.0001	0.007 0.006	0.40 0.39	0.26 0.26	
			T		Tens	sile Tes	st									59				
Plate Serial No	l Piece	s Tons	Dir.	(psi) Yield	(psi) Tensile	Elong % in		Elongation % in 8"											7	
504247-07	6	18.37	T	51,200 46,600	76,500 74,000			20.0 23.2		31/90	ile									
504248-01	6	18.37	T	53,800 48,700	79,500 75,100			22.6 21.1												
504248-03	4	12.25	T	50,700 45,900	76,400 71,100			19.1 22.4				·								
504248-04	6	18.37	T	50,000 46,200	77,100 72,800			20.0 22.3									;			
504248-05	6	18.37	T	54,000 48,000	79,300 72,300			19.3 21.7												

est coupons only, normalized 60 minutes per inch of thickness at 1650 F \pm 25 F. Hold 30 minutes minimum. ;

Annufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. lercury has not been used in the direct manufacturing of this material. Produced as continuous cast discrete plate as-rolled, unless therwise noted in Specification. For Mexico shipments:nhc-SalesMX@Nucor.com

leld by 0.5EUL method unless otherwise specified. Ceq = C+(Mn/6)+((Cr+Mo+V)/5)+((Cu+Ni)/15)

cm = C+(Si/30)+(Mn/20)+(Cu/20)+(Ni/60)+(Cr/20)+(Mo/15)+(V/10)+5B

letted 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. IN 50049 3.1,8/EN 10204 3.18(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. Allegrelia

5/22/2017 12 00 17 PM

T. A. Depretis, Metallurgist

CLIENT_	MARATHON	RECEIVING INSPECTION REPORT JOB NO/ 8/65-9 P.O. N	10.
	· MATTIO	JOB NO P.O. N	10

					1.0.NO.	
PLATE					(L)	
SPEC. NO.	SAG	RADET1			(T1) (T2)	
MIN. THICK	KNESS REQ	DT2			150	
MEC DV		-	Т3			
MTP NO			Γ4	maddin managa malalaga		
HARDNESS	S TEST IE BI	L EQDV	v		$(T3) \qquad (T4)$	
					(W)	
CONFORMS	S TO CODE	YES	O		To the second se	
HEADS SPEC.NO. S	AGR/	\DET1		_ (Ti	
MIN. THICK	NESS REQD	T2		——— T4	_))	
HEAT NO		T3	3	- "	T2 /	(L) <u>I.D.R</u>
MFG. BY		T4	·	- //	T3	
M.T.R.NO		PG/UG-79		_		1
L					+	
HARDNESS 1	TEST IF REC)DL.	K.R	THICK	IESS MEASURED AT ST	RAIGHT FLANGE
NO. OF IDEN	TICAL HEAD)S1.D).R	_ 、		
CONFORMS	TO CODE	YES NO				
PIPE	II.					
SPEC.NO.SA_	(RADET1_		_	(L)
WIN. THICKNE HEAT NO	SS REQU	T2_		- /		1
MFG.BY		T3_ T4_		- //	TI	
MFG.IDENTIFI	CATION	14 L		1 1		(0
A.T.R.NO.	-			.	4 T2	
ARDNESS TE	ST IF REQU)			T3	
ONFORMSTO	O CODE	YES NO				
ITTINGS		TES NO	ý.			<u> </u>
	I IPI INGS _	NOZZLES - COMPO	MENTO			
MARK-C		NOZZLES - COMPC	DNENIS	CONFO	RMS TO CODE	
IO. SIZE	P.S.I.	DESCRIPTION	MFG.BY	MARKINO	OTHER WEST	YES NO
12"	NA	LR 90"50780	KKFFBON	MARKING	OTHER INFORMA	
1 6"	NA	45° SeH 80	KKFF BENON		5A 234 WPB	
		10 2011 00	PART BEUT	10123	5A234 NPB	
					MALITY	
					100	- 1
FO // FD D //	_					
ECKED BY	DA	TE	_APPROVED	BY QC MAN	AGER. MAY 0 3	2018 DATE
					10	
					QC 2	
						-

CERTIFICATE OF QUALITY

CERTIFICATE TO EN10204 3.1

Order No.: P1015731 Charlotte

KKP KKFF BEND (CAMBODIA) CO.LTO ADD Bldg NO D711 Sthemout Ville SSEZ

> National RD NO.4 212km, Prey Nob Dist Sihanouk Ville Cambodia

Brand name: KKF

Certificate No.:170719NC-03-02

Customer:

Issued date: November 30th 2017

Malerial: ASTM A/SA 234-14 WPB, NACE MR0175-15/NACE MR0103-15 TEL: 00855-097-8609813 Specification for ASME B16,9-12 Original Material, ASTM A106 GR.B seamless stool pipe Ultrasonic Çu Nb N Mo Cr Mn NA Chemical C X1/100 Examination (1/100 X1/100 Composition MAX MAX MAX MAX MAX MAX MAX MIN 0.29 RT TEST MAX •1 Heat No. 0.058 0.40 0.15 0.40 0.08 0.40 0.10 1.06 0.050 0.30 0.015 0.020 0.016 0.028 0.024 0.024 0.024 0.024 0.024 PASSED PASSED PASSED 0.010 0.010 0.010 0.010 0.023 0.022 0.019 0.001 0.002 0.001 0.001 0.009 0.033 0.56 0.011 N228 N223 N252 N750 0.22 0.23 0.026 0.032 0.25 0.27 0.24 0.014 Ch 0.18 0.55 0.52 0.48 0.50 0.48 0.47 0.012 0 009 5555555 0.21 PASSED. 0.011 0.00B 0.023 0.19 0 010 0 011 0 010 0 011 0 010 0 011 0.002 0.001 0.001 0.001 0.025 021 0.010 0.013 N758 N747 0.18 Dimension Inspection PASSED 0.010 0.009 0.028 0.20 0.033 PASSED 0 008 0.010 N744 0.21 PASSED PASSED PASSED 0.009 0.013 0.18 N761 0016 0 031 0.011 0.012 0 55 0.025 0.010 0.008 Mechanical Hydrostatic **Tension Test '2** Hardness Impact **Properties** MPI Test *4 Test Test Description & Dimension Tost QTY (PC) RA. ITEM IO Specification YS T.S EL (MPA) (HB) % % Мрв Мра Heat No 197(MAX) Min 240 415-655 Min:22 総 \$4512 \$1912 \$4514 \$1914 \$5901.5 X1.901.0 X5901.0 X5901.0 NIA HA 325 143 300 485 N228 NIA NIA NA NA NA N/A 285 490 30.5 135 N223 NA N/A N/A 32.5 NIA 137 NIA N'A N252 295 485 138 NIA NA 33.0 N750 305 480 NA N/A N/A NA NIA 290 485 31.0 140 N758 NA N/A N/A N/A N/A N/A N747 300 495 32 0 NIA 146 ਸ਼ੇਸ NA NA NIA 137 NIX 32.0 N744 280 485 NA NIA NA NIA N/A N/A 32.5 144 N/A 19761 280 490 N/A XIT N/A N/A NA NIA NIA ᇄ 145 495 31.5 N742 285 NIA NIA NIA XC904 X4500 MA WA

295

HOT FORMED Annealing Tempering We hereby certify that the material herein has been made and tested in accordance with as above specification and also with the requirement called for the above order

1616

Normalizing

N753

For and on behalf of Quality Assurance System in accordance with Pressure Equipment Directive 2014/68EU Annex I Section 4.3 as well as EN 764-5.Pera 4.2 by TUV Sud Industrie Service GmbH(Notified Birdy No 0036).

NIA

Quality system certification (SO9001:2008 No. 01 100 1430809 by TUV Rheinland Cert GmbH

TOTAL

*1---ChriChemical Analysis

*4---MPI Test=Magnetic Powder Inspection

C

2--Tension Test: Y.SaYleld Strengh T.SaTensile Strengh E.LaElongation R.A. Reduction of Area

32.0

485

NIA

N/A

Water Quenching

152

Manageryl Quarry Control Dept 710/1/07/72 0 STERIATOTELS

NUA

NIX

NA

lus



Note:

Heat Treatment '3

*3---Heat Treatment: A.C=Air Cooled

TIX

MILL TEST CERTIFICATE

CERTIFICATE TO EN10204 3.1

PO No.: 185398

KKFF BEND (CAMBODIA) CO. LTD ADD:Bidg.NO.D711,Sihanguk Ville,SSEZ. National RD NO.4 212km, Prey Nob Dist.

Sihenouk Ville, Cambodia

Brand name: KKF Issued date: Sep.13th,2017 Material Grade: ASTM A234/ASME SA234-2013 WPB Specification for ACME DIE O DOLD

A1 1			MOINE OF CO	+2013 VAL	-0	Sp	octication	1 for ASM	<u>4E B18.9-2</u>	012					Ser Aile Callinoola
Chemical Compositions		С	Si	Mn	Р	S	Ni	Mo	Cr	V	Cu	Nb	N		0855-097-8609813
Compositions		X1/100	X1/100	X1/100	X1/100	X1/100	X1/100	X1/100	X1/100	X1/100	X1/100			Ultrasonic	N/A
Heat No.	1 49	MAX	MIN	0.29	MAX	MAX	MAX	MAX	MAX	MAX	MAX	X1/100	X1/100	Examination	
		0.25	0.10	1.06	0.050	0.058	0.40	0.150	0.40	- MOVA	0.40	MAX	MAX	RT TEST	
8022	Ch	0.20	0.32	0.50	0.012	0.004	0.05	0.005	0.05		0.05	0.020		1201	
B183	Ch	0.19	0.26	0.48	0.016	0.005	0.03	0.004	0.04	-		0.001			PASSED
B952	Ch	0.21	0.28	0.44	0.016	0.004	0.03	0.011	0.03	 -	0.02	0.002		Dimension	PASSED
B126	Ch	0.22	0.21	0.55	0.013	0.006	0.01	0.008		-	0.03	0.002	-	Inspection	PASSED
B672	Ch	0.18	0.22	0.48	0.016	0.007			0.01	-	0.02	0.002	-	metronii	PASSED
				0.40		_	0.03	0.007	0.05	-	0.06	0.002	-		PASSED
Description &	L Dim	ension	Size	QTY	Mechanical		Tension Test *2				Hardness	Hydrostatic		Impact	1
			(inch)	(pc) Proper		1.5		T.S	E.L	R.A.	Test		Test	Test	MPI Test
90ELL	LR	ХН	4.00	100	Heat		Мра	Мрв	%	%	(HB)	(MP)	4)	(J)	
90ELL			1/2"	150	802		285	455	29.5	N/A	163	N/A		N/A	*4
	LR	XH	1"	350	B18	3	290	460	28.0	N/A	165	NA			N/A
90ELL	LR	XH	2"	6000	B95	,						N/A		N/A	N/A
45ELL	LR	XH	2"	300	D83	4	305	475	30.0	N/A	170			N/A	N/A
90ELL	LR	XH	2 1/2"	150	B12	6	290	450	30.5	N/A	450	N/A		N/A	N/A
90ELL	LR	XH	4"	600				100	30.5	NVA	159	N/A		N/A	N/A
45ELL	LR	XH	4"	150	B67	2	295	465	29.5	N/A	165	N/A		N/A	N/A
			TOTAL:	7700								N/A		NA	N/A
Hant Toon			Nomalizing			٦									
Heat Treatment *3 Normalizing C Annealing C							Water Qu				3	hrs			
M	larkin	o Detella		Sobodulo	. 4224145				hrs	Temperir	ng .			· o	hrs
Marking Details: KKF+Size + Schedule + A234 WPB +Heat No.							1		Fittings	s conform t	NACE	MR 0175			

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

Quality Assurance System in accordance with Pressure Equipment Directive 2014/68EU Annex I Section 4.3 as weel as EN 764-6, Para 4.2 by TUV Sud Industrie Service GmbH(Notified Body No.0036)

Note:

PO: 181655041J Line: 17 Order: 1335836 Heat: B952 Slab: Descr. 2 XH LR BW 90

Certificate No.:170620-1

Customer:

*1—Ch=Chemical Analysis

*2---Tension Test: Y.S=Yield Strengh T.S=Tensile Strengh E.L=Elongation R.A.=Reduction of Area

*3-Heat Treatment: A.C=Air Cooled *4---MPI Test=Magnetic Powder Inspection

Manager of Quality Control Dep't



RECEIVING INSPECTION REPORT JOB NO. / 8/65-9 P.O. NO.

					D BY QC MAN	1	2018_DAT	
						A OURLITY (G:
						CITY		
	~	3000#	FULL CPLNG	IML	K556	SA 105		
	SIZE	P.S.I.	DESCRIPTION	MFG.BY	MARKING	OTHER INFORM	A	
AP O.	SIZE	010	DECORIDE			OF .	YES	NO
AN	GES - CC	DUPLINGS -	NOZZLES - COMPO	NENTS	CONFOR	RMS TO CODE		
	INGS)					
	FORMST	O CODE	YES NO	24				_
		EST IF REQU)			T3		
	R.NO.	EST IF DECE			- \\			
FG.	IDENTIFI	CATION	L		_ ++ T4	T2		
FG.	.BY		T4		_ / /	T1 \		
EA.	T NO		T3	n 17				
N.	THICKNE	SS REQD_	T2		- /		L)	—
PE	C.NO.SA_		GRADET1_					
PIP			YES NO					
		TO CODE			_			
10.	OF IDEN	TICAL HEAD)S(.D.	.n .R.	THICKN	ESS MEASURED AT ST	RAIGHT FL.	ANGE
L_ IAF	RDNESS 1	EST IF REC	DL.	(P	994 44 mar	I		
	.R.NO		PG/UG-79			I/	¥ 'C	
MF	G. BY		T4		_ \\	T3		
HE/	AT NO		T3		_			חים
MIN	N. THICKN	NESS REQD	T2		_ T 4	T2	(L) I.	DR
					_ / /	T1 \		The
		AGRA	DET1			TI	1 1	
HF	EADS							_
CC	NFORMS	TO CODE	YES N	0				
HA	ARDNESS	TEST IF RE	QDW			(W)		J
M.	T.R. NO		L			(T3) (T4)		
M	FG. BY		T	4				
H	EAT NO		Т	3				
M	IN. THICK	(NESS REQI	DT2			(11) (12)		
S	PEC. NO.	SA GR	ADET1			(T1) (T2)		7
	LATE							

CLIENT MARATHON RECEIVING INSPE	ECTION REPORT 18/65-9 P.O. NO.	EXHIBIT F REV.
PLATE SPEC. NO. SAGRADET1	(L) (T1) (T2)	
MIN. THICKNESS REQDT2	6	
HEAT NOT3		
MFG. BYT4		1
M.T.R. NOL	(T3) (T4)	
HARDNESS TEST IF REQDW	(W)	
CONFORMS TO CODE YES NO		
HEADS SPEC.NO. SA GRADET1	THICKNESS MEASURED AT ST	(L) I.D.R
PIPE		
SPEC.NO.SAGRADET1_	-	L)
MN. THICKNESS REQDT2	-	1
HEAT NOT3	- / T1	
MFG.BYT4	- / /	(0)
MFG.IDENTIFICATIONLLLLLLL	- T4 T2	. (0)
IARDNESS TEST IF REQD	- \ \ \	
	T3	
ONFORMS TO CODE YES NO		
ITTINGS		
LANGES COUPLINGS - NOZZLES - COMPONENTS	CONFORMS TO CODE	
ARK-C7 C3A, C3B, (8, C14, C15 C2		YES NO
NO. SIZE P.S.I. DESCRIPTION MFG.BY	MARKING OTHER INFORM	
2"x6" 3000# 6"LG (TOE) TIMKEN	L3T SA 105	

FLANGES COUPLINGS - NOZZLES - COMPONENTS CONFORMS TO CODE									
NO. SIZE P.S.I. DESCRIPTION MFG.BY MARKING OTHER INFORMAL									
	2"x6"	3000#	6"LG (TOE)	TIMKEN	L3T	OTHER INFORMA	17/100		
	1/2"	6000#	FULL CPLNG	IML	23614	5A 105			
	3/4"	6000H	FYLL CPLNG	PHOENIX	7611	SA 105 TY			
-	1/2/23"	3000#	FULL CPLNG	LOFHED	TPR	SA 105 VA			
	1413	WWO #	JLG (TOE)	KKEHEK	41K	SA 145 /	1	1	

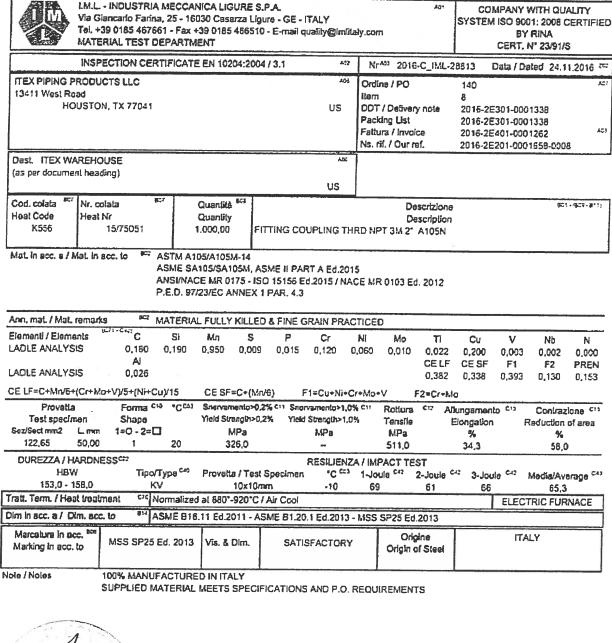
CHECKED BY_____ DATE_ __APPROVED BY QC MANAGER MAY 0 3 201 BATE

QC 2

TEST CERTIFICATE No: 1 111614 6-4-14 P/O No 3199 KREHER STEEL COMPANY, LLC. Rel 1550 NORTH 25TH AVENUE S/0 No 1 263873-001 MELROSE PARK, IL 60160 B/L No 1 213018-001 Shp 30May14 Tel: 708-345-8180 Fax: 708-345-8293 Inv No Inv Ship To: (1)Sold To: (7811) PRODUCTION MANUFACTURING CO., INC. PRODUCTION MANUFACTURING CO., INC. 5909 EAST 13TH STREET 5909 EAST 13TH STREET TULSA OK 74112 TULSA OK 74112 Tel: 918-836-3585 Fax: 918-835-9681 CERTIFICATE of ANALYSIS and TESTS 29May14 Part No COLD DRAWN ROUNDS SA105 11/2 0 SA105 1.5000 X 16'R/L . 41K ASTM A105-13 ASME SA105 HEAT NUMBER 497581 Cu .17 , V .003 AND Cb/Nb .008 LOT NUMBER 289712 WEIGHT 25846 76400 TENSILE 42000 YIELD ELONGATION 25 % 44.98 REDUCTION OF AREA AT SURFACE 151 HARDNESS MADE IN THE USA *** Chemical Analysis *** Heat Number C=0.2100 Mn=0.8100 P=0.0080 S=0.0300 Si=0.2200 Cu=0.1700 497581 Ni=0.1400 Cr=0.0900 Mo=0.0200 Al=<.027> Cb=<<.008> V=<.003> Ti=<.001> I hereby certify that this data is correct as contained in the records of this company. I hereby certify that no mercury came in contact with or no weld repair was done to this product while in our possession. PRODUCTION MFG, TULSA, OKLA

CUSTOMER NORTHShore STEEL
P.O. # 1335808 - Bd 1

Page: 1 Last





UFFICIO CONTROLLO QUALITA' AS ENTE UFFICIALE DI COLLAUDO 201 MARCHIO PRODUZIONE AND MANUFACTURER'S SYMBOL MANUFACTURER'S
Steel Certificate of Test

1835 Dueber Ave. S.W. Canton, Ohio 44706



12/13/2016

ID #0426162-1 Page 1 of 2 Production Manufacturing Company 5909 EAST 13TH STREET OT TULSA, OK 74112 USA L 0 D 3"0.D. X .422 WALL PRODUCTION MANUFACTURING COMPANY-ATTN ROLEY MCINTOSH S 5909 EAST 13TH STREET H T 137 Ι 0 TULSA, OK 74112 USA Customer Order: 3438 Customer Part Number: 55767-A (2059089) Heat Number(s): L3153 Description of Material OD: 3.000 in (76.200 mm) WALL: 0.422 in (10.719 mm) ID: 2.156 in (54.762 mm) Shape: RD Prod Type: TUBE Sales Type: 1026 Int Quality: COMMERCIAL HOT ROLL - SCALE FREE -Condition: Specification - ASTM A 105 / A 105M Rev. 14 10/01/2014 EXCEPT - ASME SA-105/SA-105M Rev. 2015 EDITION EXCEPT AS - ASTM A 961 Rev. 14 11/01/2014 EXCEPT AS NOTED Rev. 14 10/01/2014 EXCEPT AS NOTED Rev. 2015 EDITION EXCEPT AS NOTED Chemistry Information &C &Mn %Si %Cr %Ni %Mo %Cu SPEC Ladle Min: .22 :60 .10 SPEC Ladle Max: .28 .90 .030 .040 .35 .30 .40 .12 .40 .080 .28 .85 .012 .020 .26 .10 .09 .03 .28 .044 .001 Testing of elements performed at TimkenSteel Chemistry Labs except where noted. Metallurgy Information SPEC: Chemistry CR+MO 0.320 Max CR+NI+MO+CU+V 1.000 Max Heat L3153 CR+MO: 0.130 CR+NI+MO+CU+V: 0.501 SPEC: Grain Size (Info Only) SPEC: Hardness ASTM E10 UOM BRINELL HARDNESS 187 Max LOCATION MID Heat Piece# UOM L3153 2833300 HARDNESS 165 BRINELL 2833300 LOCATION MID BRINELL 2833301 HARDNESS 160 BRINELL 2833301 LOCATION MID BRINELL MAR 1 3 2018

When shipping document is attached it becomes part of this certification.

We certify the above materials have been inspected and tested in accordance with the methods prescribed in the governing specifications and consistent with our Standard Commercial Terms and Conditions for Sale, Manufacture, and Shipping, which are incorporated into and made part of this certification. The results of such inspections and tests conform with the applicable requirements including the purchase order, specification(s) and exception(s). This certificate or report shall not be reproduced except in full, without the written approval of TimkenSteel Corporation.

Notarized:

NOTARY PUBLIC

Michele Clendenen, Metallographer

TimkenSteel Corporation

Steel Certificate of Test

1835 Dueber Ave. S.W. Canton, Ohio 44706 ID #0426162-1

TIMKENSTEE

Page 2 of 2

12/13/2016

Customer Order: 3438

55767-A (2059089) Heat Number(s):

Customer Part Number:

L3153

Metallurgy Information

SPEC: Tensile ASTM E8 TENSILE 70,000 Min STRENGTH UCM PSI YIELD .2 36,000 Min MIN ELONGATION 22.0 Min GAUGE LENGTH 4 x Diameter MIN REDUCTION IN AREA 30.0 Min SHAPE ROUND DIRECTION LONGITUDINAL TEMPERATURE ROOM LOCATION MID

.2% Yld Gauge Tensile Heat Fiece# Strength UOM Strength Elong% Length %Red Specimen Direction Temp Location 59.0 .252" RD LONG. RT MID 1 IN 85,511 PSI 47,891 23.5 L3153 A

All Hardness and Tensile testing performed at TimkenSteel Metallurgical Lab except where noted.

Heat L3153 Melt Source: USA Manufacturing: USA

No welding of this material has occurred.

In reference to Section 1502 ("Conflict Minerals") of the Dodd-Frank Wall Street Reform and Consumer Protection Act, no tantalum, tin, tungsten or gold was intentionally added to this material.

> PRODUCTION MFG, TULSA, CKLA CUSTOMER NORTHShore STEEL 1335808-BAI



PO: 181655041J Line: 14 Order: 1335836 Heat: 76II Slab: Descr.: 3/4 6M FS THRD CPLG

Capitol Manufacturing 1125 Capitol Avenue Crowley, LA 70526

Phoenix * Capitol * Camco CapProducts

Commanding a Higher Standard

Certified Mill Test Report

Printed: 10/5/2017 Customer Certified: 10/03/2017 P.O. 190568-00 pt 1

Heat No 177540 Heat Code 7611

Tag

Phoenix Order # 1311382

Material ASTM A105-2014 / ASME SA105-2015 Edition

Part Number

Description

12302007

0.0320

3/4 FS 6M THD COUPLING

Chemical Properties

С	Mn	P	S	Si	Cu	Ni	Cr	7
0.2100	0.9100	0.0060	0.0180	0.2100	0.1700	0.1010	0.1380	
Mo	V	Co	Al	Cb	N	Pb	Sn	Ta

Additional	Chemical	Properties

0.0360

Cr + Cu + Ni
0.4090

C Eq. Long 0.4209

Ti

Mechanical Properties

Tensile (PSI)	Yield (PSI)	Elong. % in 2 in. or 4D	RofA	HBW	HBW2
87,200	64,700	26.0%	55.0% *	162	162

0.0020 | 0.0020

Charpy Minimum Impact - ft/lbs

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

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements.

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

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

Certified 2

ame: Sharon Thevis

Title: Certification Specialist

AR 0 9 2018



I.M.L. - INDUSTRIA MECCANICA LIGURE S.P.A. Via Giancarlo Farina, 25 - 16030 Casarza Ligure - GE - ITALY

Tel. +39 0185 467661 - Fax +39 0185 466510 - E-mail quality.iml@farinagroup.com MATERIAL TEST DEPARTMENT

COMPANY WITH QUALITY SYSTEM ISO 9001: 2008 CERTIFIED **BY RINA** CERT. Nº 23/91/S

AC+

	INSPECTION CERTIF	ICATE EN 10204:20	004 / 3.1 A32	Nr ^{A03} 2015-C_IML-	-26772 Data / Date	d 20.05.2015 ²⁰²
13411 West Ro	PRODUCTS LLC pad DUSTON, TX 77041		US	Ordine / PO Item DDT / Delivery note Packing List	I-254547ST/A 94 2015-2E301-000079 2015-2E301-000079	
				Fattura / Invoice Ns. rif. / Our ref.	2015-2E201-000015	^> 52-0028
12945 MARKE			A06			
TX 77015 HO	DUSTON		US			
Cod. colata Box	Nr. colata	Quantità 638		Descrizion	ne	80° (80° 8'1)
Heat Code 236M	Heat Nr 14/78841	Quantity 250,00	FITTING COUPLING TH	Descriptio RD NPT 6M 1/2" A105		

Mat. in acc. a / Mat. in acc. to 832 ASME SA ASTM A105/A105M-14

NACE MR 0175 - ISO 15156 Ed. 2009 / NACE MR 0103 Ed. 2012

P.E.D. 97/23/EC ANNEX 1 PAR. 4.3

Ann. mat. / Ma	it. remark	3 B32 N	MATERIA	L FULLY	KILLED	& FINE	GRAIN PE	RACTICE	D					
Elementi / Ele LADLE ANALY LADLE ANALY	ments 'SIS	0,185 AJ 0,025	Si 0,220	Mn 0,890	S 0,010	P 0,015	Cr 0,160	Ni 0,070	Mo 0,010	Ti 0,015 CE LF 0,386	Cu 0,200 CE SF 0,333	V 0,002 F1 0,442	F2	N 0,000 PREN
CE LF=C+Mn/6	s+(Cr+Mo-	+V)/5+(N i+C	J)/15	CE SF	≂C+Mn/6) F	1=Cu+Ni	+Cr+Mo+	·V F	2=Cr+Mc	0			
Provet Test spec		Forma ⁵¹ Shape	_		nento>0,2° ength>0,2°		rvamento> Strength>		Rottura Tensile		ungamen longation		Contraz Reduction	
Sez/Sect mm2	L. mm	1=0 - 2=[•		MPa		MPa		MPa		%		%	
122,65	50,00	1	20	3	18.0				501.0		34.3		58.4	

 122,00	30,00		318,0	••	301,0	,	34,3	58,4
DUREZZA /	HARDNESS				ZA / IMPACT 1			
H	BW	Tipo/Type	e ^{Ceo} Provetta / Tes	st Specimen •C ^{Cns}	1-Joule CAR	2-Joule C47	3-Joule C47	Media/Average (4)
152,0	- 158,0	KV	10x10	mm -10	65	61	69	65.0

Tratt. Term. / Heat treatment GTO Normalized at 880°-920°C / Air Cool **ELECTRIC FURNACE** ASME B16.11 Ed.2011 - ASME B1.20.1 Ed.2013 - MSS SP25 Ed.2013 Dim in acc. a / Dim, acc. to Marcatura in acc. ** Origine ITALY MSS SP25 Ed. 2013 Vis. & Dim. SATISFACTORY Marking in acc. to Origin of Steel

Note / Notes

100% MANUFACTURED IN ITALY

SUPPLIED MATERIAL MEETS SPECIFICATIONS AND P.O. REQUIREMENTS





UFFICIO CONTROLLO QUALITA' QUALITY CONTROL DEPARTMENT Boris Fizzotti - Q @Manager

ENTE UFFICIALE DI COLLAUDO INSPECTION AUTHORITY

MARCHIO PRODUZIONE MANUFACTURER'S SYMBOL

IML





I.M.L. - INDUSTRIA MECCANICA LIGURE S.P.A. Via Giancarlo Farina, 25 - 16030 Casarza Ligure - GE - ITALY Tel. +39 0185 467661 - Fax +39 0185 466510 - E-mail quality@imlitaly.com MATERIAL TEST DEPARTMENT

COMPANY WITH QUALITY SYSTEM ISO 9001: 2008 CERTIFIED BY RINA CERT. Nº 23/91/S

AC:

A22 INSPECTION CERTIFICATE EN 10204:2004 / 3.1 Nr^{A03} 2017-C_IMLNL-02336 Data / Dated 14.11.2017 202 ACC. Ordine / PO Item US **DDT / Delivery note** Packing List Fattura / Invoice 43 Ns. rif. / Our ref. 2017-32E21-0000762-0001 Cod. colata 601 Quantità 6126 Nr. colata 81. - (933- 8.1) Descrizione **Heat Code** Heat Nr Quantity Description TPR 12/35150 250,00 FITTING COUPLING THRD NPT 3M 3" A105N

Mat. in acc. a / Mat. in acc. to 600 ASTM A105/A105M-14

ASME SA105/SA105M, ASME II PART A Ed.2015 ANSI/NACE MR 0175 - ISO 15156 Ed.2015 ANSI/NACE MR 0103 - ISO 17945 Ed. 2015 P.E.D. 2014/68/EU ANNEX 1 PAR. 4.3

502 MATERIAL FULLY KILLED & FINE GRAIN PRACTICED Ann. mat. / Mat. remarks (071-032) C Elementi / Elements S Mn Cr Ni Mo Ti Cu LADLE ANALYSIS 0.190 0,220 0.930 0.008 0,006 0,090 0,060 0,010 0,016 0,150 0,002 0.0010.009 ΑJ CE LF **CE SF** F1 F2 PREN LADLE ANALYSIS 0,027 0.379 0.3450.312 0.100CE LF=C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15 CE SF=C+(Mn/6) F1=Cu+Ni+Cr+Mo+V F2=Cr+Mo Forma 519 °C 503 Snervamento>0,2%511 Snervamento>1,0%511 Rottura C'2 Allungamento C'3 Contrazione C15 Test specimen Shape Yield Strength>0,2% Yield Strength>1,0% Tensile Elongation Reduction of area Sez/Sect mm2 L mm 1=0 - 2= MPa MPa MPa % % 122.65 50.00 20 338,0 506,0 32.0 58,0 DUREZZA / HARDNESSG22 RESILIENZA / IMPACT TEST HBW Tipo/Type^{C40} Provetta / Test Specimen *C COS 1-Joule CAY 2-Joule C49 Media/Average (4) 3-Joule 122 155.0 - 159.0 ΚV 10x10mm -10 63 63 62.3 Tratt. Term. / Heat treatment Normalized at 880°-920°C / Air Cool **ELECTRIC FURNACE** Dim in acc. a / Dim. acc. to 614 ASME B16.11 Ed.2016 - ASME B1.20.1 Ed.2013 - MSS SP25 Ed.2013 Marcatura in acc. 80 Origine ITALY MSS SP25 Ed. 2013 Vis. & Dim. SATISFACTORY Marking in acc. to Origin of Steel

Note / Notes

100% MANUFACTURED IN ITALY SUPPLIED MATERIAL MEETS SPECIFICATIONS AND P.O. REQUIREMENTS



UFFICIO CONTROLLO QUALITA' QUALITY CONTROL DEPARTMENT Boris Fizzotti - Q @Manager

ENTE UFFICIALE DI COLLAUDO INSPECTION AUTHORITY

MARCHIO PRODUZIONE MANUFACTURER'S SYMBOL

IML

MAY 0 3 2018 DATE

QC 2

EXHIBIT F REV. 0 RECEIVING INSPECTION REPORT CLIENT MARATHON JOB NO. 18/65-9 P.O. NO. (L) PLATE SPEC. NO. SA____GRADE____T1___ (T1)(T2)MIN. THICKNESS REQD_____T2____ HEAT NO.____ T3 MFG. BY __T4_____ M.T.R. NO. L (T3)(T4)HARDNESS TEST IF REQD. (W) CONFORMS TO CODE YES NO HEADS SPEC.NO. SA____GRADE____T1___ T1 MIN. THICKNESS REQD_____ T2 T4 T2 (L) I.D.R HEAT NO______T3_ MFG. BY______T4 **T**3 M.T.R.NO. PG/UG-79 HARDNESS TEST IF REQD _____ L.K.R.___ THICKNESS MEASURED AT STRAIGHT FLANGE NO. OF IDENTICAL HEADS______I.D.R.____ CONFORMS TO CODE YES NO PIPE SPEC.NO.SA_____GRADE____T1___ (L) MN. THICKNESS REQD_____ T2____ HEAT NO_____ Т3_____ T1 MFG.BY _____T4___ MFG.IDENTIFICATION L (0)T4 T2 M.T.R.NO. HARDNESS TEST IF REQD T3 CONFORMS TO CODE YES NO **FITTINGS** FLANGES - COUPLINGS - NOZZLES - COMPONENTS **CONFORMS TO CODE** MARK- CG. CL. 4 YES NO NO. SIZE P.S.I. DESCRIPTION MFG.BY MARKING OTHER INFORMA RETURNSCH 80 METALFAR 15/40109 150# SA 105 RFSO SHO BEBITZ 150# 605063/1

CHECKED BY _____ DATE _____ APPROVED BY QC MANAGER.





Lebendorfer Str.1 - 06420 Könnem OT Bebitz / GERMANY (A01) Tel. +49 34691 40 0-Fax +49 3469140 329-Email: flanges@bebitz.de Bebitz Flanges Works Pvt. Ltd.-Survey No. 140/2, Saravali Boisar - Tatuka Palghar - Thane 401501 Maharashtra, INDIA - Email: quality@bebitz.in Bebitz U.S.A., INC. 100 Quentin Roosevelt BLVD-Garden City, NY11530/USA Tel. +1-516-2808380-Fax +1-516-2808382-Email: bebitzusa@bebitz.de

Abnahmeprüfzeugnis 3.1 / Inspection certificate 3.1 / Certificat de reception 3.1 nach (A02) / acc. DIN EN 10204 : 2005 Nr. (A03) / No.17-07908 Datum (Z02) / Date 15.08.2017

Zeichen des Herstellers (A04) Manufacturer's brand

Stempel des Abnehmers (Z03) Stamp of the testing engineer

TKO

Oberprüft als Hersteller nach AD-Merkblatt W0 / TRD100 und VdTÜV Werkstoffblätter 350/3, 354, 399 / Approved as manufacturer acc. AD-Merkblatt W0 / TRD100 and VdTÜV Material Sheets 350/3, 354, 399 Zertifiziert nach DGR 97/23/EG durch TÜV NORD Systems GmbH Co. KG, notifizierte Stelle 0045 / Certified acc. to PED 97/23/EC, certifying body TÜV NORD GmbH Co. KG, notified body no. 0045

Besteller (A06) Customer Bestell-Nr (A07) / Order-No. 412170BG Auftrag (A08) / Order 20000198 Lieferschein / Delivery No. 30001230 Position (B07.1) / Item

Stck (B08) Bezeichnung (B01; B09 - B11) Quantity Product

Schmelze/Prüflos (B07)

27

Heat no./Test no.

18 inch Slip-On Welding Flange 150 lbs raised face Customer ID: L1SR18-BG

605063/1

A 105N - ASTM A105M-14 / ASME SA-105M Material (B02; B05) normalized 900 °C, air cooled

Anford. ASME B 16.5-2013

(B03)

NACE MR0175-2015 / MR0103-2010 - DIN EN ISO 15156-2:2015 Require- 2015 ASME Boiler & Pressure Vessel Code - Section II Part A; ASTM A961-14

Schme	zenana	lyse (C	71 - C92) / Ladle	analys	ls	E	rschme	lzung (C70) / Ma	elting p	rocess	Ē
С	Si	Mn	Р	S	Cr	Ni	Ti	Mo	Nb V	N	Cu	AI CEV
0,190	0,22	0,84	0,016	0,003	0,19	0,10		0.03	0,001 0.002		0.19	0.032 0.39

0,10	1 0,03 (0,001 0,002	0,19 0,032 0,39
Mechanische Prüfungen / Mechanical tests	$CEV = C + \frac{Mn}{c} + \frac{V + Mo + Cr}{c} + \frac{NI + Cu}{4c}$	PREN = Cr + 3,3 x Mo + 16 x N

Zugv	enlage (C02): T / Position of ersuch / Tensile Test - AS		Kerbso DIN EI	Härte (C32) Hardness							
(C03)	Streckgrenze (C11) / Yield 0,2% 1,0% MPa (N/mm²) MPa (N/mm²)	(C12) Tensile		ng (C13) ngation %	Einschnürg. Red. of area %	Temp. (C03)	Einze	werte (C gle value	(42)	MW (C43) Average	ISO 6506-1 HBW 2,5/187,5
20	min 250 max	485	5d ₀	2,0 4d ₀	30	20				· :	137 187
20	293	516	32,6	40,7	67	20	112	121	116	116,3	153
20	291	515	32,9	41,1	68	20	125	119	115	119,7	150
20	287	510	33,5	41,9	69	20	122	134	126	127.3	148
20	290	513	33,1	40,7	68	20	121	118	129	122,7	150

Country of Melting: Germany - Country of Origin: Germany

Am Material wurden keine Reparaturschweißungen vorgenommen. / No welding repair on the material. Material ist nicht radioaktiv oder mit Quecksilber kontaminiert. / Material is free from radioactive or mercury contamination. Sicht- und Maßprüfungen ohne Beanstandungen. (D01) / Visual and dimensional examinations without objections. Die Anforderungen der Bestellung sind erfüllt. / The product meets the requirements of the order specifications. Die Angaben in Klammern entsprechen den Vorgaben der DIN EN 10168 / Data in parentheses refer to DIN EN 10168. APZ ist mit EDV erstellt und ohne Unterschrift gültig. / MTR was electronically generated and is valid without a signature.

R. Sparing

Abnahmebeauftragter des Herstellers (Z02) / Inspection Representative of the Manufacturer

421



METALFAR PRODOTTI INDUSTRIALI SPA 23861 CESANA BRIANZA (LC) - ITALY VIA G. PARINI, 28

PHONE + 39 031 655441 - FAX +39 031 655149

COMPANY WITH
MANAGEMENT SYSTEM
CERTIFIED BY DNV
= ISO 9001 =
= ISO 14001 -

	certifica	ic@metalfarit	aly.com										ISO 1400	
	INSPE	CTION CERT	IFICATE	EN 102	04:2004	/ 3.1	ž	≈ N	r 2016	-C_MFF-	03196	Data / O:	aled 25.0	8.2016 ZZZ
CONTINENTA VIA VOLONTA 22036 EF	L FLANG VRI DELL RBA	ES & FITTING A LIBERTA',	GS ITAL 1	ia spa			CO IT	Iter	line / PO n T / Deliver	y note	741 009 2016-38	301-000	2289	£;
								Fat	cking List tura / Invoi rif. / Our n		2016-36	201-000	2747-000	A98 18
Dest. CONTINUES VIA MAGNI, 11	NENTAL I 3 (FRAZ. VERIGO	FLANGES & F CARPANEA	ITTING	SITALIA	SpA		A	×						
							CO							
Cod. colata Est Heat Code	Heat N	r		Quantità Quantity						scriziona scription			n:	! - (ECP - 8! 1)
	1 1	5/40109		200,00	W	N 150 RF	6" XS	A105N	1					
s _{t.}	t-	сі ^{п. сад} с	ERT.468	37-2014-	CE-ITA-A	CCREDI	A	KEU1.9	7/23/EC(P	EU) ANN	EX I, PAR	AGRAPI	H 4.3	
Elementi / Eleme			Si	Mn	5	P	Cr	Ni	1.10	Ti	Cu	V	Nb	N
LADLE ANALYS	515	0,200 Al	0,240	1,060	0,009	0,010	0,100	0,050	0,010	0,017 CE LF	0,130 CE SF	0,002 F1	0,001 F2	0,010 PREN
LADLE ANALYS	SIS	0,025								0,411	0,377	0,292	0,110	PAGN
CE LF=C+Mn/6+	+(Cr+1:10+	·V)/5+(Ni+Cu)	/15	CE SF	=C+(Mn/	ō) F	1=Cu+Ni	+Cr+Ma	+V 1	F2=Cr+IA	0			
Provetts Test specir	_	Forma ^{C19} Shape	*Cca1		nenlo>0,2 ength>0,2	% CH Snai % Yield	vamenio>: Strongth>	-	Rottura Tensile		ungamen		Contraz	of area
Sez/Sect mm2	L. mm	1=0 - 2= 🗆		A	4Pa		MPa		MPa	_	%		%	010100
126.60	50,80	1	20	3:	58,6				526,0		30.0		58,0	
DUREZZA / H	IARDNES	Sca					RESILIE	NZA / IN	PACT TE	ST				
HBV	•	Tipo/Ty	/pe c+c			Specimen	*C *	²³ 1√1	oule ^{C42}	2-Joule c	⁴² 3-Jou	le ca	Media/Av	erage ^{Cc)}
152,0 - 1 Traft. Term. / Ho		KV	01444		10x10 m		-10		3	48	59		53,3	
				official and a strategy of the		COOLED	IN STILL	AIR				ELEC.	TRIC FUR	RNACE
Dim in acc. a / D	im, acc. t	D TAS	ME/ANS	SI B16.5	-2013									

Note / Notes

100% MANUFACTURED IN ITALY

MANUFACTURING IN ACCORDANCE WITH ORDER AND SPECIFICATION

COMMESSA 2650



224

UFFICIO CONTROLLO QUALITA'
QUALITY CONTROL DEPARTMENT

La Topeno

ENTE UFFICIALE DI COLLAUDO INSPECTION AUTHORITY

MARCHIO PRODUZIONE MANUFACTURER'S SYMBOL

MFF

Page 3 - 6

CUSTOMER	2.0 .	ITEM No.	DESCRIPTION D.TY
NORTH SCRE	279569	80	PLANGES W/N 150 RF 6" XS A105N 200

QC 2

CLIENT_/	MARATIK	RECEIVING	G INSPE	CTION RE	PORT P.O. NO.	EXHIBIT F REV. (
					(L)	
PLATE					(-)	
SPEC. NO. S	AGR	\DET1			(T1) $(T2)$	
		T2				
		тз				
		T4			-	
M.I.R. NO		L	·		(T3) (T4)	
HARDNESS	EST IF RE	QDW			(W)	
CONFORMS	TO CODE	YES NO)			
HEADS					_	
	GRA	DET1			TI	
·				- / /	11	1
MIN. THICKNE	ESS REQD_	T2		++ T4	T2	(L) I.D.R
HEAT NO		T3_		-	12 / /	(L) <u>1.D.R</u>
		T4		_ / /	Т3	
		PG/UG-79		-		1
L					1	
HARDNESS TE	EST IF REQ	DL.K.	.R	_ THICKNE	SS MEASURED AT ST	RAIGHT FLANGE
NO. OF IDENT	ICAL HEAD	S I.D.F	R	_		The state of the s
CONFORMS TO	O CODE	YES NO				
PIPE		120 110				
SPEC.NO.SA	G	RADET1_				
MN. THICKNES	S REOD	T2				<u>L)</u>
HEAT NO				. //		
MFG.BY		18 T4			T1 \	
		L))	(0)
M.T.R.NO.		<u> </u>	· · · · · · · · · · · · · · · · · · ·	T4	T2	1
HARDNESS TE)			Т3	
CONFORMS TO	CODE	YES NO	ē			
ITTINGS						
LANGES - CO	UPLINGS –	NOZZLES - COMPO	NENTS	CONFOR	MS TO CODE	
						YES NO
NO. SIZE	P.S.I.	DESCRIPTION	MFG.BY	MARKING	OTHER INFORM	A
1 2200	NA	3/8 THK REPAD	NUCOR	A644070	SA 5110-70	
1 105/800	NA	3/8"THK REPAI	Nucor		5A 516-70	
				1		
					OVALITY	1013
IEAUES						1
HECKED BY	DA	TE	_APPROVE	BY QC MAN	AGER MAY 0	3 2018DATE

The state of the same than the same of the

1909 og til kolig gradi Suko almakar, koli 45 april 100 gal Sub al-O-Bylak Graffingerker vir ellmar om saki kom

NUCCH STEEL TUSCALOUSA. INC.

Load Number Tally Mill Order Number PG NO Latin No.	planter of the control of the contro		
C140038 0000000700805 N 151777 003	Part Number	Certificate Number	Prepared
Grade	Custoner;	1970080603	12/23/2016 11:02
Order Description: Hot Roll Plate From Coil		THE REAL PROPERTY OF THE PROPE	
A516 70, 0.3790 3N x 96,000 IN x 480,000 IN Quality Plan Description:			The state of the s
A51670 43CF 15CU: A516-70/A5ME GA516-70AR-15 LOW CH NORM TESTS			The state of the s

				The same of the same of	\$ 1 11 ********************************	and a restrict and address of the trade of the second and the seco								
Shipped	Heat/Slab	Cartifical	y- 1 A4				***************************************	table to the special and the second sections of the second sections and the second sections and the second sections and the second sections are second sections as the second section	a day and graph a state of the control of the contr	and the second s	THE CONTRACT OF STREET, AND ADDRESS OF THE PARTY OF THE P			
Item	Number	CELLIFEG	Mn	1,	S Si	Cu	Vi Cr	Mo Ch	V AI		things are an in the second and a second and a second and a second decrease and second and a second and a second		- Marian in Administration with	***************************************
61 10000	***************************************	D.Y			1			CD	V AI	Li NS	B Ca	Sn	CFV	ACT
61.18958	A6Y4970305	A6Y4070	0.21 1.0	0.015/6	71/13 171	0 3								MCA
6L1895C %	%6Y4070=0-	46V4020	(1)	****	* MANAGE 17 - 12.12	0.14 0	.05 0.06	0.017 [0.00]	0.004 0.028	0.001 0 000	0.0000 0.001			
Statement and process and response from the contract of the set of the contract of the contrac	the second received and the second se	1	0.21 1.02	0.025 0	.003 0.19	0.14 0.	05 16.06	0.01216.001	/N 200514	20.4 20.0 0 00.0 00.00	10.0000 0.001	0.007	0.42	
Shripped Co	VGY4070308 **	***************************************			arriani seran senganya Si nyan antara arrangan na sa			0.017 [0.110]	10.004[0.028]	0.001 0.009	0.0000 0.001	0 007	13 03	************
Trom	rtified Heat	751ab Yi	ield Tensi	le Y/T	ELONGAT	TON % How	d I Hand	\$ ****** *****************************	The state of the s					

Shripped Item	Certified By	Heat/Slab Number	Yield ksi	Tensile ksi	Y/T	ELONG/	TION %	Bend	Hard		Annual ca consistent contraction	Impacts			····			003 0.4	121
6L1895B	SGLL895BTT	A6Y4070-03 ***		***************************************	76		8"	OK?	HB	Size	imi 1	2	3	Ava		She	ar %	TO THE PARTY OF TH	Test
6L1895B		A6Y4070-03 ===		75.1	71.1	32.9	The second second second second			1				7.00		7	3	Avg	4 emp
		A6Y4070-03 ===	48.8	71.9	67.9	30.9		·					andres from him him of the day of any and		militar (at the analysis in a section) in an analysis	Mari house a sili a dodu a farmaniado, o a	· · · · · · · · · · · · · · · · · · ·		
1	The state of the s	A6Y4070-03 ***		76.3	70.9	31.9	to a special dept memory class as	and the second second second second					. For the belonding to high to have been a long to		rak i mesal ir ini dak Kandanasa da araba				ļ
6L1895B	56L1895NFT	A6Y4070-03 see	54.5	76.2	71.5	34.0	raania aponor v nyanga ada garanada n		ANDRESSE AS PROPERTY AND THE BASE		P TALIFFER STORY I THE GRADE ALL STATES SELECTION		- THE PROPERTY IS NOT EASY OF THE		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	Photo Ment to contact	************************************	-	
	56L1895NMT	A6Y4070-03 */-	52.7	25.5	69.8	35.7	e-de M 1-1- es a Ma de es as appeniones, a	1	*************		-months of the the first of the section of the sect					AND THE REAL PROPERTY AND THE			-
		A6Y4070-03 000	53.4	25.1	71.1	32.34	The second section of the second seco				na s. seg (s.) s dendy desiranty on the higher state	MAT. MARRIE DE BROW MATERIAL PRINCET FALLS		-			. Personal state to the state of the state o		
		A6Y4070-03 ***	55.2	79.1	69.8	30.9	MERINARIAN A MANAGARAN I FAN I ANG PANG		e come construence to descend out of the		Principle in the statement and the same regulations		Maria (10 10 10 10 10 10 10 10 10 10 10 10 10 1						
1,1000000000000000000000000000000000000	A CONTRACTOR OF THE PARTY OF TH	A6Y4070-03 e	48.8	71.9	67.9	31.9	WE I S ASS I THE WOOD A RESIDENCE OF		form them to come to the same and		r i nakri novi kritiva program njela vrnjavana i g		AAAA OO TUU FARFORNIUU FAA AAA AAA		***************************************		the spring and the spring and temperature was a	PT - PP CONSERVATOR - COS STREET STREET STREET	to it follows party street a survivage
		A6Y4070-03 ***	54.1	76.3	70.9	34.9	***************************************		trom to de norma como como como como como como como co		-annual san san san san sa sangar annual s						PPPER Administração de la merca	n a finn a changing and no dig the first aggress on pages	
		A6Y4070-03 may	54.5	76.2	71.5	34.6			The second section of the second section is a second section of the section of the section of the second section of the section of				man ran was some range or the con-				was it may be seen)- normal virginia del production della virginia de
ems:	DOLLING CHALL	A6Y4070-03	54.7	75.5	69.8	45.7									1/2	*** **************************		*****	THE CHARLES OF THE PROPERTY OF THE PARTY OF

Mercury has not come in contact with this product during the manufacturing process nor has any consulty beer insently the manufacturing process. Carblied in accordance with EN 10204-3-1. No world repair has been performed on this, material Normalized test coupons at 1550 for at reast 30 minutes, per inch of thickness. Material is compliant with NACE MR01-2, Across 4-1-2, and MR0103. Manufactured to a tolk killed fine grain practice. NUTEMPTR TEMPTR PASSED plate from corresponding to the PLD Contitled.

We hereby certify that the product described above present all of the tests remined by the apecifications.

MTR'S Approved

Mich of

Commercial Metamorph

are trustes ideals evolted and Massificance in the $\gtrsim 5~\text{A}$

CLIENT MARATIMON RECEIVING INSPECTION REPORT

JOB NO. 18/65-9 P.O. NO.

SP MI HE	N. THICH AT NO	KNESS REQ	RADET1 DT2	Г3		(L) (T1) (T2)		
M.7	r.R. No			v		(T3) (T4) (W)		
CO	NFORMS	S TO CODE	YES 1	NO				
MIN. HEA MFG M.T.	THICKN T NO B BY R.NO	IESS REQD	ADET1T2T3T4 PG/UG-79L.		= (T1 T2 T3	(L) I.D.R	
NO. C	OF IDEN	TICAL HEAD	DS1.D	N.R	THICKN 	ESS MEASURED AT STE	RAIGHT FLANGE	Ē
PIPE SPEC MN. T HEAT MFG.E MFG.II	MARI NO.SA_ HICKNE NO_// BY I A7 DENTIFIC	SS REQD_ 152776 ER Pipe CATION_	GRADE <u>B</u> T1_ T2_ T3_ T4_ L	. 462 . 457 . 452	T4	TI		(O)
		CODE	YES NO	ž				
TLANG	10	UPLINGS –	NOZZLES – COMPO	DNENTS	CONFOR	RMS TO CODE		
NO.	SIZE	P.S.I.	DESCRIPTION	MFG.BY	MARKING	OTHER INFORMA	YES NO	
			- x	_		WALITY	0,1	
IECKE	D BY	DA	TE	_APPROVED	BY QC MANA	MAY 0 3	2018 DATE	
						QC 2		

RECEIVING INSPECTION REPORT JOB NO. / 8/65-9 P.O. NO.

_						1.0.110.		
S	LATE PEC. NO. IIN. THICK	SAG	RADET1 QDT2			(L) (T1) (T2)		
H M	EAT NO FG. BY			T3 T4		(T3) (T4)		
H	ARDNESS	TEST IF F	REQD	w		(W)		
MIN HE MF	N. THICKN AT NO G. BY	NESS REQI	ADET1 DT2T: T2T2T2T2T4PG/UG-79	31	T4	T1 T2 T3	(L) I.D.R	
HAF	RDNESS 7	TEST IF RE	QDL.	K.R D.R	THICKN	ESS MEASURED AT ST	RAIGHT FLANGE	
PIP	E MAR	10 CODE k - C5		-237			2	
MN. HEAT MFG. MFG. M.T.F	THICKNE TNO/(BY_ <u>Bye/</u> IDENTIFI R.NO	SS REQD_ 69720 Orussian	T2 T3 <i>STEEL</i> T4 L	,223	T4	TI	-)	(O)
FITT	ORMS TO		NOZZLES - COMP	ONENTS	CONFOR	MS TO CODE		-
NO.	SIZE	P.S.I.	DESCRIPTION	MFG.BY	MARKING	MS TO CODE	YES NO	
			- 3			OVALITY CO	1/2	
HECK	ED BY	D.	ATE	_APPROVE	BY QC MANA	AGER. MAY 0 3 7	DATE	
						QC 2		

RECEIVING INSPECTION REPORT

	LIENI_	MAKATI	TO N	JOB NO.	18165.	-9 P.O. NO.	
P	LATE			19.1		(L)	
S	PEC. NO.	SAG	RADET1			(T1) $(T2)$	
M	IN. THICH	(NESS REQ	DT2			(==)	
H	EAT NO		•	Г3			
M	FG. BY			Γ4			
M	T.R. NO		L			(T3) (T4)	
HA	ARDNESS	TEST IF R		V		(W)	
CC	NFORMS	TO CODE	YES 1	10			
	ADS						A
SP	EC.NO. S	AGR	ADET1		_ / /	T1 \	
8/18	THICK	JESS DEAD	T0))	1 3
HE	T NO	iess negu	T2T3		$ \uparrow$ \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow	T2 -	(L) <u>I.D.R</u>
MF	G. BY	n .	13	3	- \ \	тз //	
M.T	.R.NO.		14 _PG/UG-79		- / \		
L			. 4,04 75				1
HAF	RDNESS T	TEST IF REC	QDL.	K.B.	THICKN	ECCNEACURE AT A	
۷O.	OF IDEN	TICAL HEAI	DS1.D).B.		ESS MEASURED AT ST	RAIGHT FLANGE
		TO CODE			_		
		K-141					
7P	CNOSA	101	GRADE BT1_	950			
IN.	THICKNE	SS REOD	T2T2	9/2	-		L)
EA.	r No 7	10882	T3_		- //		T
					- //	T1 \	
FG.	IDENTIFI	CATION	1B CHONNTOV TA			.))	(0)
.T.F	I.NO34	134/17		18"00	. T	T2 +	
ARE	NESS TE	ST IF REQI	D. Yes			T3	
)NE	ORMST	CODE	(VEC.) NO				
		O CODE	YES NO				
	NGS						
AN	GES – CC	OUPLINGS -	NOZZLES - COMPO	DNENTS	CONFOR	MS TO CODE	
0.	CIZE	1501				a.	YES NO
<u>J.</u>	SIZE	P.S.I.	DESCRIPTION	MFG.BY	MARKING	OTHER INFORMA	4
						DIVEY CO	
-						ODALYFY CO	
						A. /	(2)
Cĸ	ED RV	DA	\TE	100000		MAY 0 3 20	10
11			TE	_APPROVED	BY QC MAN	AGER:	DATE.
						7	
						00 =	





Válcovny trub Chomutov, a.s. Továmí 629, Chomutov 430 61, Czech Republic www.vtchomutov cz

Pfficha - Anlage - Annex - Annexe

3

Výsledky zkoušek - Ergebnis der Prüfungen - Test results - Résultats des tests

Atest č. - Attest Nr. - Certificate No - Certificat No :

3434/17

13.11.2017

Mechanicks	zkoušky-Mecha	nische Prüfur	igen-Mecha:	nical tests-Ti	ests méchaniques		ASTA	4 A 370		ASTM A 370			
		Rozměry vz Probeabmes		Odběr vzo Procenení		Mez kruzu Streck/Dahngr enze	Pevnost v tahu Zuglestigkeit	Tažnost Bruchdenn ung		Nárazová práce Schiagarbe t	Vrub.Houževnatos Kerbschlagzänig ka t		
		Dim. of Spe	ciner	Spec men		Yield strength/ Proof stress	Tans le strength	Eiongat on	Reduction of area	Energy of Impact	Impact strangth		
		Dim. de l'eci	hantiil on	Préleveme	rt	Limite d'elasticité	Résistence à la traction	Allengement	Contraction	Energie de ructure	Résil ence		
Č. zkoušky	Císlo tavby	Tłouštka	Siře	Smër	Zkuš, teplota								
Probe Nr.	Schmeize Nr.	Dicke	Breite	Richtung	Prüttemperatur	40000	70000						
Test No No du test	Heat No No coulée	Thickness Epaisseur	Width	Direction Direction	Test temperature Temperature du te	Rt 0.5	Rm	2"	Z	Kv			
		**	"		C°	psi	σsi	%	%	J	J/cm2		
15085	70844		Ø 1/2	L	20	52055	75690	33,60					
15097	70882		Ø 1/2	L	20	49735	74240	35,60					

L = Podél - Lángs - Along - En longueur. T = Příčně = Quer = Transverse = En travers, A = Average

Torring Africa		Che	emické sl	ożení - Cł	emische	Zusamm	ersetzun	g - Chem	ical comp	csition -	Composit	on chimiqu	Le (%)				
Tavba číslo Schmelze Nr						Н	eat ana	lysis (S)	/ produ	ct anal	vsis (K)						
Heat No								75.5 (5)	7 p. out	ct and	V.513 (11)						
No Couiée	C	Mn	Sı	P	S	Cr	Ni	Cu	Мо	V	Nb	T:	ΑÌ	N	В	Cev	Co
70844S	0,15	1,20	0,28	0,015	0,004	0.10	0.08	0,17	0,02	0,00	0.002	0,002					
70844K	0.14	1,21	0,29	0,015	0,002	0,10	0.07	0.14	0,02	0,00	0,003	0.002					
0844K	0.14	1,22	0,21	0,015	0,003	0,10	0.07	0,14	0.02	0.00	0,003	0.002					
0882S	0,15	1,19	0,30	0,015	0,004	0,99	0,08	0,17	0.02	0.00	0.002	0,002					
0882K	0,14	1,20	0,30	0,012	0,003	0.09	0.07	0.14	0.02	0.00	0.003	0.002					
70882K	0.14	1,20	0,30	0,012	0.003	0,09	0.07	0.14	0.02	0.00	0.093	0.002					

Chemutov S. 13.11.2017 Dne - Datum - Date - Date Jana SOCHROVÁ
Zodpovědná osoba - Der Werkssachverständige - in

Válcovny trub Chomutov, a.s. Tovární 629, 430 01 Chomutov IČ: 227 74 645





Válcovny trub Chomutov, a.s. Továmí 629, Chomutov 430 01, Czech Republic www.vtchomutov.cz

Inspekční certifikát Abnahmenprüfzeugnis Inspection Certificate

Atest č. - Attest Nr. Certificate No - Certificat No :

Certificat de Reception

Zákazník - Besteller - Customer - Client:

EN 10204:2004/3.1

3434/17

Objednávka č. - Bestell Nr.

Order No - No de la commande :

16209

Code: 1741383

Zakázka č. - Bestell Nr. - Order No - Commande No:

831342

Znak výrobce - Herstellerszeichen

Brand of the manufacture-Marque du fabricant:

Razilko znalce - Stempel des Sachverständiger

Inspector's stamp - Poincon de l'expert

TK7

Ocelové bezešvé trubky - Nahtlose Stahlrohre - Seamless steel tubes - Tubes en aciers sans soudure black, lacquered

Úkosy - Beweled ends

beveled for welding 30° (-0/+5°) with flat 1,6 mm with tol. -0/+0,8 mm

Technické požadavky - Průfgrundlagen/Anforderugen - Technical requirements/Demand - Exigences techniques:

API Spec. 5L - 45 ed., july 1, 2013 PSL1 ASTM A106/A106M-15 ASME SA-106/SA-106M - 17 ASTM A53/A53M - 12 ASME SA-53/SA-53M - 17 ANSI/NACE MR0175/ISO 15156:ed2015 ANSI/NACE MR 0103/ISO 17495:ed2016

Materiál - Werkstoff - Material - Matiére:	Die - Entsprechend - According to - Selon	Vydání - Ausgabe - Edition - Edition:
X42	API 5L	2013
GR.B	API 5L	2013
GR.B	ASTM A 106	2015
GR.C	ASTM A 106	2012
GR.B	ASTM A 53	2017
GR.B	ASME SA 106	2017
Gr.C	ASME SA 106	2017
GR.B	ASME SA 53	2017

Stav dodávky - Lieferzustand - State of delivery - Etat de livraison:

Hot rolled - normalized 925 +/- 15 °C - cooled in air

Způsob zpracování tavby - Erschmelzungsart - Melting process - Procédé d'élaboration:

Steelmakers: Válcovny trub Chomutov, a.s., Workplace-Rokycanská 204, 338 42 Hrádek, Czech republic; Fully killed vacuum E+LF+VD

Značení - Kennzeichnung - Marking - Marquage:

Stencilled: logo VT API SPEC 5L 0286 API (10-2017) ASTM/ASME A/SA 106/53 18" x 0,938 X42/Gr.B PSL1/Gr.B/C SMLS HEAT No. (heat no.) TESTED 2970 PSI LENGTH (length) ... ft WEIGHT (weight) ... lb

Tolerance

Prům. těl. trub/diameter pipe: 2.40 mm Stěny / wall thickness: + 15.00 % 0.80 mm 12.50 % Prům. konce. trub/diameter pipe end: 1.60 mm Hm/mass: 10.00 % 0.80 mm 3.50 %

Specifikace - Specification:

Kusy Stücke Pieces Piéces	Ceiková dělka (Gesamtlänge Total length Longueur totale (ft)	Celková hmotnost Gesamimasse Total mass Masse totale [t]	avky - Umfang der Lieferung - Ex Rozměry Dimensionen Dimensions Dimensions [mm]	Tavba číslo Schmelze Nr. Heat No. No Coulée	Vodní tlak Druckprobe Hydr. Test Essai hydralique [psi]	Avízo: Aviso: Advice: Avis	Datum: Datum: Date: Date:
6	220,472	17,287	18" x 0,938	70844	2970.0	15544917	23.10.2017
7	245,079	19,217	(457,2 x 23,83)	70882	10 sec.	15545017	23.10.2017

The Manufacturer declares that it is certified by the notified body TUV NORD reg. No 0045 according to Article 4.3 Annex Lof Cirective 2014/68/EU and AD-2000 Merkblatt WO and EN 10210-1:2006 appendix to ZA CFR (EU) No. 305/2011.

Unedené výroby sou ve shodě s předpisy, které jsou specifikovány kupní smlouvou. -Angegebene produkte sind in einklang mit den vorschriften, die im Kaufvertrag scezifiziert werden. We thereby declare that the above mentioned products were manufactured in accordance with specifications and contract recurrements. - Des produits indiqués sont dans un accord avec les disposition contrait de vente on spécifie.

haw material by used for pipe production is without radicactive contamination.

.....Jana SOCHROVÁ

Válcovny trub Chomutov, a.s. Tovární 629, 430 01 Chomutov IČ: 227 74 645

Chomutov S. 13.11.2017

Dne - Datum - Date - Date

Pfiloha-Anlage-Annex-Annexe 1

Zodpovědná osoba - Der Werkssachverständige - Inspector-le responsable



Inspekční certifikát Abnahmenprützeugnis Inspection Certificate

Atest č. - Attest Nr. Certificate No - Certificat No :

Certificat de Reception

EN 10204:2004/3.1

3434/17

Zakazník - Bestelier - Customer - Client:

Objednávka č - Besteil Nr.

Order No - No de la commande

16209

Code: 1741383

Zakázka č. - Bestell Nr. - Order No - Commande No:

831342

Znak výrobce - Herstellerszeichen

Brand of the manufacture-Marque du fabricant:



Razítko znalce - Stempel des Sachverständigen

Inspector's stamp - Poincon de l'expert

TK7

34 - 42 ft

Doplňující údaje - Zusätzliche - Additional remarks - Autres remarques: Visual inspection and dimensional check without objection.

Country of melt - Czech republic.

The Manufacturer declares that it is certified by the notified body TÚV NORD reg. No 0045 according to Article 4.3 Annex Lot Directive 2014/68/EU and AD-2000 Mentohatt Wo and EN 10210-1:2006 appendix to ZA CPR (EU) No. 305/201:

Uvedené výrobký jsou ve shodě s předpísy, které jsou specifikovány kupní smicuvou. -Angegebene produkte sind in einklang mit den vorschniten, die im Kaulvertrag spezifizirent werden We thereby declare that the above mentioned products were manufactured in accordance with specifications and contract requirements. Des produits indiqués sont dans ûn accord avec les disposition contrait de vente on spécific.

Eaw material by used for pipe production is without rádioactive contamination.

Válcovny trub Chomutov, a.s. Tovární 629, 430 01 Chomutov IC: 227 74 645

Chomutov S. 13.11.2017

One - Datum - Date - Date

Příloha-Anlage-Annex-Annexe 2

Zodpovědná osoba - Der Werkssachverständige - Inspector-le responsable

Jana SOCHROVÁ

INSPECTION CERTIFICATE DIN EN 10204: 2005-01 3.1 / 1-2880 /

Quality management system has been certified according to ISO 9001:2008 by TUV Thuringen e.V. (Certificate Number TIC 15 100 159230) Environmental management system has been certified according to ISO 14001:2004 by TUV Thuringen e.V. (Certificate Number TIC 15 104 151299) Occupational health and safety management system has been certified according to OHSAS 18001:2007 by TUV Thuringen e.V. (Certificate Number TIC 15 118 15624)

Open Joint-Stock Company *Byelorussian Steel Works - management company of "Byelorussian Metallurgical Company" holding" 37, Promyshlennaya street 247210 Zhlobin - Belarus Tel. +375 (2334) 5-41-29, Fax +375 (2334) 5-60-42 www.belsteel.com qualdin@bmz.gomel.by

Description of the goods: Seamless hot deformed pipes for oil and gas pipelines.

Oncores rouge: Toyle decument represseponences are negro in recorporation.

Final application: For pipeline transportation systems for petroleum and natural gas industries. ник: Для трубопроводичая тренспортных систем для нефтиной и газовой промымильности Deckidation degree: Fully deckidized steel.

Type of pipe: SMLS Plain End.

Тип трубые бесшовные с гла Delivery Conditional: As-rolled. Условие поставис Стичартние произтив.

Technical specification level: PSL1 Уровень опецификации PSL1

Contract No 17021621 appendix 6 Kompan le PO mumber

Wagon Na 60470663

Country of destination: USA

Consignee:

	T	_					_																1					
Šį	Number	e Num															hemical	compo	sition, 9	- Xmar	acoust con	TON. %	<u> </u>					
le positio	of heat Home	of b	ot p		Steel/St CTE/N/CT	tandard www.				С	SI	Mn	P	S	Cr	NI	Cu	π	Mo	٧	Al	Nb	8	Nb+V	Nb+ TI+V	Cr+Ni+ Mo+ Cu+V	CE 🛶	Steel
		-	- 8	7.42 acc. to	APLEPTC	SI_2012(45	2	Nort Hops		mex .28	min .10	.29 - 1.06	.030	.030	max .40	.40	max .40		max .16	max .08			max .0010	max 30.	max .15	max 1.00		making- process:
				B occ. to AS	ASTM ASI ME BASI/S	VASSM-13 SA-53M-201 N/A1004-1		Ladle (1 Konumen Product	(фент)	.26	.26	.53	.008	.012	.11	.13	.25	.002	.02	.012	-	.001	.0002	.013	.015	.52	.40	
1	169720	1735	73 M	ACC. NO AS	MIE SAING	-GA1404-21	913	F/c (de		.26	.27	.51	.009	.012	.11	.13	.25	.002	.02	.014		.002	.0010	.016	.018	.52	.14	Electric
		1		LD 97/LMC	C, NACE N	154-2-2009 a CR 0103-201		Product Fic (de		.26	.27	.51	.010	.013	.11	.14	.26	.002	.02	.014	•	.002	.0002	.016	.018	.54	.14	furnace
		Dhr	nensio	16 - Pass	тры						Quantity	/ - Komen	CTBO			7					20	<u></u>		<u> </u>				
ltion	OD Drawn			/T	Len An	ngth	ckages	pipes pcs mestex, ur			Weig Boc				ital leng		Hardne acc, t NACE / 0175-2:2	D MR	Longitud	iinal Str nonccu Gauge Wepen	t - none ip Test	Speci 0.75 (pacreus imens o rpasses inch	ere Gorenn o		AST Imension Passa	pact test, on yape M A370	imen
Ne position Ne noseque							Number of pa	Quantity of phonon programments of the comments of the comment		Net Herro			mo	•	rioced en		Teepsoc 20798010 NA 0175-02:2	CE MR	Tensile strengti npagen rpo-som Rm	n st	Yield rength bease my sects Res	lo	onga- tion ngitu- final necessa Ass	Ratio Kospips Hent Rtad Rm		Impact e (longitu Patora : (rposon	mergy dinai)	7
	THE	inch	mm	inch	u.	ft		*	t		Ь	t	lь	_ m			ISO 650	6-1	pel		psl		%			RTH.	of	

ET and UT is qualified acc.	No
to ISO 9712, level II	tes
Персонал по нераврушноцему	AS
ROMPORIO MITOLEM BITC III VOIC	700

60.3 2.375

TOTAL

5.54 0.218 6.10

indestructive Electric Tested/Eddy current

TM E 309 Perference standard pipe with hole (© 3.2 mm/ 0,126 inch) Этелоника трубе с отверстимы (© 3.2 mm/ 0,125 authors

173

3 173 8.047 17740.57 8.059 17767.03 1069.05 3507.3 NDT/UT Results:ok Results:-**ASTM E 213**

8.047 17740.57 8.059 17767.03 1069.05 3507.3

Technological test Flattening Tests ASTM A106/A106M

min 70000

78000

154 156

Results: of

min 22

min 42100

53000

Hydrostatic testing according API 6L 45th ed API SL 45m ed P: 2970 pal **Duration:** min 6 sec

2 3

41 37 35

min 10

Results: Результат.

- It is hereby certified that products covered by this certificate has been tested and is complied with the requirements of the contract and the material specifications
- -flagmentages, vio recovers, yearn-ser a recrease deprecions, son-rise a conserceyer yerceses compare a special as settlemany orson Visually measuring test was performed with satisfactory result.
- визуально-комерительный потпроть проведен с удовлитеорительным разультатом.

 No weld repair, Free of mercury and mercury containing compounds.
- Sea creates assectes exepted. Sea prym s prymongeplicates aresserves. Country of origin: Belarus (including steel melting process).
- Стране происхождения: Беларусь (включея выплану стали).

Technical Control Inspector: Shchemeliova

On Behalber Bild Boliston



пат "інтерпайп нижньодніпровський трубопрокатний завод"

Україна, м. Дніпропетровськ, вул. Столєтова, 21

Тел./факс +38(0562) 34-90-99

Заказчик Customer Сертификат № 1701/5

Page 1 of 2

1512184

INSPECTION CERTIFICATE ACC. TO EN 10204-2004/3.1

Контракт № Contract No

Заказ № 751102/101 Customer order № 15-1102

PO # 90309

№ транспортного средства АЕ 2803 НІ / АЕ 5358 ХО № vehicle

Лист Sheet Листов

Sheets

Наименование и код товара нд Термообряботка Description and code of goods Standard Heat treatment API SL (PSL 2) -2012/ ASTM A106/A106M-2014/ASME SA106-2013/ STEEL SEAMLESS HOT-ROLLED PIPES Normalized FOR OIL AND GAS PIPELINES ASTM A53/A53M-2012/ASME SA53-2013/ NACE MR0175-2009/ NACE MR0103-2012 Метраж, фут Metreage Homep naptuu Number Номер Марка Размеры, дюйы Dimensions, In. Длина К-во труб, Вес, фунт Weight, Ib. стали Grade фут Length ELT Q-ty of Epyrro Gross Нетто Ton. et. Диаметр Net of heat of lot O.D. steel W.T. ft. B/X42N Actual weight 1. 1152755 2583 6.625 0.280 37.99-38.71 768.34 20 15189.9 15123.7 1152776 2557 6.625 0.432 37.99-38.71 1386.61 36 40984.0 40785.6 Total: 2154.95 56173.9 56 55909.3

			По	казател	и качес	TRE TOR	apa	Quality	charact	eristics	of goods	3			
Ns.	Номер			Химич	еский со	CTOB, ME	совая д	оля %	Che	mical con	nposition	, mass fr	action %		
п.п. p. No	плавки Number of heat	C ×	Si x	Mn x	S x 1000	P x 1000	Cr x 100	Ni x 100	Cu x 100	Mo x 1000	Ti ×	V	Nb	B x 1000	CE _{ii} max. 0.43%
		100	100	100	1000	1000	100	100	1 100	1000	1000	1000	1000	1000	1 0.4376
, 1.	1152755 H	18	24	51	5	10	11	12	18	12	5	5	10	1	0.31
	1152755 P	18	29	57	6	11	15 .	12	16	14	5	5	1	0.1	0.32
		18	29	56	6	10	15	12	16	13	5	5	1	0.1	0.32
2.	1152776 H	19	26	46	7	9	11	11	16	22	5	5	10	1	0.31
	1152776 P	18	26	49	5	8	14	11	15	31	5	5	1	0.2	0.31
		18	26	48	5	8	14	11	16	31	5	5	1	0.2	0.31

Cr+Cu+Ni+Mo+V≤1% Π родолжение на обороте Nb+V ≤ 0.06 % Nb+V+Ti ≤0.15%

The continuation on the back

PJSC INTERPIPE NIZHNEDNEPROVSKY TUBE ROLLING PLANT UKRAINE, Dnepropetrovsk, 21, Stoletova str. Tel./fax +38(0562) 34-90-99

053447



ASME RECEIVING INSPECTION REPORT

SPEC. NO. SA 6 GRADE 70 T1	ONFORMS TO CODE YES ON NO	YES NO
SPEC. NO. SA/16 GRADE 70 71 74 71 74 71 75 74 75 74 75 74 75 74 75 75	ONFORMS TO CODE YES ON NO	YES NO
PEC. NO. SA 6 GRADE 70 71 74 72 74 75 74 75 74 75 75 76 75 76 75 76 75 76 75 75	ONFORMS TO CODE YES 🗆 🗆 NO	
PEC. NO. SA 6 GRADE 70 T1	ONFORMS TO CODE YES	
PEC. NO. SA/16 GRADE 70 T1 1/4 IN. THICKNESS REQD 1/4 T2 1/4 EAT NO. A 752459-02. T3 1/4 FG. BY	RDNESS TEST IF REQD	
PEC. NO. SA 6 GRADE 70 T1		
PEC. NO. SAME GRADE 70 T1 /4 IN. THICKNESS REQD	G.IDENTIFICATIONL	_
PEC. NO. SA	FG.BYT4	
PEC. NO. SA 16 GRADE 70 T1		
PEC. NO. SA 6 GRADE 70 T1 1/4 IN. THICKNESS REQD 4/4 T2 1/4 EAT NO. A 752459-02. T3 1/4 FG. BY	PEC.NO.SAGRADET1	(L)
PEC. NO. SA/16 GRADE 70 T1 /4 IN. THICKNESS REQD	ONFORMS TO CODE YES N	0
PEC. NO. SA 16 GRADE 70 T1	OF IDENTICAL HEADS 1.D.R.	THICKNESS MEASURED AT STRAIGHT FLANGE
PEC. NO. SA 6 GRADE 70 T1 1/4 IN. THICKNESS REQD		
PEC. NO. SA 16 GRADE 70 T1	FG. BYT4T4T.R.NO. PG/UG-79	- T3
PEC. NO. SA 16 GRADE 70 T1	T3T3	_ \ \
PEC. NO. SA 16 GRADE 70 T1 1/4 IIN. THICKNESS REQD	IN. THICKNESS REQDT2	T4 T2 (1) (DB
PEC. NO. SA 16 GRADE 70 T1 1/4 IIN. THICKNESS REQD		TI
PEC. NO. SA 16 GRADE 70 T1 1/4 IIN. THICKNESS REQD 1/4 T2 1/4 IEAT NO. A 752459-02. T3 1/4 IFG. BY 1/4 I.T.R. NO. 1/4 L 96° ARDNESS TEST IF REQD. 1/4 W 1/8° (T1) (T2) (T3) (T4)	ONFORMS TO CODE LI LYES NO	1
PEC. NO. SA 16 GRADE 70 T1 1/4 IIN. THICKNESS REQD 1/4 T2 1/4 EAT NO. A 752459-02. T3 1/4 IFG. BY 1/4 L 96° (T1) (T2) (T2) (T3) (T4)		(W)
PEC. NO. SA <u>5/6</u> GRADE 70 T1 1/4 (T1) (T2) IIN. THICKNESS REQD ~4/A T2 1/4 IEAT NO. <u>A 752459-02</u> T3 1/4	I.T.R. NO. <u>~/</u> L <u>96°</u>	(T3) (T4)
PEC. NO. SA <u>516</u> GRADE <u>70</u> T1 <u>1/4</u> (T1) (T2) IN. THICKNESS REQD <u>A/A</u> T2 <u>1/4</u>		_
LAIE		(T1) (T2)
(L)	LATE	(L)

S

ALLOY



MILL TEST CERTIFICATE

Tuacaloosa, AL 35404-1000 800 800-8204

QCOK 3-28-18 Page:1 of 2

customerservice@nucortusk.com Load Number Tally Mill Order Number T155922 PO NO | Line NO 00000000731912 N-156793-001 Part Number Grade 112217 Certificate Number Prepared Order Description: 573191201-1 Customer: Hor Roll Plate From Coil 06/22/2017 12:40 A516 70, 0.2500 IN x 96.000 IN x 480.000 IN Sold To: Quality Plan Description: AMERICAN ALLOY STEEL HOUSTON TX A51670 .43 CEV: A516-70/ASME SA516-70AR-15 LO CE NORM TESTS Ship To: AMERICAN ALLOY STEEL Houston TX Sent TO:

								19	ent TO	:	. SILLEL	noust	on TX		173.4	AIE#	-21-		- 2 to 1	- 1
	Shipped Item	Heat/Slab Number	Certified By	С	Mn	P. 1. S.	Si													
>	7F0519F	A7S2329-01 ***	Бу			7		Cu Ni	Cr	Мо	:Cb	ν	AT	Ti	N2	В	Co			
	7	A7S2459-02 *** A7S2459-02 ***	A7S2459	0.21	1.05 0.	.011 0.003 .015 0.005	0.19	0.14 0.04	0.04	0.019	0.002	0.004	0.024	0.001	0.000	0.000-	Ca	>n	CEV	ACI
			A7S2459	0.21	1.05 0.	.015 0.005 .015 0.005	0.22	0.16 0.05	0.05	0.016	0.000 0	0.000	0.033	0.001	0.009	0.0001	0.0009	0.005	0.40	
						.015 0.005				0.0101	0.000	000	0.033	0.001	0.009	0.0000	0.0024	0.006	0.41	

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

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Normalized test coupons at 1650f for at least 30 minutes per inch of thickness Material is compliant with NACE MR0175 Annex 2.1.2 and ISO 15156, and NACE MR 0103. Manufactured to a fully killed fine grain practice, NUTEMPER TEMPER PASSED

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

Dr. Quilin Yu - Metallurgist

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



MILL TEST CERTIFICATE 1700 HOLT RD N.E.

3-28-18 JOB#18165 Page: 2 of 2

Tuscaloosa, AL 35404-1000 800 800-8204

	O NO Line NO	Part Number		
- due	12217 1	- Manuael.	Certificate Number	Prepared
Order Description: Hot Roll Plate From Coil 516 70; 0.2500 IN x 96.000 IN x 480.000 IN Nality Plan Description: 51670 .43 CEV: A516-70/ASME SA516-70AR-15 LO CE NORM TESTS		Customer: Sold TO: AMERICAN ALLOY STEEL HOUSTON Ship TO: AMERICAN ALLOY STEEL Houston Sent TO:	S73191201-1	06/22/2017 12:40

Shipped Item	Certified By	Number	Yield ksi	Tensile	Y/T	ELONGATION %	Bend	Hand										
7F0519F	S7F0519BTT	A752329-01 ***		ksi	%	2 ¹⁰ 8 ¹⁰	OK?	HB	12.6	Charpy	Impacts	(ft-1)	s)	-				
7F0519F	S7F0519FTT	A7S2329-01 ***		71.5	72.3	34.5	-	110	Size	num 1	2	3	Avg	1		ar %		Test
7F0519F	S7F0519M7T	A7S2329-01 ***	57.0	78.3	72.8	25.2	-							-	2	3	Avg	Tem
7F0519F	SZEDSTONOT	A/52329-01 ***	55.4	72.5	76.4	32.6	-											
	STEGGA	A7S2329-01 ***	54.6	75.5	72.3		-						 					
7505205	STRUST SNET	A7S2329-01 ***	57.6	77.9	73.9	31.7							-					
703135	5/F0519NMT	A7S2329-01 ***	51.5	71.7		31.8					-		-					
11772R	S7F1525BTT	A752459-02 ***	FO 6		71.8	35.8					-							
1LT252R	S7F1525FTT	A752459-02 ***	57.8	73.3	68.9	31.7					-					-		
7F1525B	S7F1525MTT	A752459-02 ***		78.9	73.3	26.7												
7F1525B	S7F1525NBT	A7S2459-02 ***	55.5	74.6	74.4	27.1			-									
7F1525B	S7F1525NFT	A7S2459-02 ***	60.9	82.3	74.0	31.0												
7F1525B	S7F1525MAT	A762459-02 ***	59.2	81.5	72.6	30.8												
7F1525C	STETETED	A7S2459-02 ***	58.4	80.6	72.5	31.8												
	5771323811	A7S2459-02 ***	50.5	73.3	68.9													
	37F1325F1T	A7S2459-02 ***	57.8	78.9	73.3	31.7												
	5/F1525MTT /	A752459-02 ***	55.5			26.7					-							
	7F1525NBT	A7S2459-02 ***	60.9	00.0	74.4	27.1			-									
7F1525C S	7F1525NFT	17574F0 02	59.2	0.0	74.0	31.0										-		
/F1525C S	7F1525NMT	753450 05			72.6	30.8						T						
ems: 3		Weight: 39205	58.4	80.6	72.5	31.8			-								-	

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Normalized test coupons at 1650f for at least 30 minutes per inch of thickness Material is compliant with NACE MR0175 Annex 2.1.2 and ISO 15156, and NACE MR 0103. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED ISO 9001:2015 Registered, PED Certified

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

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

by the specifications.

CLIENT MARRATHON LORNO 18166 9 50 1

10.	SILE	F.S.I.	DESCRIPTION	MFG.BY	MARKING	OTHER INFORMA		
		P.S.I.	- NOZZLES - COMPO			MS TO CODE	YES	NO
	NGS	, CODE	169 1111	NO				y
			YES 000	NO		T3		
		ST IF REQ	<u> </u>					
IFG.II	DENTIFIC	ATION	L		+ T4	T2		
IFG.E	3Y		T3 T4			ті		
IN. T	HICKNES	S REQD_	T2					1
PEC.	NO.SA_		GRADET1_			(L)		
IPE	and and the second section of the second second	TODE	YES [IUU NO				
)SI.D.F					
ARD	NESS TE	ST IF REQ	L.K.	R	THICKNES	S MEASURED AT STRAI	GHT FLAN	GE
			-GIUG-19				*	
IFG.	BY		T4 PG/UG-79			r3 +		
IEAT	NO		T3_				(L) <u>I.D.</u>	K
MIN.	THICKNE	SS REQD_	T2		——————————————————————————————————————	T2		D
SPEC	.NO. SA_	GRA	DET1			ri \	LE	R
HEA							* IC	
CONF	FORMS T	O CODE	□ □ (YES)	NO				
HARI	ONESS TI	EST IF REC	QD. <u>~/A</u> W	2 "	-	(W)		
M.T.F	R. NO	~I	IA L			(T3) (T4)		
MFG.	BY_AR	5102	8 400 T3. MITTAL T4	318 318				
MIN. Ueat	THICKNE	SS REQD 212 Y C	×/A T2 3/8	3/0				
	, NU. 5A	516 GRA	DE 70 T1 3/6	3		(T1) (T2)		
SPEC	NO CA							

Cent King

ArcelorMittal Burns Harbor Plate

SIMPMENT					REP	ORT OF TEST	SSURANCE AND ANAYLSES					US HWY 12 Bu	ms Harbor, Inc
804-0	мо. 1926	2			06-29-		CAR OR VEHICL	E NO.					
					00-23-	1/	CSS-C	IGO-UP		BNSF 5	45743		
ė							8 H						
D							I						
0							Ī						
N													
O SERIAL		AT HE		NC. THE	CONESS	SIZ WIOTH OR D	E AND QUANTIT	LENGTH		YIELD	TENSAL		. 1
E NUMBE	R M	D. NUM	BER	PCS.	NCHES	INCH			WEIGHT	POINT	STRENG	TH ELONG	
QUALI	TY S	STEEL	MELTE	C MAN	TIES CHID	DD 3717		INCHES				SI IN	용 용
PLAT	es -	. WOIM	WOTP-F	16 GR 7	D PVO K	ודים ח.ז	TECO ST	AT DDAG		THEO P		•••	
		GR /U	PVQ 2	015 ED	ITION,	ASME S	SA516 G	R 65 P	VQ 2015	EDITIO	N. AS	ME ME	0
													2
V/XX					NI, NOT S PERFOR					D PER N	ace M	R0175	
MES	ST -	LIE O. I.	wrrt 2	EKTAL#	E PATTE	ERN# W	יממ הספח	7 007	1720				
		OCOT	webl I	EST CE	RTS IN F		וער המפת	ATTORNO .	T11				
		TASA	. 2004	TIPE 3	.1.5 PT.T	'S ME'S	T CONTE	A TAT -	18				
		MR017	or ves	OTSHOK	IZED, BE	N <=2	00 PER	NACE					
		LIFT-			LIFT MA	X 5 T	ON UNLI	G FORE	K				
CO# P	158	11 GH	103-12	44									
TEST	SPE	CIMENS	LABOR	ATORY F	HEAT TRE	ATED :	AND YIE	LD STE	RENGTH A	E2 0	77 7		
E56410										.50 E.	о.ь.		
20410	7	813X6	8400	3 3/8	3 9	6	480		14703	55400	7790	00 в	24
(M55) M	FST	REF#:5	1A037	SMD						54200			25
•				,,,,,									
Q-QUENCH TE	MPERAT	1:00											
		514			T-TEM	PER TEMPER	LATURE		N-NOF	MALIZE TEMPER	LATURE		
	Т			1									
SERIAL NUMBER	PAT NG.	HEAT NUMBER	HARD	BEND	THICKNESS	YPE SIZE	DIR TEST	ENERGY	CHAR	Y IMPACT	α <u>Γ</u>	AV 5-0	
			Britis		INCHES	TPE SALE	DIR TEMP	4		SHEARI	,	at.eo i	ILLS
									2 3	1 2	3	1 2	3

MEAT NUMBER		T					HEMICAL	ANALYS	13								
	С	Mn	P	S	gu	Cu	NI	Cr								·	MOUAID
813868400	16	1 00	01.0						Mo		17	Al	8	Cb	N	Srs	GRAIN
813X68400	CE	1.08	.016	.004	.314	1.231	.18	.03	3.006	5.002	2.002	2.02	9.0002	.00	2.006	.003	3
	.37	7										D	ITR'S A ate: _2 nitials:_	pprov 122 V	ed >/18		

ASME RECEIVING INSPECTION REPORT

NO.	SIZE	P.S.I.	DESCRIPTION	MFG.BY	MARKING	OTHER INFORMA		
LANG	GES - CC	OUPLINGS -	NOZZLES - COMPO	NENTS	CONFOR	MS TO CODE	YES	NO
-	NGS	CODE	YES 🗆 🗆 🗆	NO				<u>*</u>
		ST IF REQU				T3		
I.T.R.	NO				14	T2		
IFG.E IFG.I	BY DENTIFIC	ATION	T4 L_					(
IEAT	NO		T3			TI		
IN. T	.NO.SA_ HICKNES	S REQD_	RADET1 T2			(L)		7
PIPE		errakrinistas jasisukirariiki 👊 👝						
			YES []					
ARD O. O	NESS TE F IDENTI	ST IF REQUE)L.K.F S1.D.R	R	THICKNES	S MEASURED AT STRA	IGHT FLAI	IGE
							¥	
IFG. I.T.R	BY	Đ	T4 G/UG-79			3		//
EAT	NO		T3				(L) <u>I.D</u>	K
AIN.	THICKNE	SS REQD	T2		+ T4	T2	1	
HEA SPEC		GRAD	ET1				1	R
				,,,,		\		
		O CODE		NO		(**)		
WI. I .F HARI	C. NO DNESS TI	EST IF REQI	D. <u>KA</u> W	9-1/16		(T3) (T4) (W)		
MFG.	BY AR	CELOR /	MITTAZ TA	1/2				
HEA1	NO. 8	227.30	7730 T3	1/2				
SPEC MIN). NO. SA THICKNE	<u>576</u> GRAD	DE 70 T1 1/2 NA T2 1/2	•		(T1) (T2)		
						(=/		
PLA						(L)		

Llug

YCLONE STEEL SERVICES, LLC

4950 W. GREENS ROAD / HOUSTON, TX 77066

PHONE: 713-635-5555 / FAX: 281-537-7144

STRAIGHT BILL OF LADING 195956

Date: 03/19/18

Page:1

Delivery Carrier: DELIVERED

CONSIGNOR CYCLONE STEEL SERVICES, LLC 4950 WEST GREENS ROAD HOUSTON, TX 77066

CONSIGNED TO: MOORO1 MOORE CONTROL SYSTEMS, INC - 1435 KARY FLEWELLEN ROAD -KATY, TX 77494 14827 I-106

DAY7WM 1x 77573

2 26 18

CUSTOMER P.O. NUMBER PMLn DESCRIPTION

S.O. NUMBER DUE'DATE CUSTOMER MATERIAL CODE HEAT NUMBER SLAB

PCS

WEIGHT

MATERIAL: NO CHINA OR INDIA

MARKING: MARK ALL PARTS WITH PO # AND BOM #

1 516-70 AS ROLLED PRINT 1/2 X 6 X 9 1/16 PRINT # BOM # 19 Notes: DRILL > 181655039J 187976 03/14/18 822Z39730 H072227 20 154 181655039J 5 A 36 PRINT 3/8 X 2 X 3 1/16 PRINT # BOM # 25 Notes: DRILL 187976 03/14/18 280309 1 280312 39 25

Sub total:

26

CYCLONE STEEL SERVICES, LLC 4950 W. GREENS ROAD HOUSTON, TX 77066

PHONE: 713-635-5555 / FAX: 281-537-7144

The following documents were requested for sales order 187976 Ran on 03/19/18 07:47

DOCUMENT	REFERENCE	NUMBER		DATE	TIME '
00045715 00045723	0036-0.37 0036-0.37 0036-0.37	822Z39730- H072227 ARC02 1 280309 AHM01 18 280312 AHM01 18 180300 AHM01 18 380041 AHM01 18	8	03/19/18 03/19/18 03/19/18 03/19/18 03/19/18	07:47 07:47 07:47

Mill Test Reports furnished by

Cyclone Steel Services, LLC

Order Date...: 03/05/18

Customer...: MOORE CONTROL SYSTEMS, INC

Customer P.O.: 181655039J

Sales Order #: 187976

Item....:

QUALITY ASSURANCE

03-29334	12-31-17	CAR OR VEHICLE NO. CSS-CHGO-UP	LMIC 2	66002	
	T	S H I P T O			
SERIAL PAT HEAT NUMBER NO NUMBER	NO, THICKNESS WIDTH C	SIZE AND QUANTITY OR DIA. LENGTH	YIELD YIELD THION	TENSILE AF FRAC. STRENGTH ELONG.	1
UALITY STEEL MELTE	D & MANUFACTURED 7	CHES INCHES	-001.55 151	PSI IN	HED. 용용
SA516 GR 6	2015 EDITION, ASME 0 PVQ 2015 EDITION	PVQ, ASTM A516 SA516 GR 65 PV L FIRST TST AS	-06 GR 60 PVQ, VQ 2015 EDITIO	ASME SA516 ON, ASME	
TEST C	T TREATMENT MI ERTS IN ACCORD PRO	CEDURES IN EN	2M 1650F F0P 1	TID / TAY =	

PLTS CONTAIN < 1% NI, NOT RESULPHURIZED, BHN <=200 PER NACE MR0175 NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S) MFST - MFST MILL SERIAL# & PATTERN# MFST PPI 0073558-0001 MFST TEST CERTS IN ACCORD PROCEDURES IN EN 10204:2004 TYPE 3.1,& PLTS MFST CONTAIN < 1% NI, NOT RESULPHURIZED, BHN <=200 PER NACE MR0175 - LIFT MAX 5 TON UNLDG FORK

LIFT-SIDE

CO# P15999 GH 405-1101A

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

H072227

822Z39730 2 1/2

120

480

16336

44400 73400 8

27 73300 8

(M55) MFST REF#:51A0500MD

Q-QUENCH TEMPERATURE THE WPER TEMPERATURE

N-NORMALIZE TEMPERATURE

50400

			1	1									
SERIAL	PAT	HEAT	1							CHA	RPY IMPACT		
	1 2 1		HARD	BEND	The state of the same	1 1		TEST	ENERGY	PIDD			
NUMBER	NO	NUMBER	BHN	000	THICKNESS	TYPE	SIZE		I HINEKGAR .	r res	SHEAR %	LAT EXP	MILS
			2	1	INCHES	-		TEMP	1		- 1	DATE CALL	277770
			1		TMCUES	1 1		1				1	
								1 1 -	1 1	2 1 3	1 2 -	1	
											1 4 4 3		2 3

117171111111111111		CHEMICAL ANALYSIS															
HEAT NUMBER	C	Min	Р	S	Si	nu I	N/I	· ·									MOUAD
822239730	17	1 04	010	005	205	33 1		u,	Mc	V 1	Ti	A:	В	СЪ	N	Sn	GRAIN
022233730	. 1 /	1.04	.010	.005	. 325	.225	.17	. 03	3.003	.002	.002	.032	2.0002	003	2 004	00'	2
	CE														003	002	<u>.</u>

.38

MTR'S Approved Date: 2 Initials:

LSS

ASME RECEIVING INSPECTION REPORT

	/1 \
PLATE	(L)
SPEC. NO. SA 516 GRADE 70 T1 3/8	(T1) (T2)
MIN. THICKNESS REQD Not T2 3/8	
HEAT NO. 280312. T3 3/8	
MFG. BY <u>AHMSA</u> T4 3/8	
M.T.R. NO. 6118380B	(T3) (T4)
HARDNESS TEST IF REQD. Not W 3	1/16 1 (W)
CONFORMS TO CODE TES NO	
HEADS	
SPEC.NO. SAGRADET1	TI LEB
	/ " \ IBB
MIN. THICKNESS REQDT2	
HEAT NOT3	
MFG. BY	
M.T.R.NOPG/UG-79	
HARDNESS TEST IF REQD L.K.R	THICKNESS MEASURED AT STRAIGHT FLANGE
I.D.R	
CONFORMS TO CODE YES YES	
PIPE	
SPEC.NO.SAGRADET1	(L)
IN. THICKNESS REQDT2	
EAT NOT3	
IFG.BYT4	— // TI \\
IFG.IDENTIFICATIONL	
I.T.R.NO	- \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
ARDNESS TEST IF REQD	_ \ _{T3} //
ONFORMS TO CODE YES TO NO	
A STATE OF THE PROPERTY OF THE	
ITTINGS	
LANGES – COUPLINGS – NOZZLES – COMPONENTS	CONFORMS TO CODE
	YES NO
NO. SIZE P.S.I. DESCRIPTION MFG.	
	The state of the s

ASME RECEIVING INSPECTION REPORT

CLIENI NACATHON JOB NO	18165-	P.O. NO	-
PLATE		(L)	
SPEC. NO. SA 5/6 GRADE 70 T1 3/8		(T1) (T2)	
MIN. THICKNESS REQD NA T2 3/8		(11)	
HEAT NO. 280309 T3 3/8			
MFG. BY AHMSA T4 3/8	-		
M.T.R. NO. 8/18380B L 2"		(T3) (T4)	
HARDNESS TEST IF REQD. ~A W 3 1/16	-	(W)	
CONFORMS TO CODE [YES NO			
HEADS			
SPEC.NO. SAGRADET1			
	- / /	T1 \	IKR
MIN. THICKNESS REQDT2	++ T4	T2	
HEAT NOT3	-	17 7 7	(L) <u>I.D.R</u>
MFG. BYT4	- // .	гз //	
M.T.R.NOPG/UG-79	-	+//	
L			1
HARDNESS TEST IF REQD L.K.R	THICKNES	SS MEASURED AT STR	AICUTELANOE
NO. OF IDENTICAL HEADS		WEIDONED AT STA	AIGHT FLANGE
CONFORMS TO CODE YES NO			
PIPE			
SPEC.NO.SAGRADET1		1)
MN. THICKNESS REQDT2	. /		1
HEAT NOT3	. //	TI	
MFG.BYT4T4	. //	.	
MFG.IDENTIFICATIONL	. + T4	Т2	(0)
M.T.R.NO	. \\	//	
HARDNESS TEST IF REQD		T3 /	
CONFORMS TO CODE YES 🗔 🗌 🗎 NO			1
FITTINGS			
FLANGES - COUPLINGS - NOZZLES - COMPONENTS	CONFOR	MS TO CODE	
No lous lous			YES NO
NO. SIZE P.S.I. DESCRIPTION MFG.BY	MARKING	OTHER INFORM	A
		1	
CHECKED BY V DATE 3-20 - 18 APPROVE	D BY QC MAN	AGER.	DATE



MILL TEST CERTIFICATE AHMSA: QUALITY WITH THE STRENGTH OF STEEL PROLONGACION JUAREZ SIN NUMERO COLONIA LA LOMA MONCLOVA COAHUILA 25770

B118380B

	AHMSA INT/											44 PE 1 IF 1 (F D)	CERTIFIE	AT CHEMICAL AND / r
ADDRESS	e restriction e cultical antisphotologico discontinuo programma de se per una restrictiva de seguina e considerante de servicio de seguina e considerante de seguina e conside			The state of the s	and the state of the second se	estina dele assenzi proprio prottoriproda e fori que manaraj	-	16.0	1.2018	to the I would be a supposed to the supplement	1	TEST SHOW CONTAINED	IN THIS REP THE RECORI	AT CHEMICAL AND / CORT ARE CORRECT A DS OF THE COMPANY
PRODUCT			A COURT OF THE PARTY OF THE PAR	The state of the s	THE RESERVE THE STATE OF THE PARTY OF THE STATE OF THE ST	phonon-separation group of an electrical in constitution in a								7
	STECKEL PLATE								A. A. order or recorded a three produced and advantage on the pro-	and the state of t		ING. RA	MIRO CIDNER	ROSMENCHACA
	Man and the first two last of the part that	The Section of the Se				And the state of t			annumber of the state of the same of the s			MECHANIC	AL TESTO AN	D CERTIFICATION
HEAT	SPECIFICATION	G.	Mn			OMPOSIT	ION							
280309	ASTM A36/ASME SA36		0.840	P	S	Si	Cu		Ni	MO	Alt	V	Cb	Ti
280312	ASTM A36/ASME SA36		0.860	0.011	0.007	0.120			0.017	0.004	0.045	0.002	0.002	0.002
HEAT	В	0.100	V . 0 0 0	0.018	0.006	0.120	0.036	0.031	0.018	0.005	0.043	0.002	0.002	0.002
280309	0.0002												7,80	0.002
80312	0.0002													
				THE	202 (312 031	LEL TABLES								
EAT	SLAB	PLATE NO.	THICK	sau atiopal	ohl v o	E PRODU PRENGTH								
80309	7050	7184026001	0.2500					T.STRENGT		% ELON.		T.EL	ONG.	
80309	7130	7184058001	0.3750			754 (KSI)		72.103 (KS		24(%)		8		
80309	7140	7184052001	0.3125			817 (KSI)		70.495 (KS		25(%)		8		
80309	7150	7184055001	0.3750			905 (KSI)		70.454 (KS		26 (%)		8		
80309	7160	7184028001	0.2500			341(KSI)		71.070(KS		27(%)		8		
80312	7130	7182052001	0.7500			352 (KSI)		71.342 (KS.		27(%)		8		
80312	7140	7186052004	0.2500			552 (KSI)		67.815 (KS)		25 (%)		-8		
80312	7150	7186049001	0.2500			334 (KSI)		72.228 (KS		26 (%)		8		
			2 - 4 - 5 (1))50 (KST) PRODUCT		72.507 (KS)	I)	24(%)		8		
EAT	PLANCHON	PLATE NO.	THICKN			rkobuct H (Inch)			** * ** ** ** **	** *** ** ** ** ** **	130 × H = -			
80309	7070	7188059001	0.3750					GE (Inch)	ORE			ITEM	DI	ELIVERY
80309	7070	7188059002	0.3750		96.0 96.0			.0000		0209478		000030		002585246
80309	7070	7188059003	0.3750		96.0			. 0000		0209478		0000030	.ì. (002585246
80309	7070	7188059004	0.3750		96.0			. () () () ()		0209478		000030		002585246
30309	7070	7188059005	0.3750					.0000		0209478		000030		002585246
80309	7070	7188059006	0.3750		96.0			.0000		0209478		000030		002585246
30309	7070	7188059007	0.3750		96.0			0000	0.00	0209478	j. 1	000030	1.0	002585246
80309	7070	7188059008	0.3750		96.0			0000		0209478		000030	1.0	002585246
30312	7090	7188060001	0.3750		96.0			0000	0.00	0209478	{	000030		002585246
30312	7090	7188060002	0.3750		96.0			0000	000	0209478	(000030		002585246
30312	7090	71.88060003	0.3750		96.0			0000	000	0209478	(000030		02585246
30312	7090	7188060004	0.3750		96.0			0000		0209478		000030		02585246
30312	7090	7188060005	0.3750		96.0			0000		1209478	(000030		02585246
30312	7090	7188060006	0.3750		96.0		240.			209478		000030		02585246
30312	7090	7188060007	0.3750		96.0		240.		0000	209478	(000030		02585246
			0.1/20		96.0	000	240.	0000	0000	209478	. 0	000030		02585246
														or so we said the VE

CYCLONE STEEL SERVICES, LLC

4950 W. GREENS ROAD / HOUSTON, TX 77066

PHONE: 713-635-5555 / FAX: 281-537-7144

Page:1

Delivery Carrier: DELIVERED

QCOK

~ \ 3-20-18

CONSIGNOR

CYCLONE SIEEL SERVICES, LLC 4950 WEST GREENS ROAD HOUSTON, TX 77066

CONSIGNED TO: MOORO1

MOORE CONTROL SYSTEMS, INC 18165

STRAIGHT BILL OF LADING 195956

Date:03/19/18

KATY, TX 77494

14827 I-10C

DAY70WM 7x 77523

CUSTOMER P.O. NUMBER PMLn DESCRIPTION

S.O. NUMBER DUE DATE CUSTOMER MATERIAL CODE HEAT NUMBER SLAB PCS

MATERIAL: NO CHINA OR INDIA

MARKING: MARK ALL PARTS WITH PO # AND BOM #

181655039J

187976 03/14/18

1 516-70 AS ROLLED PRINT 1/2 X 6 X 9 1/16 PRINT # BOM # 19 Notes: DRILL

822Z39730- H072227 20

181655039J

187976 03/14/18

5 A 36 PRINT 3/8 X 2 X 3 1/16 PRINT # BOM # 25 Notes: DRILL

280309

280312

1 39

1 V = 25 🗸

Sub total:

26



The following documents were requested for sales order 187976 Ran on 03/19/18 07:47

DOCUMENT	REFERENCE	NUMBER			DATE	TIME
00045723	0036-0.37 0036-0.37 0036-0.37	822Z39730- H07222 280309 AHM01 18 280312 AHM01 18 180300 AHM01 18 380041 AHM01 18	27 ARC02	18	03/19/18 03/19/18 03/19/18 03/19/18 03/19/18	07:47 07:47 07:47

Mill Test Reports furnished by Cyclone Steel Services, LLC

Order Date...: 03/05/18

Customer....: MOORE CONTROL SYSTEMS, INC

Customer P.O.: 181655039J

Sales Order #: 187976

Semper and actions on a defining Sing	Semper	Fi	Fabrication	- F	Packing	Slip
---------------------------------------	--------	----	-------------	-----	---------	------

Customer Name	MCSI - Moore Controls Systems Inc.	Delivery Date	4/2/2018
Customer PO#	181655037J	Freight	N/A
Packing Slip No.	PS-001	Items	Davit Arm Assembly Kit

Line Item	Quantity	Item Description	Ordered	Back Order	Delivered
1	1	MTR's Package	0	0	0
2	10	2" Pipe S/80 Davit Arms	10	0	10
3	10	2.5" Pipe S/40 Davit Arm Socket	10	0	10
4	20	1/4" NPT Straight Grease Fittings	20	0	20
5	10	3/4" -10 Eye Bolt Assembly w/ 2H Nuts and 1 Flat Washer	10	0	10
6	20	1/2" Plate 4.375" OD x 2.375" ID	20	0	20
7	10	1/4" Plate 1.9375" OD (Davit Arm End Cap)	10	0	10
8	10	1/4" Plate 2.375" OD (Davit Arm Bottom Cap)	10	0	10
9	10	1/4" Brass Wear Plate	10	0	10
10	10	3/4" Flange Hook	10	0	10
11	10	7/8" Flange and Socket Gusset	10	0	10
12	N/A				0
13	N/A				0
14	N/A				0
15	N/A				0
16	N/A				0
17	N/A				0
18	N/A				0
19	N/A				0
20	N/A				0

Notes

7/8" thk gussets approved in lieu of 3/4" on 3/30/18 by Engineering and communicated by Jay Nelson

Proof of Delivery

Customer Signature	UH		Date:	8-2-18	
Freight Representative		 107	Date:		
SFF Representative	Hone	(W)	Date:		

REV. 1

Brass Wear Plate



Non-Ferrous Metal Works (SA) (Pty) Ltd

EXTRUSION DIVISION

1 The Avenue East, Prospection, Kwa-Zulu Natal, South Africa Reg. No.: 1951/000559/07

Telephone: +27 (31) 902 7470 Fax: +25 (31) 902 8865

TEST CERTIFICATE

	Test Certificate Number Works Order Number Sales Order Number Delivery Note No Invoice Number Purchase Order No. Alloy Quantity Ordered	TORC026590 TORC026590 SO0438563 SO-DN00007164 SO-IN00262582 HOU- 12111-XG 360 10000 Lbs	•	
Description 4-1/2" DIA X 6 - 7 FT	Weight Despatched Specifications ASTM B18 C36000 [15]	10251.391 Lbs		3
MACHINED BRASS BILLET Free Cutting Brass	ASTM B249 [14]			
HALF HARD				

Mechanical/Physical Test Results

Size	1	Size 2	Area	Yield Strength		Tensile Stren	igth'	Elongation	Hardness				
mm	mm mm²		Kg/mm²	PSI	Kg/mm²	PSI .	%	Vickers	Brineli	Rockwell			
12	19.91	0.00	311.34	23.90	33,988,95	30.83	43,845.75	29.00	0.00	0,00	43.90		
	19.92	0.00	311.65	. 24.19	34,398,34	30.96	44,029.87	28.00	0.00	0.00	43.90		

			(hem	ical C	ompo	sitio	n				
Charge Number	Cu	Zn	Fe	Mn	AJ	NI	Sn ·	Pb·	81	As	P	Te
D\$377 ·	61.30	35:43	0.17	0.00	0.00	0.02	0.07	2.97	0.00	0	0	0

Charge Number	Sb	Mg	Ti .	Co	Cd	Sr	Cr	Ca	Other
DS377	0.01	0	0	0	0	0	0	0	0.00

APPROVED

12:09 pm, Jul 20, 2017 ANITA MCGRAY, MTR Administrator

We certify that the material is free from mercury contamination Signed for on behalf Non-Ferrous Metal Works(SA) (PTY) Ltd QUALITY CONTROLLED COPY Quality Manager 2017/06/23

4.375 OD x 2.375 1D

1000 Skupje, Republic of Macedonia

16 Makedonska Brigada 18.

www.makstil.com

Customer DUFERCO S.A.

Customer's order no. Ang: SO4201006753

Order No. / Lot No. 1

Manufacturer's symbol AGH ŽSK

Delivered conditions NR - normalizing rolling

INSPECTION CERTIFICATE No. 703436 4014 001

FM ML.03.54

Pages: 1/1

According to EN 10204 / 2004 : 3.1 Issued in electronic form

Technical delivery conditions nor

ASTM A516M:15/ASTM A20M:15/ASTM A370:15 G=200mm ASME \$A516M:15/ASME \$A370:15/ASME \$A20M:15 G=200mm

50% of"-"tol.for thickness and flatness

Issued zot: 10.04.2017

		нс	T ROLI	LED STEE	L PLATES			801							CI	IEMIC	CAL CO	MTO S	ITION	ı							
Heat No.	Steel grade		Item	Pleces	Dimer	sions (inc	h)	Weight (kg)	C 10 ⁻²	Si 10-2	Mn 10 ⁻²	P 10-3	S 10 ⁻³	Al 10 ⁻³	N 10 ⁻³	Cr 10 ⁻²	Cu 10*2	Ni 10*2	Ti 10 ⁻³	V 10-3	Nb 10 ⁻³	Mo 10 ⁻¹	R 10 ⁻⁴		Pb 10 ⁻³		10 -3
TACMITION	Steel Brade	i	no.	1 ICCC	Thickness	Width	Length		%	%	%	%	%	%	%	%	%	%	9i	%	%	% CI4	% CR5	%	% C\$1	%	%
476333 476394	SA/A516M Gr.70	B02	8 8	B68 1 4	1/2 1/2	120 120	480 480	3705	17	28	131	14	7	38 31		5	20	сжя 8 9		1	Cas 1	1	6	Cso	Cs/		
			Ð		A																	81					
				is.																							

Total .

18525

MANUFACTURING PROCESS: EAF c70

		Totat :	J						10.	323										
PRO	DUCT IDENTIF	CATION				TENSILE	TEST							IMPACT	TEST			SUPP	LEMENTA	RY REQUIREMENTS
Heat No.	Plate No.	Plate No.	Test No.	recion	£2)	Yield MPa	Tensile MPa	Elong:		Derection	Туре	lac	lividual v ft.lbr	alues	Mean volue ft.fbr	At F*	Width of tests piece	Direction (1	a	
807	807	BC7	Cou	CM	CDU	CI:	C12	CI			C40	C42	C42	C42	C43	C:03		CAT		В
476333	14951-01		14951	1	T	410	569	25.5								6				N.
476394	14927-01		14927	1	T	377	538	27.5							1 1				51 15	
n .	14928-01		14928	1	Т	388	551	26.5												
и	14929-01	4	14929	1	T	406	553	26.5			30.									
	14931-01	4	14931	1	Т	400	557	25.0			Ì						•			
								-											100	= ₁₀
*8					Ţ.															
				1														1	0	
] =	ı	1					1		1	1						1	

"Fully killed with fine grain structure"

PRECISE STEEL INTERNATIONAL

PO# 6507

HT# 476394-14931-01

PL# 11346

Bend test C50

Ultra-sonic test DO2:

Visual and dimensional ispection: without objection

We hereby certify, that the delivered material complies with the terms of the order.

Direction of the test piece : L - longitudinal; T - transverse; $\mathcal L$ - in the thickness direction

2) Location of the test sample: 1 - top; 2 - bottom Die-stamp marking;

Makstil's symbol / Grade / Heat No. / Plate No./CS mark

1/2" SA516-70 A/R



RZ TECHNICAL CONTROL A.D. - SKOPJE

O.D. 'MAKSTIL' A.D

QM:dip.eng I.BOGESKI

Laboratory RZ TECTINICAL CONTROL AD - Skopje, ISO 9001:2008 CERTIFIED BY LRQA, CERTIFICATE No.

MAKSTIL AD - Skopje, ISO 9001:2008 CERTIFIED BY BSI, CERTIFICATE No. FM 55589



AHMSA:QUALITY WITH THE STRENGTH OF

B042575B

ADDRESS					d.D.a.1	11frre-7	2066T	Supply,	LILL			13.	07.7.117		1	WE HEREBY THAT CHEMICAL AND / OR T SHOW IN THIS REPORT ARE CORRECT AS CONTAINED THE REDORDS OF THE COMM
PRODUCT	5150 N LOOP1604 W	Y San An	itanio,	Tx.											:	ING. BAMING CHICHOSANENCHACA
	STECKEL HOT ROLLE	ed colf														MECHANICAL TESTS AND CONTINCATION
								TEMENTON	T COMBO	CTTTON				<u> </u>		9
HEAT	SPECIFICATION	-	C	Mn	D	s	Si	Cu	Cr	Ní Ní	Mo	Alt	v	Nb (Cb)	Ti	
275352	ASTM A 1018 SS 36 TYPE	2	_		0.014		0.1400				0.004	0.039	0.002	0.001		
372401	ASTM A 1018 SS 36 TYPE										0.016			0.001	0.002	
HEAT	NZ		0.110	0.040	0,010	0.000	4.1344	0.110	0.00.		*****					
275352	0.0053															
372401	0.0055															
\$12.TOI			~~~	_				TEST O	e the P	RODUCT						
HEAT	COIL NO.	SLAB	'n	- PHICKNES	S/Inch)	v cros			RENGTH		ELON.		T. ELON	.		
275352		7010		0.2550	O/HMI	50.160			72(KSI)		12(%)		2			
275352		7050		0.2500		53.666	•		242 (KSI)		13(%)		2			
372401		7010		0.3750		54.418			215 (KSI)		47 (%)		2			
372401		7020		0.3750		56.250			828 (KSI)		43{%}		2			
372401	S6212001	7030		0.4980		50.760 (KSI) 70.294 (KSI) 48 (%) 2										
372401	\$6214001	7070	(0.5000		48.552	(KSI)	68.	683 (KSI)	1	45 (%)		2			
-				_				SHIE	PPED PRO	DUCT						The state of the s
HEAT	COLL NO.	THICKNE	SS (Ind	h) WIDT	i (Inch)	ORDER		TTD	М		DELLIVERY		CUSTON			
275352	\$6208014	0.2450		96.00	000	000020	03343	000	010		10024977	00			55~JC)/	
275352	\$6208011	0.2450		96.00	000	000020	03343	000	010		10024977				55~JC)/	•
372401		0.4980		72.00	000	000021	03315	000	070		10024977	00	AHI495	4 (JVT-7	53-JC)/	
	NVERSION TO ASIN A36															
1	NVERSION TO ASTM A36															
COUNTR	Y OF CRIGIN: MÉXICO															
+	**** ***** ***************************			_					END O	e data						
l P	recise Steel	Inte	rna	tion	al											
	04.0400															
P	O# 6496															
l H	IT# 275352															
l P	L# 11331															
l		rA.														
	1/4" A-36	43														
1																

MUCOR NUCOR CORPORATION NUCOR STEEL TEXAS

Mill Certification 3/7/2018

MTR #: J1-403228 8812 Hwy 79 W Jewett, TX 75846 (903) 626-4461 Fax: (903) 626-6290

Sold To:

NORTH SHORE SUPPLY CO BOX 9940 HOUSTON, TX 77213-0940 (713) 453-3533 Fax: (713) 671-5578

Ship To: NORTH SHORE SUPPLY CO WAREHOUSE 5 12929 MARKET ST HOUSTON, TX 77015 (713) 453-3533

Customer P.O.	299745								
Product Group	Merchant Bar Quality	Sales Order	268438.96						
Grade	A36/A529GR50/CSA44W/50W	Part Number							
Size	3/4" (.7500) Round	Lot#	JW1810195301						
Product	3/4" (.7500) Round 20'A36/A529-50/44W/50W	Heat #	JW18101953						
Description	A36/A529-50/44W/50W	B.L. Number	J1-810921						
Customer Spec		Load Number	J1-403228						
I hereby certify that the m	aterial described herein has been manufactured in accordance with it	Customer Part #							
Roll Date: 3/4/2018	Customer Part # II Date: 3/4/2018 Melt Date: 2/28/2018 Oty Shipped LBO See See See Shipped LBO See See See Shipped LBO See See See See Shipped LBO See See See See See See See See See Se								

Roll Date: 3/4/2018 Melt Date: 2/28/2018 Qty Shipped LBS: 5,047 Qty Shipped Pcs: 168

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]

С Mn S Si Cu 0.14% Ni 0.85% Cr 0.012% Mo 0.033% Cb 0.21% 0.34% 0.15% 0.14% 0.050% 0.0347%

Yield 1: 56,900psi

Yield 2: 57,000psi

Tensile 1: 73,500psi

Tensile 2: 73,700psi

Elongation: 21% in 8"(% in 203.3mm)

0.002%

Specification Comments: MEETS THE REQUIREMENTS OF: ASTM A36/A36M-14, A529/A529-05 GR50(345), A709/A709M-10 GR36(250); CSA GR44W(300W)&GR50W(350W); AASHTO M270/270M-10 GR36(270); ASME SA36/SA36M-10 MEETS REPORTING REQUIREMENTS OF EN10204 S

Comments: E-mail: websales@nstexas.com

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

C

Hook Details

Sde R Vartani

Bhargava R Vantari **Division Metallurgist**

SSAB

Preliminary Test Certificate

Form TC1: Revision 1 Date 31 Oct 2000

1770 Bill Sharp Boulevard, Muscatine, IA 52761-9412 **Official copy to follow** Customer: Customer P.O. No.: SLC-3352 Mill Order No.: 41-246235-18 Shipping Manifest: MR086775 **STEELCO** Product Description: ASTM A516-70(06)/ASME SA516-70(07ED.) C/O E. TREVINO Ship Date: 13 Jul 09 Cert No: 061162312 P.O. BOX 21119 Cert Date: 13 Jul 09 HOUSTON (Page 1 of 1) TX 77226-1119 Size: 0.875 X 120.0 X 240.0 (IN) **Tested Pieces** Tensiles Charpy Impact Tests Heat Piece Piece Tst YS %RA Elong % Tst | Average UTS Abs. Energy(FI'LB) % Shear Tst Tst Tst Id **BDWTT** ld **Dimensions** Loc (PSI) (PSI) 2in 8in Dir Hardness 1 2 3 Avg 2 3 Avg Tmp Dir Siz Tmp %Shr A9C127 C08 0.875 X 120.0 (DISCRT) L 49000 75000 Heat Chemical Analysis Tot Al Sol Al Cb Ti A9C127 .011 <.001 .20 ORGN .031 .031 .29 14 .13 .04 .001USA 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)/15100% MELTED AND MANUFACTURED IN THE USA. MTR DIN EN10204 TYPE 3.1 COMPLIANT. A9C127 PCES: 1, WGT: 7169 PL 10- gussels Precise Steel International LLC PO # 4340 HT # A9C127 PL# 8751 WE HEREBY CERTIFY THAT THIS MATERIAL WAS Cust Part #: FLOOR STOCK TESTED IN ACCORDANCE WITH, AND MEETS THE REQUIREMENTS OF, THE APPROPRIATE SPECIFICATION SENIOR METALLURGIST - PRODUCT

PO: vbl Aaron Line: 3 Order: 1338874 Heat: 169720 Slab: Descr. A106 SML GR B 2 S/80 X S/R

	, ii								INS	PECT	DOM (CDT	FICATI	- 12121	- 11 40													- 2
4		Qu	sality i	manage	ement	system has t	oen c	ertified a	according	to ISC	9001:	2008 by	FICATE	dogen (EN 10	204:	2005-0	1 3.1	/ 1-28	30 /								
0	t Ocupatio	:nvvror nal he:	nmen alth a	lai man nd safe	agem	ent system ha	as bee	en certifie	ed accord	ding to	ISO 14	001:200	4 by TUV	Thuring	en e.V	. (Cert	ficate Nu	mber 13	C 15 104	230) 15129	9)							
			1	99	سلمه ت	nagement sys	June 1	Des	cription	of the	ang to	- Sana	10001:20	U/ BY I	UV IN	uringen	e.V. (Ce			TIC 15	118 156	24)						
			1200	2																				act No	17021	21 ap	pendix	6
			(3)) — <u>153</u>									ansportar The crops					nd natu	rei ges li	ndustri	es.		PO es	umber		- Tipe	nonbook	
		Ope	n Joir	nt-Stock	k Corr	MANY		Dec	xidation	deare	e: Fullh	decul	dised ste	SER CHETTER	True Head	PPHONESIA NE I	association (bo	10.0LU10-01	OCTIL,				House	000000				
B	relorussk	an Ste	el Wo	irles n	nanao	ement comos	my of	Type	o of pipe	work fix	Plain	permissione Emul	HARM CLEUP										Baron	in Ne (i04706	63		
37	Byelon	ussian	Meta	llurgics	el Corr	pany" holding Zhlobin – Bel	,	Ton to	Define Secu	-	************	-	L										Coun	try of d	etina	ion: US	A	
T	eL +375	(2334)	5-41	-29. Fa	1/21U 1x +37	'2.mooin — Bei '5 (2334) 5-60		Venne Venne	very Cor		el: As	-rolled			•	Techni	cel speci	fication	level: P	SL1				ignee:	MIC;			
¥	nw.bels	teel.co	am.		queldi	@bmz.gome	Lby										Урс	SOUR CHAI	hepassibac	PSL1			Conye	ueur: «Riscer				
_																												
3 .		l	. [-												hemical	compo	sition, 7									
1	Number of heat		lot	G	ada a	teel/Standen	. 1			c	SI		١			1	1			- /4	CODE CO	7880, %				CHNI		
18	House	Ho	шр			TEAN CTINAL PLANT	•		- 1	•	31	Mn	1 " 1	S	Cr	NI	Cu	π	Mo	V	Al	Nb	8	Nb+V	Nb+	Mo+	CE	Steel
! ~		map	TO BE					Nor		max	min	-29 -	max	mex	mex	mex	max		max	max		\vdash				Cu+V		making-
_		1	-	3/3/42	ect. to A	PLENC SLININ	as	Ladle (.28	.10	1.06	.030	.030	.40	.40	.40		.16	.08			.0010	max 30.	max .15	1.00	1	process:
- 1		l		B acc.	er to AS to ASM	TM ASVASDA-LI R BASVSA-SDM-2	1	Коншина	(((part)	.26	.26	.53	.008	.012	.11	.13	.25	.002	.02	.012		.001	.0002	.013	.015	.52	.40	
1	169720	1735	543	BJC as	oc. to AS	TM ALOUATORA	-15	Product (%)		.26	.27	.51	.009	.012	.11	.13	.25	.002	.02	.014		000					+	
- 1						NDE WSO 15154-3-200		Product		.26	03		1			-	-		.02	.014	<u> </u>	.002	.0010	.016	.018	.52	.14	Electric
ᆜ				PED 91	I/EMEC,	NACE MR 0103-3	Uc (ф	=1)	.20	.27	.51	.010	.013	.11	.14	.26	.002	.02	.014		.002	.0002	.016	.018	.54	.14	1	
- }		Di	men	ions –	Panen	M				Q	wentity	- Kone	CIBO								Mach							
					- 1				1									-	Tens	ile Tes	d _ mari	-	-	103 -Me			pact tes	4 401
- 1			1					1			Weigi	ht					Manda	1	-outliene	MH 20	np Test	Speck	mens o	foresse o i		Per	іота удара	•
	OE		1	LAGO			8	1 5	i		Bec						Hardne acc. t	100	and)	- HOUDOM	e receore e width	PHONE HOUSE	DESCRIPTION OF REAL PROPERTY.			AS	TM A370	
	Дини		١,	Wf Tonspea		Length	3	8 8						T	ni leng	_	NACE	MR		Weps	и обращ	0.75 aud			U	Pasa	in of spe mp objecty	
ğ				CTOHON			packa	9 4 9							nany m		0175-2:2 Teepgoo				ASTM A		nga-			0,197	t 0,394 l	nch
3		1) I		18 1	D	심	Net		G	088			ŀ	0175-02-2	CE MR	Tensile strength		Yield renath		ion	Ratio		Impact		
- 1		11	1		/		3 5	bundles		Herto			AUD AUD				0113-02-2		Предел		Tpagen		gitu-	Compton Peters		(longit	(ianibu	1
- 1		V			_		Number	Quantity bundle								- 1			rpo-eocres R _m	"	Ras		nai	Rm		Pations		
- 1	mm l	inch	_		[m ft	12	3		\top				-				_		-		1	60	ruii				
-1		дойы	u)u	n in		M 497 04-0.10) (-04-0.33	J	1	1		b MT	t	lb	m		R	ISO 650	6-1	psi		psi	!	%	- 1		min		
-	60.3	2.375	5.5	-			1						Фунт		٩	7	HBW	-	nin 7000	0 mi	n 42100	mi	1 22		11	2 3		*F
	00.3 1	2.3/3	TO		18	6.10 20.0	3	173	8.047	1774	_	8.059	17767.03			07.3	154	156	78000		3000		6			37 3	Con	****
ers	onal for	NDT -	-									8.059	17787.03		5 350	07.3							~			3/ 3	3	8 68
T a	nd UT i	s qua	lifled	ACC.	Non	destructive (Electr	ic Testo	d/Eddy (current	i]		NDT/R Merca	IT .							1		146	droatal	le tool	laa	andlan.	
	0 9712, (An <i>h</i> o Hepe				Heps	ablangeonting stock	Tperspec	подънска бы	ъ Юнерето	TO BLOOM	Rest	ilta:ok	Augusty Negative	-d/V/Lip	w 0.	sulls:-	Tech	nologic	cal test				-1	A	4 6L 4	ing acc 5th ed	oraing	
остра	ACTOM CON	IAMA BTIC	a Yak	-	AST	M E 309 rence standard pl					Резул	STET;		E 213		Aurien.	Flatte	ening Te	ists ASTI	À		suits: (Die Ca	MOCTATIVE !	API SL 4	re-me-era d	9776040	Results:
12, y	POSSON (I				3 TEA	онная труба с отв	ифстин.	WH (Ø 3.2 H	au / 0,125 a	dece-the								VA106M			- 1	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		2970 p	ni .			Результат:
tb	heroby c	ertifie	d 85a	produ	cts co	wered by this	Certif	icate has	s been te	sted a	rd la co	molled	with the	DOLLAR	anta c	/ the c-	oderand -	3 84	A E	101				ration:				
40000	THE RESERVE AND	по посили	March son	all the name of	A contractor of									- den 201	O	60	in act &	-0 019 N	MANUSTREE &	pocifici	nions	T	achnic	al Con	rol In	pector	Shchen	neliova
V HB4	atily me	esurin	ig tes	t was	perfor	med with sa	defact	pory rest	uft,		riposto et 1	handpere	a seglopedri	A GLENCOMPH I	-aug							- 1		Perfectors	-			
	PARK CONTRACTOR	04479/0440	ALC: NAME OF	-		*********																		-			-	
No	raid rep	air. Fr	100 OC	Moses and	HOLDON HOLDON	c Atoeuezeobius	raneas p	DESCRIPTION OF THE PARTY OF THE		S.,												S	On Beh	albert B	Mapai	Sobieny ort come-		in Steel

_	RTIFICATE	_).			201 NO		091	02				_		_			7						<u> </u>																						F	Page 1	/1
-	STOMER			:						_			_					-										And the								•••		1	LJ	11	4 IL	NIL	Ste	el C	or	po	rat	io
co	NTRACT(P	/O) I	VO.	:	71(0623	1			-								-				I	VS	SP	E	C 7	П	10	1	CI	ER	RT.	F	IC	A1	ΓE		Jeonju	Plan	t Ad	ldress			. 34				
co	MMODIT	Υ		:	SE	AML	ESS	CA	RBO	N S	TEE	L HO	TC	FINIS	HEI	D PI	PE						:							•								1746 H	loguk-	-ro, Ir	msil-eup,	, Imsil	l-gun,	Jeollab	uk-dı	o, Ko	rea 5	56-
STA	NDARD			:	ASA	M A	53 2 A57.	2012 /SA1	Editio	01/	\106	2015 on //	S Ed	lition	//																							805 TEI	L : 82-	-63-7	30-4574	/ FA)	X : 82-	-63-730	-4798	8		
	T :	•										2012		***									E	N1(20	4-3	3.1		/	' E	N1	020	4-3.	.2					SL	JPPL	IER		1	LIN ST	reel	Соп	pora	tion
NO.	W/O							OF	RDER	SIZ	E										QUA	NIII	γ				to	TAL	T	Manu	factu			Pipe I		TRI	HEAT EATMENT							REMAR				-
-	(HEAT N	0.)		ID		T		DD D	T		Wī		T	LEN	 GTH		-	PCS					MASS					IGTH	\vdash		*1		+-	*2		+"	*3	- 0	Srade		1. THE HAR	IDNESS I	DESCRINE	ED HEREIN	COMPLE	ANCE	WITH N	ACE N
1	5717100	114	1	469		+	2.	B75"	\dashv	- (0.203	3 "	+	42	.0 .	-	- 2	207	_		5.80	1	-	FAL (1		1	869	4.00 '	+		HF		-	BEI		_	N/A	ACTI	M A53		0175/MR-01 2. 'R - CHE	EMICAL C	COMPOS	STION REQU	LIREME	NL NT POL	TOM2 I	1DCT
	(D0452	2)										:														l	003				• •			OL	•		NA	ASTM A			- AS	STM ALDI	FRAC: T	E 1. (REMAN TABLE 1 (RE)		1		
							(A			B																											ASME S	E SA53		3. NO WELD 4. NO MERC	D REPAIR	R WAS PE					
							7	~	1		14																						1					9	L B (PS		BEARING IN ANY MANN	USTRUME	ENTS AN	TO/OR EQUI	PMENT	HAVE I	BEEN US	ED IN
_									TOT	AL			1	_		-	- 2	207			5.80	\dashv		0425	20	+	8,69	94.00	\dashv									API X	42 (PSI	LI)	MANUFACTO 5. Pb CONT	TURE, ASS TENT (SPI	SEMBLY,	OR TEST OF	F MATE	MAL		
			S							-	C	HEMI	ICAI	L CON	IPO:	SITIK	N(%)											YDRO				LE TEST			MPACT TEST	HARDNESS			ATT	RAIDING		wr	HYDRO	T	T.	, [, T
NO.	. w/o		Â			Т	Т	Т	Т	-	Г	Т	Т	\neg	Т	7	_							_	+	N		-	छा	-	_	: 50.8 Y.S	10.13==	_	(AS	TM E23)	(ASTM E18)	TEST		EST	TEST		-	-BURST	╛,			
	(HEAT N	0)	S	C	Sì	M	n	P	s	Cr	Ni	Mo		iu 4	u	π	v	Nb	В	U4	VN	V1	VZ	CEQ		T		Sec	55	SURE	Width	0.5%	1		(D) Ti	emp *C	III HRS			L+e)t/		Skg	X 2m	MPa	1 5		E F	
	4		•4		00	*R	1	X100	20		X	100	٠.	+			000	_		•5	•6	7	*8	*9	+	*10	D	1		ᇜᅡ	*L	bay Enr	psl			init Aule	D HB		in-t	(O.D.)		Temp	p: °C	Temp:	د ۱			
Spec			MAX	25	10	139		30	30	40	40	15	F	10	T		80			10		0.15		0.44	80		υT		2	970	19.05			1	1	+-	1		+			+			┨,		5 5	
1	ST17100	- 1	- 1	19	22	117	- Li.	0	6	11	4	2	1	0 2	,	23	2	3	0.4	0.3		0.03		0.39	╁	+		5		+	_	42100	7030	0 18.6	-	+-			39	24		+			+	1	'-	+
	(D0452)	2)	BA PA	17 17	24	1	1	- [- 1	11 11	4	1	1			24 24	- 1	1	- 1	0.3		0.03		0.36		l																						
										-			ľ	1	1		1		"	"		0.03		0.36		1	*G		* G	-		1	8429	1			86.9		1.	9					*6	• •	6	1
									-												- 1							١.						1			87.2											
	•						ı		١																																				1			
	:						ŀ						ı													ı																		8				
	197	7	*1-j	VF:	Non	nalizi	ng	Form	ing /	/ HF	: Ho	t Fini	ishe	d/						4	4 - 1		adle	Analy	sis /	BA:	Billet	Analys	sis /	PA: Pi	mdu	rt Ana	hreis	1			410 - 117				Eddy Curr				上	L	\perp	上
	NOTE		*2 - *3 -	н. Р :	Holen.	احوالت	Env	4 / Di	CO • 0	72	End	1				•				,	*5 - : *6 -	Cu+N Nb+N	Vi+Cr V	+Mo-	V				,				.,,,,,				MT : P - Tubu	: Magnetic lar or Plati	: Particl e Type	le Test of AS	V EM : Ele TM EB Fia	arten A	ist / Aagneti	ic Inspec	tion			
			- 1	J+1	: Uu	ench	medi i	RI Tel	moer	med /	/ N-	T : N	OPPO	alizec	æ	Tem	perec	ŧ	•	•	-8 -	Nb+\ Cr+N C+Mi	II.														"F - Full 5	ection Tvt	pe of A	STM I	EB Fig.11 •T - Transı							
Thire	party Sec	tion					1				• w	E HER	EBY C	ERTEY	THAT	THE	MATE	RIAL	HERE		APPLICATION OF	-	-	TESTED	IN AC	CORD	ANCE V	MTTH AB	OVE S	PECITIC	ATION	AND Th	Œ	•	_				T	•								
			٠				1				◆ 17	HE OUN	ALITY	ALL TE	H AR	OUR	eptab Work	z ha	S BEE											150 90									1	10	UNG	; K	γι	SFA	0	器	S I	
	•						:				♠ TI	HIS CEI	KTIFI	CATION	BIA	TENE	ED ON	RY F	OR PF	DED A	TS LES	TED. N RGERY	ACOUR OF DO	CATION	TO OF	R UNA	UTHOR SUNIC	12ED US	E CIF T	THIS CEN	NTIFICA BOUTHO	ATTION ES									of Q.M De			!				7
Name and Address of the Owner, where	-	-	_	-	-		-																																4 *******	-3-4	KIN DE	- Bran			- 1	<u> </u>	90	J



Katy: 1435 Katy Flewellen

Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 5 NDE REPORTS / NDE TECH CERTIFICATIONS

Moore Control Systems, Inc.



14827 I-10 East Baytown, TX 77523 P 281-385-0009 F 281-392-7727

CERTIFICATION STATEMENT

This document certifies that <u>VASILE VITAN</u> has the training and experience, has met all qualification requirements in accordance with Moore Control Systems, Inc. procedure for the qualification, certification, and training of nondestructive test personnel and is hereby certified in the applications listed below.

	EX	(AMINATION I	RESULTS
METHOD	MT	PT	VT
LEVEL	11	11	- 11
GENERAL EXAMINATION	80	94	80
SPECIFIC EXAMINATION	100	100	90
PRACTICAL EXAMINATION	96	95	95
COMPOSITE SCORE	92	96	88

Original Test Date:	02/20/2018						
Performance Evaluati	on in accordance with ASNT SNT-TC-1A	and CP-189.					
Date of method evaluation: 02/20/2018							
Next method evaluation / certification due on or before: 02/20/2023							

EXAMINED AND / OR APPROVED BY:	TITLE:	LEVEL III	ASNT CERTIFICATE #	170794
William R.K. Localy	DATE:	02/20/2018	WILLIAM R.K. GOOLSBY	



ASNT LEVEL III

APPOINTMENT / TITLE

GOOLSBY TESTING, INC.

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

CERTIFICATION STATEMENT & VISUAL ACUITY RECORD

This document certifies that <u>JUSTIN REPP</u> has the training and experience, has met all qualification requirements in accordance with GOOLSBY TESTING, INC. procedure for the qualification, certification, and training of nondestructive test personnel and is hereby certified in the applications listed below.

and training of nondestructive te		EXAMINATION F			application	is listed below.							
METHOD	RT	MT	PT	VT	UT	7							
LEVEL	ll l	II		11	N/A	1							
GENERAL EXAMINATION	82	80	90	86	N/A								
SPECIFIC EXAMINATION	94	95	90	90	N/A	-							
PRACTICAL EXAMINATION	95	95	95	94	N/A	-							
COMPOSITE SCORE	90	90	92	90	N/A								
CONIFOSITE SCORE	30	30	32	30	IN/A	_							
Original Test Date: 10/07/2017		TIFICATION N	IO.: 43	888									
Performance Evaluation in accordance with A	ASNT SNT-TC-	1A and CP-189											
Date of method evaluation:				01/10/2018									
Next method evaluation / certificatio	n due on oi	before:		01/10/2023									
Next Visual Acuity evaluation due or	or before:			01/10/2019									
	VI	SUAL ACUITY	RECOF	RD	-								
NEAR-VISION ACUITY:													
PER ASNT SNT-TC-1A, THE EXAMINATION SHOULD ENSURE NATURAL OR CORRECTED NEAR-DISTANCE ACUITY IN AT LEAST ONE EYE													
ICH THAT THE APPLICANT IS CAPABLE OF READING A MINIMUM OF JAEGER NUMBER 2 OR EQUIVALENT TYPE AND SIZE LETTER AT THE													
ISTANCE DESIGNATED ON THE CHART BUT NOT LESS THAN 12 INCHES ON A STANDARD JAEGER TEST CHART.													
CONFIRM THAT THE CANDIDATE: (PLEASE MARK ONLY ONE BOX) ☑ MEETS THE JAEGER NUMBER 2 OR EQUIVALENT TYPE REQUIREMENTS WITHOUT CORRECTION													
MEETS THE JAEGER NUMBER 2 OR					CTION								
DOES NOT MEET THE JAEGER NUMI	BER 2 OR EC	QUIVALENT TY	PE REQU	JIREMENTS									
DISTANCE-VISION ACUITY:													
THE EXAMINATION SHALL EQUAL SNELLEN	FRACTION 2	0/30 OR BETTER	IN AT LEA	AST ONE EYE, EIT	HER CORREC	TED OR UNCORRECTED.							
I CONFIRM THAT THE CANDIDATE: (PLE				DECTION									
MEETS THE SNELLEN FRACTION 20/													
MEETS THE SNELLEN FRACTION 20/				IION									
☐ DOES NOT MEET THE SNELLEN FRA	CTION 20/30	REQUIREMEN	15										
	TEGT (OLIO	DT OD I ONO I											
A TECHNICIAN WHO PASSES ISHIHARA													
I CONFIRM THAT THE CANDIDATE CAN						ENDIMETHOD(S)							
CONCEDNED AND/OD HAS DASSED AN	CONCERNED, AND/OR HAS PASSED AN ISHIHARA TEST EITHER CORRECTED OR UNCORRECTED.												
		TEST EITHER C	ORRECT	TED OR UNCOR	RECTED.								
EYE EXAMINATION: SHADES OF GR	RAY												
EYE EXAMINATION: SHADES OF GR THE INDIVIDUAL SHALL BE CAPABLE OF DIS	RAY STINGUISHING	S SHADES OF GR	AY ON "E	YE EXAMINATION	N: SHADES OF	GRAY". THEY MUST USE							
EYE EXAMINATION: SHADES OF GF THE INDIVIDUAL SHALL BE CAPABLE OF DIS A HARD COPY OR ON THE COMPUTER SCRE	RAY STINGUISHING EEN AT A DIST	S SHADES OF GR	AY ON "E	EYE EXAMINATIOI /16" - 19 11/16") U	N: SHADES OF	GRAY". THEY MUST USE L DESKTOP WORKING							
EYE EXAMINATION: SHADES OF GR THE INDIVIDUAL SHALL BE CAPABLE OF DIS	RAY STINGUISHING EEN AT A DIST	S SHADES OF GR	AY ON "E	EYE EXAMINATIOI /16" - 19 11/16") U	N: SHADES OF	GRAY". THEY MUST USE L DESKTOP WORKING							
EYE EXAMINATION: SHADES OF GR THE INDIVIDUAL SHALL BE CAPABLE OF DIS A HARD COPY OR ON THE COMPUTER SCRE LIGHT CONDITIONS. THE PASSING GRADE I	RAY STINGUISHING EEN AT A DIST IS A MINIMUM	S SHADES OF GR FANCE OF 30-50 20 OF 25 CORRE	RAY ON "E cm (11 13/ CT READ	EYE EXAMINATIOI /16" - 19 11/16") U INGS.	N: SHADES OF NDER NORMA	L DESKTOP WORKING							
EYE EXAMINATION: SHADES OF GREATHEINDIVIDUAL SHALL BE CAPABLE OF DISA HARD COPY OR ON THE COMPUTER SCRELIGHT CONDITIONS. THE PASSING GRADE IN CONFIRM THAT THE CANDIDATE CAN	RAY STINGUISHING EEN AT A DIST IS A MINIMUM	S SHADES OF GR TANCE OF 30-50 20 OF 25 CORRE H CONTRAST E	AY ON "E cm (11 13 CT READ	EYE EXAMINATIOI /16" - 19 11/16") U INGS. N THE SHADES	N: SHADES OF NDER NORMA	L DESKTOP WORKING SED IN THE NDT							
EYE EXAMINATION: SHADES OF GR THE INDIVIDUAL SHALL BE CAPABLE OF DIS A HARD COPY OR ON THE COMPUTER SCRE LIGHT CONDITIONS. THE PASSING GRADE I	RAY STINGUISHING EEN AT A DIST IS A MINIMUM	S SHADES OF GR TANCE OF 30-50 20 OF 25 CORRE H CONTRAST E	AY ON "E cm (11 13 CT READ	EYE EXAMINATIOI /16" - 19 11/16") U INGS. N THE SHADES	N: SHADES OF NDER NORMA	L DESKTOP WORKING SED IN THE NDT							
EYE EXAMINATION: SHADES OF GETHE INDIVIDUAL SHALL BE CAPABLE OF DISA HARD COPY OR ON THE COMPUTER SCRELIGHT CONDITIONS. THE PASSING GRADE IS I CONFIRM THAT THE CANDIDATE CAN METHOD(S) CONCERNED, AND/OR HAS	RAY STINGUISHING EEN AT A DIST IS A MINIMUM	S SHADES OF GR TANCE OF 30-50 20 OF 25 CORRE H CONTRAST E	AY ON "E cm (11 13 CT READ	EYE EXAMINATIOI /16" - 19 11/16") U INGS. N THE SHADES	N: SHADES OF NDER NORMA	L DESKTOP WORKING SED IN THE NDT							
EYE EXAMINATION: SHADES OF GETHE INDIVIDUAL SHALL BE CAPABLE OF DISA HARD COPY OR ON THE COMPUTER SCRELIGHT CONDITIONS. THE PASSING GRADE IS I CONFIRM THAT THE CANDIDATE CAN METHOD(S) CONCERNED, AND/OR HAS	RAY STINGUISHING EEN AT A DIST IS A MINIMUM	3 SHADES OF GETANCE OF 30-50 / 20 OF 25 CORRE H CONTRAST E	EAY ON "E cm (11 13; CT READ BETWEE NATION:	EYE EXAMINATIOI /16" - 19 11/16") U INGS. N THE SHADES	N: SHADES OF NDER NORMA OF GRAY US RAY" EITHER	L DESKTOP WORKING SED IN THE NDT							

EXAMINED AND / OR APPROVED BY:	TITLE:	LEVEL III	ASNT CERTIFICATE #	170794
William R.K. Land Ly	DATE:	01/10/2018	WILLIAM R.K. GOOLSBY	

DATE OF EYE EXAMINATION

01/10/2018



Engineering & Design • Field Support • Fabrication & Buildings • Construction Moors Parsonal, Boore Value, Blown Control. • Stace 1981

REPORT NO.: 140

NON-DESTRUCTIVE EXAMINATION REPORT

JOB NO	D.:	181	65	D	ATE: のう	- 22 -20	OISFACILITY: THE	YTOWN KATY	
							PART DESCRIPTION		
									REV. 18-1
CODE/A	ACCEPT CRI	TERIA:	ASME SE	CT. VIII. TRÉDIV	/ 1. 🗆 DIV	2 ASME	R31 3 SERVICE	- B31 4 D	B31.8 API-1104
AWS D	I I I CONN	ECTION	TYPE [] S	TAT LOADED!		LOADED A	IT IT TUBELLAD COM	. OTHER :	B31.8
MATER	INI - CO TOFO	c [] ot	шер. []		OUT	LOADED N	ID A CONTRACTOR	. OIMEN []:	
IVIATER	IAL. CO III O	s [] 01.	nen: U		SUF			ROUND CLEANED	
E	QUIP. DESC		1	MANUFACTURE	R	EQUIPME	MODEL NO.:	SERIAL NO.:	CAL DUE DATE
	YOKE		C	ontour Prob	ре		B100	11342	3/14/2019
LI	GHT METER			N/A			N/A	N/A	N/A
В	LACKLIGHT	_		N/A			N/A	N/A	N/A
	UT SCOPE		******	N/A			N/A	N/A	N/A
TR	ANSDUCER:	S		N/A			N/A	N/A	N/A
	CABLES			N/A			N/A	N/A	N/A
C	AL. BLOCKS			Parker			TB-10	11328	4/16/18
		CLI	EANER	PENETRANT		ONSUMAB		1	
MANUE	ACTURER	N/A	ZANCH	N/A	N/A	ELOPER	MAG. PARTICLE	CONTRAST PAINT	COUPLANT
	ND/TYPE	N/A		N/A	N/A N/A		Sherwin	Sherwin	N/A
	CH NO.	N/A		N/A	N/A		B.O. No. 1 727-D42	CP-2	N/A
	-	1 14/74		19/73		TECHNIQU		78-H-23	N/A
MT PT WA	☐ TYPE I F	UORES	CENT 🗆 T	YPE II VISIBLE	RADION A WATER OP TIME, LI	TETER MOD WASH, GHT INTEN	B LIPOPHILIC, C S	CAL DUE I	PHILIC
UT/ N/A	ST. BEA	M 🗆 AN	IGLE BEAM	☐ 45° ☐ 60° [ZE & FREQUENCY	O. >CAL DUED	ATE
VT/N/A	DIRECT.	REM	OTE BORE	SCOPE, 🗌 RE			NTENSITY	OCAL DUED	ATE:
					EXAMI	NATION RE	SULTS		
	INDICAT	ION CO	DES: NR =	NO RECORDAE	LE INDICAT	ION, L = LIN	NEAR INDICATIONS, C	= CRACK, NI = NO INI	DICATIONS
				ACC. /REJ.			RISTENCIL	REMARKS	
45 W	BRACKET		47	Acc	MI	1 Q			
1300K		R	4	ACC	NI	+1			
						1 .	t tha v		aprad NSPECTION
CERTIFIC	ATION								
TECHNICIA SIGNATURI		lita	u			LEVEL	-	/	05-22-2018 DATE
CLIENT SIGNATURE	-77- Sp					DATE			JOB HOURS



REPORT NO .: 127

NON-DESTRUCTIVE EXAMINATION REPORT

JOB NO	0.:	18165	DA	TE: 05 -	17-18	FACILITY: BA	YTOWN TKATY	
								SPARATOR
EXAMIN	IATION PERI	FORMED: MT	PT UT V	T PROCEDU	RE NO.:	5000		REV. 18-1
CODE/A	CCEPT CRIT	TERIA: ASME SE	CT. VIII 🖬 DIV.	. 1. DIV. 2	. ASME	B31.3, SERVICE	— . B31.4 ∏	B31.8
							N. OTHER :	
	_					_	ROUND CLEANED	
					QUIPME		HOOMS - OLLAND	CAT A COLUMN TO
E	QUIP. DESC.		MANUFACTURE	R		MODEL NO.:	SERIAL NO.:	CAL.DUE DATE
	YOKE		ontour Prob	е		B100	11342	3/14/2019
-	GHT METER		N/A			N/A	N/A	N/A
	LACKLIGHT		N/A			N/A	N/A	N/A
	UT SCOPE		N/A			N/A	N/A	N/A
TR	ANSDUCERS	3	N/A			N/A	N/A	N/A
	CABLES		N/A			N/A	N/A	N/A
С	AL. BLOCKS		Parker			TB-10	11328	4/16/18
	<u> </u>	CLEANER	PENETRANT		NSUMAB OPER	MAG. PARTICLE	CONTRAST PAINT	COLIDIANT
MANUE	FACTURER	N/A	N/A	N/A	OI LIT	Sherwin	Sherwin	COUPLANT
	ND/TYPE	N/A	N/A	N/A		B.O. No. 1	CP-2	N/A N/A
	CH NO.	N/A	N/A	N/A		727-D42	78-H-23	N/A
					ECHNIQL		70-11-23	I IV/A
UT/N/A	☐ ST. BEA	_ DWELL TIME,	DEVEL	RADIOME 70° TRANS MOTE VIDEO	HT INTER ETER MOI DUCER S D, LIGHT I	NSITY, SUDEL:, SERIAL NIZE & FREQUENCY NTENSITY	NO.:CAL DUE I	DATE:
	West of the second	Sana en porte de la company					O.:CAL. DUE I	DATE:
1.	INDICAT	TION CODES: NR =	NO RECORDAR		ATION RI	The second representation of	C = CRACK, NI = NO IN	DICATIONS
IDENTI		SIZE/THICKNESS						DICATIONS
	4-1						REMARKS	
	4-2	1404	ACC	HZ HZ				
					Re	H Si CATIO	B OF 145 WAS P BY GRAD SPECIED	rdo Add
CERTIFIC		* - 1				5.		
TECHNICI SIGNATUR	AN	11144	LEVEL		05 DATE	-17-18		
CLIENT SI	GNATURE		5					
					DATE		A SAMA SAMAN NO AND	IOR HOURS

Goolsby Testing, Inc.

Accepted by: Representative of:

2620 WILSON ROAD - P.O. BOX 1416

RADIOGRAPHY REPORT

GT TICKET/ORDER ID#: RT46 - 18 - 05 - 43236 - 4 -*-

This Box for GTL Office	
Use Only:	<u>.</u>

2620 WILSON ROAD - P.O.	BOX 1416							036	Olliy.			
HUMBLE, TX. 77347-1416								J/N#:	18165-9	P.O.	#: 1816566294	A.
PH:281.540.1255 FX:28:	1.540.8125							S/N#:	0	GT	#: 0	
Technician:	: JUSTIN REPP	46	Date:	05/16/18	Report:	04	REV#:		J/N#:	18165-9	S/N#:	
7			,						P.O.#:	18165662	9A GT#:	
Manufacturer:	MOORE CONTROL											
Diameter:	: 48.000 in.	Thickness	00.375 in.	Material Type:	CS	Weld Thickness:	00.475 in.	W	eld Reinforcment:	00.100 in.		
Source to Object (Min.):	: 24.000 in.	So	irce to Film (MAX.):	24.000 in.	Source sid	le of object to film:	00.475 in.		#Film in	assette: 1	ASME Req.:	UW-52 (Spot)
Wall Exposure:	: Single	Viewing	Single	Spec.:	ASME Section V	III Div.1	PED(97/23/EC):	N/A	Procedure #:	2000	Rev.:	18-1
Radiation:	: IR-192	Curies	26	Focal Size	00.160 in.	Film Mfg.:	Agfa			Film Typ	e: D7	-3
Voltage		Amperage:		Penetrameter Size:	B Pack		Placement:	Film Side	Shim Ti	nickness: N/A		
Markers:	: Film Side		Front Lead Screens:	0.005		Back Lead Screens:	0.005		Techniq	ue Used: D		
				7	Optional overtwo	Ä		7	Source	Å	A MAIN	
Capetore Artistants A	Espains Academ	fully and the second	Control of the Contro		Falor		Folion E approprio Mina	repartment f F4m	S spream at angument	General Control of the Control of th		
Capital Assertance A	Espaint Accommo			D	Folian Folian Folian D	<u> </u>	F F	Q	S agreement all all agreement	Casa Casa Casa Casa Casa Casa Casa Casa		

Radiographic Terms and Abbreviations

•BT-Burn Thru •BTA-Burn Thru Area •C-Crack •P-Porosity •NW-Narrow Weld •LC-Low Crown •FA-Film Artifacts •SI-Siag Inclusion •SI-Siag line •NE-Non Fusion •GP-Gas Pocket •III-Internal lindercut •OII-Outside lindercut •IP-Inadequate Penetration

Weld Number	Film Number	Interpretation	Remarks		Weld Number	Film Number	Interpretation	Remarks	1
C1 ·	1-2	Accepted	Q	1					1
				1					1
C2	1-2	Accepted	B1						1
]
						-			1
									1
						-		 	-
									1
						-			1
						+			1
						+			1
									1
				1					
									1
enneth L	Vithers)	Kennett	With 5-16-18	Date:	05/16/18	Level II Radiogra	pher:	JUSTIN REPP	
110000 /	70. 1-00.	C.11 ====	or training and			Level II Interpret	er:	JUSTIN REPP	And in column 2 is not a second

The results reported represent options only and are not to be considered as warranties or quaranties of quality classified or usability of material examined. In no event shall the liability of Goolsby Testing, Inc. as to any items inspected or tested (including any liability as to selection and/or results of such tests) exceed the charge of Goolsby Testing, Inc. for the inspection of such items. We shall assume no responsibility following the acceptance by the customer's field representative upon signing of field ticket.



RADIOGRAPHIC REPORT - Continued

Client: Pize Wedinx Date: Report No.: SIZE & WELD NO. PENT SFD DEFECT TYPE/SIZE WELDER LOCATION REMARKS THICKNESS 36,48 70 2 U 2 5 (0 8 9 11 F 3 12 U 5 0 6 8 9 10 TECHNICIAN: LEVEL ASST: LEVEL CLIENT REPRESENTATIVE & & B. ito PEREZ LEVEL DATE:

Signature certifies time & material correct

Diamond G Inspection, Inc. assumes no responsibility for losses of any kind due to interpretation. Radiography produces two dimensional images only and cannot tell depth.



RADIOGRAPHIC REPORT - Continued

Client: Date: Report No.: DEFECT TYPE/SIZE WELDER WELD NO. LOCATION PENT SFD REMARKS THICKNESS YES TECHNICIAN: LEVEL LEVEL CLIENT REPRESENTATIVE: DATE: LEVEL Signature certifies time & material correct

Diamond G Inspection, Inc. assumes no responsibility for losses of any kind due to interpretation. Radiography produces two dimensional images only and cannot tell depth.



Katy: 1435 Katy Flewellen

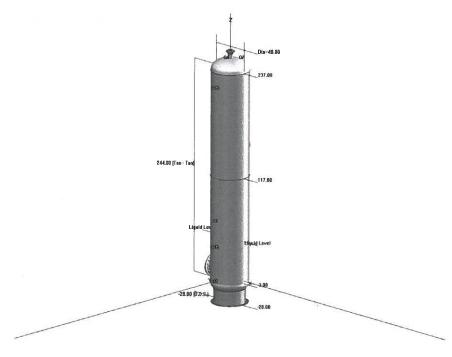
Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 6 ASME CODE CALCULATIONS

Moore Control Systems, Inc.

1435 Katy Flewellen



COMPRESS Pressure Vessel Design Calculations

Vessel No.: VERTICAL 2-PHASE SEPARATOR

Job: 18165

Customer: Marathon Oil

P.O.: 181656011A

Designer: L. Rodriguez

Date: January 20, 2018

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

ISSUED FOR APPROVAL

MCSI #: 18165 DATE: 1/29/18

Table of Contents

Revision History	1
Settings Summary	2
Pressure Summary	4
Nozzle Schedule	6
Nozzle Summary	7
Thickness Summary	8
Weight Summary	9
Hydrostatic Test	10
Wind Code	11
Seismic Code	15
TOP HEAD.	18
Straight Flange on TOP HEAD.	20
SHELL RG 2	29
SHELL RG 1	39
Straight Flange on BOTTOM HEAD.	49
BOTTOM HEAD.	59
Support Skirt #1	61
Skirt Base Ring #1	70
INLET (C1)	81
WATER OUTLET (C2)	87
GAUGE GLASS (C3B)	91
GAUGE GLASS (C3A).	95
SUPPLY GAS (C4).	99
DRAIN (C5)	103
GAS OUTLET (C6)	107
SAFETY HEAD (C7)	115
PI (C8)	119

Table of Contents

WATER LLC (C10).	123
RELIEF (C13)	127
WATER LEVEL LOW (C14)	131
OIL LEVEL HIGH (C15)	135
MANWAY (M1)	139
Liquid Level	
LIFTING LUG	148

Revision History

	Revisions						
No.	Date	Operator	Notes				
0	1/20/2018	KDG4	ISSUED FOR APPROVAL				

Settings Summary

COMPRESS 2018 Build 780	0
ASME Section VIII Division 1, 2017	Zedition
Units	U.S. Customary
Datum Line Location	3.00" from bottom seam
Vessel Design Mode	Design Mode
Minimum thickness	0.0625" per UG-16(b)
Design for cold shut down only	No
Design for lethal service (full radiography required)	No
Design nozzles for	Design P only
Corrosion weight loss	100% of theoretical loss
UG-23 Stress Increase	1.20
Skirt/legs stress increase	1.0
Minimum nozzle projection	1"
Juncture calculations for $\alpha > 30$ only	Yes
Preheat P-No 1 Materials > 1.25" and <= 1.50" thick	No
UG-37(a) shell tr calculation considers longitudinal stress	No
Cylindrical shells made from pipe are entered as minimum thickness	No
Nozzles made from pipe are entered as minimum thickness	No
ASME B16.9 fittings are entered as minimum thickness	No
Butt welds	Tapered per Figure UCS-66.3(a)
Disallow Appendix 1-5, 1-8 calculations under 15 psi	No
Hydro/Pneumatic Test	
Shop Hydrotest Pressure	1.3 times vessel MAWP [UG-99(b)]
Test liquid specific gravity	1.00
Maximum stress during test	90% of yield
Required Marking - UG-116	
UG-116(e) Radiography	RT4
UG-116(f) Postweld heat treatment	None
Code Cases\Interpretations	
Use Code Case 2547	No
Use Code Case 2695	No
Apply interpretation VIII-1-83-66	Yes
Apply interpretation VIII-1-86-175	Yes
Apply interpretation VIII-1-01-37	Yes

MOVED TO THE PROPERTY OF THE P
Yes
No
No
No
No
Yes
Yes
No
Yes
Yes
Yes
No
THE RESERVE THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TO THE PERSON NAMED IN CO

License Information						
Company Name	King Design Group					
License	Commercial					
License Key ID	24086					
Support Expires	April 21, 2018					

Pressure Summary

Component Summary							
ldentifier	P Design (psi)	T Design (°F)	MDMT (°F)	000000000000000000000000000000000000000	OMT nption	Impact Tested	
TOP HEAD	250	150	-40.4	No	ite 1	No	
Straight Flange on TOP HEAD	250	150	-40.4	No	ite 2	No	
SHELL RG 2	250	150	-40.5	No	ite 3	No	
SHELL RG 1	250	150	-39.9	No	ite 4	No	
Straight Flange on BOTTOM HEAD	250	150	-39.8	No	ite 6	No	
BOTTOM HEAD	250	150	-39.8	No	te 5	No	
INLET (C1)	250	150	-32.3	Note 7		No	
WATER LLC (C10)	250	150	-155	Note 8		No	
RELIEF (C13)	250	150	-155	Note 8		No	
WATER LEVEL LOW (C14)	250	150	-155	Note 9		No	
OIL LEVEL HIGH (C15)	250	150	-155	No	te 8	No	
WATER OUTLET (C2)	250	150	-155	No	te 10	No	
GAUGE GLASS (C3A)	250	150	-155	No	te 11	No	
GAUGE GLASS (C3B)	250	150	-155	No	te 12	No	
SUPPLY GAS (C4)	250	150	-34	No	te 13	No	
DRAIN (C5)	250	150	-155	No	te 14	No	
GAS OUTLET (C6)	250	150	-32.3	Nozzle	Note 7	No	
	200	100	02.0	Pad	Note 15	No	
SAFETY HEAD (C7)	250	150	-155	No	te 8	No	
PI (C8)	250	150	-155	No	te 12	No	
MANWAY (M1)	250	150	-31.8	Nozzle	Note 16	No	
				Pad	Note 17	No	

Chamber Summary						
Design MDMT	-20 °F					
Rated MDMT	-31.8 °F @ 250 psi					
MAWP hot & corroded	250 psi					

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

	Notes for MDMT Rating	
Note #	Exemption	Details
1.	Straight Flange governs MDMT	
2.	Material impact test exemption temperature from Fig UCS-66 Curve B = -20°F Fig UCS-66.1 MDMT reduction = 20.4°F, (coincident ratio = 0.796)	UCS-66 governing thickness = 0.375 in
3.	Material impact test exemption temperature from Fig UCS-66 Curve B = -20°F Fig UCS-66.1 MDMT reduction = 20.5°F, (coincident ratio = 0.7953)	UCS-66 governing thickness = 0.375 in
4.	Material impact test exemption temperature from Fig UCS-66 Curve B = -20°F Fig UCS-66.1 MDMT reduction = 19.9°F, (coincident ratio = 0.8008)	UCS-66 governing thickness = 0.375 in
5.	Straight Flange governs MDMT	
6.	Material impact test exemption temperature from Fig UCS-66 Curve B = -20°F Fig UCS-66.1 MDMT reduction = 19.8°F, (coincident ratio = 0.8017)	UCS-66 governing thickness = 0.375 in
7.	Flange rating governs: 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	
8.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.0479).	
9.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.0481).	
10.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.0592).	
11.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.0161).	
12.	Nozzle is impact test exempt to -155°F per UCS-66(b)(3) (coincident ratio = 0.016).	
13.	Nozzle impact test exemption temperature from Fig UCS-66 Curve B = -20°F Fig UCS-66.1 MDMT reduction = 14°F, (coincident ratio = 0.8597)	UCS-66 governing thickness = 0.3125 in.
14.	Nozzle is impact test exempt per UCS-66(d) (NPS 4 or smaller pipe).	
15.	Pad impact test exemption temperature from Fig UCS-66 Curve B = -20°F Fig UCS-66.1 MDMT reduction = 14°F, (coincident ratio = 0.8597)	UCS-66 governing thickness = 0.375 in.
16.	Flange rating governs: Flange rated MDMT per UCS-66(b)(1)(b) = -31.8°F (Coincident ratio = 0.8818) Bolts rated MDMT per Fig UCS-66 note (c) = -55°F	
17.	Pad impact test exemption temperature from Fig UCS-66 Curve B = -20°F Fig UCS-66.1 MDMT reduction = 19.9°F, (coincident ratio = 0.8011)	UCS-66 governing thickness = 0.375 in.

Nozzle Schedule

				Specifications					
Nozzle mark	dentifier	Size		Materials	Impact Tested	Normalized	Fine Grain	Flange	Blind
<u>C1</u>	INLET	NPS 6 Sch 80 (XS)	Nozzle	SA-106 B Smls pipe	No	No	No	NPS 6 Class 150 WN A105	No
<u>C10</u>	WATER LLC	NPS 2 Class 3000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>C13</u>	RELIEF	NPS 2 Class 3000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>C14</u>	WATER LEVEL LOW	NPS 2 Class 3000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>C15</u>	OIL LEVEL HIGH	NPS 2 Class 3000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>C2</u>	WATER OUTLET	NPS 3 Class 3000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>C3A</u>	GAUGE GLASS	NPS 0.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>C3B</u>	GAUGE GLASS	NPS 0.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>C4</u>	SUPPLY GAS	NPS 0.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>C5</u>	DRAIN	NPS 2 Sch 80 (XS)	Nozzle	SA-106 B Smls pipe	No	No	No	N/A	No
<u>C6</u>	GAS OUTLET	NPS 6 Sch 80 (XS)	Nozzle	SA-106 B Smls pipe	No	No	No	NPS 6 Class 150 WN A105	No
			Pad	SA-516 70	No	No	No		
<u>C7</u>	SAFETY HEAD	NPS 2 Class 3000 - threaded	Nozzie	SA-105	No	No	No	N/A	No
<u>C8</u>	PI	NPS 0.5 Class 6000 - threaded	Nozzle	SA-105	No	No	No	N/A	No
<u>M1</u>	MANWAY	NPS 18 Sch 80	Nozzle	SA-106 B Smls pipe	No	No	No	NPS 18 Class 150	NPS 18 Class 150
			Pad	SA-516 70	No	No	No	SO A105	A105

Nozzle Summary

						Dimens	ions					
Nozzie	OD	t _n	Req t _n	A ₁ ?	A2?	Shell		Pad		Corr	A _a /A _r	
mark	(in)	(in)	(in)	At.	A2.	Nom t (in)	Design t	User t	Width (in)	t _{pad} (in)	(in)	(%)
<u>C1</u>	6.625	0.432	0.28	Yes	Yes	0.375	0.2985		N/A	N/A	0	106.3
<u>C10</u>	3	0.3125	0.0625	Yes	Yes	0.375	N/A		N/A	N/A	0	Exemp
<u>C13</u>	3	0.3125	0.0625	Yes	Yes	0.375	N/A		N/A	N/A	0	Exemp
<u>C14</u>	3	0.3125	0.0625	Yes	Yes	0.375	N/A		N/A	N/A	0	Exemp
<u>C15</u>	3	0.3125	0.0625	Yes	Yes	0.375	N/A		N/A	N/A	0	Exemp
<u>C2</u>	4.25	0.375	0.0625	Yes	Yes	0.375	N/A		N/A	N/A	0	Exemp
C3A	1.5	0.33	0.0625	Yes	Yes	0.375	N/A		N/A	N/A	0	Exemp
<u>C3B</u>	1.5	0.33	0.0625	Yes	Yes	0.375	N/A		N/A	N/A	0	Exemp
<u>C4</u>	1.5	0.33	0.0625	Yes	Yes	0.3125*	N/A		N/A	N/A	0	Exemp
<u>C5</u>	2.375	0.218	0.154	Yes	Yes	0.3125*	N/A		N/A	N/A	0	Exemp
<u>C6</u>	6.625	0.432	0.28	Yes	Yes	0.3125*	0.2687		2	0.375	0	180.5
<u>C7</u>	3	0.3125	0.0625	Yes	Yes	0.3125*	N/A		N/A	N/A	0	Exemp
<u>C8</u>	1.5	0.33	0.0625	Yes	Yes	0.375	N/A		N/A	N/A	0	Exemp
<u>M1</u>	18	0.938	0.1368	Yes	Yes	0.375	0.3004		2	0.375	0	109.9

	Definitions
tn	Nozzle thickness
Req tn	Nozzle thickness required per UG-45/UG-16 Increased for pipe to account for 12.5% pipe thickness tolerance
Nom t	Vessel wall thickness
Design t	Required vessel wall thickness due to pressure + corrosion allowance per UG-37
User t	Local vessel wall thickness (near opening)
Aa	Area available per UG-37, governing condition
Ar	Area required per UG-37, governing condition
Corr	Corrosion allowance on nozzle wall

Thickness Summary

	Com	ponent Da	ita				
Material	Diameter (in)	Length (in)	Nominal t	Design t	Total Corrosion (in)	Joint E	Load
SA-516 70	48 OD	12.1563	0.3125*	0.2967	0	1.00	Internal
SA-516 70	48 OD	2	0.375	0.2986	0	1.00	Internal
SA-516 70	48 OD	120	0.375	0.3509	0	0.85	Internal
SA-516 70	48 OD	120	0.375	0.3533	0	0.85	Internal
SA-516 70	48 OD	2	0.375	0.3007	0	1.00	Internal
SA-516 70	48 OD	12.1563	0.3125*	0.2993	0	1.00	Internal
SA-516 70	40 OD	16.17	0.25	0.0156	0	0.55	Seismic
	SA-516 70 SA-516 70 SA-516 70 SA-516 70 SA-516 70 SA-516 70	Material Diameter (In) SA-516 70 48 OD SA-516 70 48 OD	Material Diameter (in) Length (in) SA-516 70 48 OD 12.1563 SA-516 70 48 OD 2 SA-516 70 48 OD 120 SA-516 70 48 OD 120 SA-516 70 48 OD 2 SA-516 70 48 OD 2 SA-516 70 48 OD 12.1563	Material (In) (In) (In) SA-516 70 48 OD 12.1563 0.3125* SA-516 70 48 OD 2 0.375 SA-516 70 48 OD 120 0.375 SA-516 70 48 OD 120 0.375 SA-516 70 48 OD 2 0.375 SA-516 70 48 OD 2 0.375 SA-516 70 48 OD 12.1563 0.3125*	Material Diameter (in) Length (in) Nominal t (in) Design t (in) SA-516 70 48 OD 12.1563 0.3125* 0.2967 SA-516 70 48 OD 2 0.375 0.2986 SA-516 70 48 OD 120 0.375 0.3509 SA-516 70 48 OD 120 0.375 0.3533 SA-516 70 48 OD 2 0.375 0.3007 SA-516 70 48 OD 12.1563 0.3125* 0.2993	Material Diameter (in) Length (in) Nominal t (in) Design t (in) Total Corrosion (in) SA-516 70 48 OD 12.1563 0.3125* 0.2967 0 SA-516 70 48 OD 2 0.375 0.2986 0 SA-516 70 48 OD 120 0.375 0.3509 0 SA-516 70 48 OD 120 0.375 0.3533 0 SA-516 70 48 OD 2 0.375 0.3007 0 SA-516 70 48 OD 12.1563 0.3125* 0.2993 0	Material Diameter (in) Length (in) Nominal t (in) Design t (in) Total Corrosion (in) Joint E SA-516 70 48 OD 12.1563 0.3125* 0.2967 0 1.00 SA-516 70 48 OD 2 0.375 0.2986 0 1.00 SA-516 70 48 OD 120 0.375 0.3509 0 0.85 SA-516 70 48 OD 120 0.375 0.3533 0 0.85 SA-516 70 48 OD 2 0.375 0.3007 0 1.00 SA-516 70 48 OD 12.1563 0.3125* 0.2993 0 1.00

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

Weight Summary

			Wei	ght (lb) Cont	ributed I	y Vessel I	Elements				
Component	Metal	Metal		Insulation		Piping	Operating Liquid		Test Liquid		Surface Area
Component	New*	Corroded	Insulation	Supports	Lining	+ Liquid	New	Corroded	New	Corroded	ft²
TOP HEAD	260.4	260.4	0	0	0	0	0	0	633.5	633.5	21
SHELL RG 2	1,901	1,901	0	0	0	0	0	0	7,597.8	7,597.8	125
SHELL RG 1	1,874.1	1,874.1	0	0	0	0	3,076.2	3,076.2	7,633.5	7,633.5	124
BOTTOM HEAD	263.8	263.8	0	0	0	0	629.3	629.3	629.3	629.3	21
Support Skirt #1	138.4	138.4	0	0	0	0	0	0	0	0	28
Skirt Base Ring #1	108	108	0	0	0	0	0	0	0	0	11
TOTAL:	4,545.6	4,545.6	0	0	0	0	3,705.5	3,705.5	16,494.1	16,494.1	331

				Weight (I	b) Contrit	outed by Atta	chment	s				
Component	Rody Flandes		1-CCCCCSTepular	zzles & langes	Packed Beds		IIIavs	Tray Supports	Rings & Clips	Vertical Loads	Surface Area	
	New	Corroded	New	Corroded	Dodd	Deas	Platforms		Cupports	Olips	Louds	
TOP HEAD	0	0	46.4	46.4	0	0	0	0	0	0	2	
SHELL RG 2	0	0	38.6	38.6	0	0	0	0	0	0	2	
SHELL RG 1	0	0	518.2	518.2	0	0	0	0	0	0	8	
BOTTOM HEAD	0	0	1.1	1.1	0	0	0	0	0	0	0	
Support Skirt #1	0	0	0	0	0	0	0	0	0	0	0	
TOTAL:	0	0	604.4	604.4	0	0	0	0	0	0	13	

Vessel ⁻	Totals	
	New	Corroded
Operating Weight (lb)	8,856	8,856
Empty Weight (lb)	5,150	5,150
Test Weight (lb)	21,644	21,644
Surface Area (ft²)	344	-
Capacity** (US gal)	1,973	1,973

^{**}The vessel capacity does not include volume of nozzle, piping or other attachments.

Vessel Lift Condition	
Vessel Lift Weight, New (lb)	5,150
Center of Gravity from Datum (in)	101.5514

Hydrostatic Test

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

Gauge pressure at 70°F

1.3*MAWP*LSR

= 1.3*250*1

= 325 psi

Horiz	Horizontal shop hydrostatic test						
ldentifier	Local test pressure (psi)	Test liquid static head (psi)	UG-99(b) stress ratio	UG-99(b) pressure factor			
TOP HEAD (1)	326.71	1.71	1	1.30			
Straight Flange on TOP HEAD	326.708	1.708	1	1.30			
SHELL RG 2	326.708	1.708	1	1.30			
SHELL RG 1	326.708	1.708	1	1.30			
Straight Flange on BOTTOM HEAD	326.708	1.708	1	1.30			
BOTTOM HEAD	326.71	1.71	1	1.30			
DRAIN (C5)	325.89	0.89	1	1.30			
GAS OUTLET (C6)	325.959	0.959	1	1.30			
GAUGE GLASS (C3A)	326.504	1.504	1	1.30			
GAUGE GLASS (C3B)	326.504	1.504	1	1.30			
INLET (C1)	325.959	0.959	1	1.30			
MANWAY (M1)	326.938	1.938	1	1.30			
OIL LEVEL HIGH (C15)	326.343	1.343	1	1.30			
PI (C8)	325.87	0.87	1	1.30			
RELIEF (C13)	325.898	0.898	1	1.30			
SAFETY HEAD (C7)	325.898	0.898	1	1.30			
SUPPLY GAS (C4)	325.87	0.87	1	1.30			
WATER LEVEL LOW (C14)	326.343	1.343	1	1.30			
WATER LLC (C10)	325.898	0.898	1	1.30			
WATER OUTLET (C2)	325.918	0.918	1	1.30			

The field test condition has not been investigated.

The test temperature of 70 °F is warmer than the minimum recommended temperature of -1.8 °F so the brittle fracture provision of UG-99(h) has been met.

⁽¹⁾ TOP HEAD limits the UG-99(b) stress ratio.(2) The zero degree angular position is assumed to be up, and the test liquid height is assumed to the top-most flange.

Wind Code

Building	g Code: ASCE 7-10		
Elevation of base above grad	1.00 ft		
Increase effective outer diam	eter by	1.00 ft	
Wind Force Coefficient, Cf		0.7000	
Risk Category (Table 1.5-1)		Ш	
Basic Wind Speed, V		115.00 mph	
Exposure Category		В	
Wind Directionality Factor, K	d	0.9500	
Top Deflection Limit	6.00 in. per 100 ft.		
Topographic Factor, Kzt	1.0000		
Enforce min. loading of 16 ps	Yes		
Hazardous, toxic, or explosiv	e contents	No	
Vesse	el Characteristics		
Height, h		23.2628 ft	
Minimum Diameter, b	Operating, Corroded	4.0000 ft	
William Diamotor, D	Empty, Corroded	4.0000 ft	
Fundamental Frequency, n,	Operating, Corroded	19.9582 Hz	
i anadinomari roquonoy, n	Empty, Corroded	20.1052 Hz	
Damping coefficient, β	Operating, Corroded	0.0250	
Daniping docinolont, p	Empty, Corroded	0.0200	

Table Lookup Values

Load combi	nations considered in accordance with ASCE section 2.4.1:
5.	$D + P + P_s + 0.6W$
7.	$0.6D + P + P_s + 0.6W$
	Parameter Description
D	= Dead load
P	= Internal or external pressure load
P_s	= Static head load
W	= Wind load

Wind Deflection Reports:

Operating, Corroded
Empty, Corroded
Wind Pressure Calculations

Wind Deflection Report: Operating, Corroded								
Component	Elevation of Bottom above Base (in)	Effective OD (ft)	Elastic Modulus E (106 psi)	Inertia I (ft ⁴)	Platform Wind Shear at Bottom (lb _f)	Total Wind Shear at Bottom (lb _f)	Bending Moment at Bottom (lb _F ft)	Deflection at Top (in)
TOP HEAD	264.9979	5.00	29.0	*	0	48	30	0.0093
SHELL RG 2	144.9979	5.00	29.0	0.7672	0	528	2,998	0.0087
SHELL RG 1	24.9979	5.00	29.0	0.7672	0	1,008	11,862	0.0039
BOTTOM HEAD (top)	16.17	5.00	29.0	*	0	1,042	12,617	0.0003
Support Skirt #1	0	4.33	29.0	0.2974	0	1,098	14,059	0.0001

Wind Deflection Report: Empty, Corroded									
Component	Elevation of Bottom above Base (in)	Effective OD (ft)	Elastic Modulus E (10 ⁶ psi)	Inertia I (ft ⁴)	Platform Wind Shear at Bottom (lb _f)	Total Wind Shear at Bottom (lb _f)	Bending Moment at Bottom (lb _f -ft)	Deflection at Top (in)	
TOP HEAD	264.9979	5.00	29.4	*	0	48	30	0.0092	
SHELL RG 2	144.9979	5.00	29.4	0.7672	0	528	2,998	0.0086	
SHELL RG 1	24.9979	5.00	29.4	0.7672	0	1,008	11,862	0.0038	
BOTTOM HEAD (top)	16.17	5.00	29.4	*	0	1,042	12,617	0.0003	
Support Skirt #1	0	4.33	29.4	0.2974	0	1,098	14,059	0.0001	

Wind Pressure (WP) Calculations

Gust Factor (G⁻) Calculations

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

 $= 2.01 * (Z/1,200.00)^{0.2857}$

 $qz = 0.00256 * Kz * Kzt * Kd * <math>V^2$

= 0.00256 * Kz * 1.0000 * 0.9500 * 115.0000²

= 32.1632 * Kz

WP = 0.6 * max[qz * \underline{G} * \underline{Cf} , 16 lb/ft²]

= 0.6 * max[qz * <u>G</u> * 0.7000, 16 lb/ft²]

Design Wind Pressures								
Height Z	Kz	sf)						
(')		(psf)	Operating	Empty	Hydrotest New	Hydrotest Corroded	Vacuum	
15.0	0.5747	18.48	9.60	9.60	N.A.	N.A.	N.A.	
20.0	0.6240	20.07	9.60	9.60	N.A.	N.A.	N.A.	
25.0	0.6650	21.39	9.60	9.60	N.A.	N.A.	N.A.	

Gust Factor Calculations

Operating, Corroded Empty, Corroded

Gust Factor Calculations: Operating, Corroded

Vessel is considered a rigid structure as $n_1 = 19.9582 \text{ Hz} \ge 1 \text{ Hz}$.

$$\begin{split} z^- &= max[\ 0.60 * \underline{h} \ , \underline{z_{min}} \] \\ &= max[\ 0.60 * 23.2628 \ , \ 30.0000 \] \\ &= 30.0000 \\ I_{z^-} &= \underline{c} * (33 \ / \ z^-)^{1/6} \\ &= 0.3000 * (33 \ / \ 30.0000)^{1/6} \\ &= 0.3048 \\ L_{z^-} &= \underbrace{I} * (z^- \ / \ 33)^{ep} \\ &= 320.0000 * (30.0000 \ / \ 33)^{0.3333} \\ &= 309.9934 \\ Q &= Sqr(1 \ / \ (1 + 0.63 * ((\underline{b} + \underline{h}) \ / \ L_{z^-})^{0.63})) \\ &= Sqr(1 \ / \ (1 + 0.63 * ((4.0000 + 23.2628) \ / \ 309.9934)^{0.63})) \\ &= 0.9381 \\ G &= 0.925 * (1 + 1.7 * \underbrace{g_Q} * I_{z^-} * Q) \ / \ (1 + 1.7 * \underbrace{g_W} * I_{z^-}) \\ &= 0.925 * (1 + 1.7 * 3.40 * 0.3048 * 0.9381) \ / \ (1 + 1.7 * 3.40 * 0.3048) \\ &= 0.8885 \end{split}$$

Gust Factor Calculations: Empty, Corroded

Vessel is considered a rigid structure as n_1 = 20.1052 Hz ≥ 1 Hz.

$$\begin{split} z^- &= max[\ 0.60 * \underline{h}\ , \underline{z}_{min}\] \\ &= max[\ 0.60 * 23.2628\ , 30.0000\] \\ &= 30.0000 \\ I_{z^-} &= \underline{c}\ * (33\ / z^-)^{1/6} \\ &= 0.3000\ * (33\ / 30.0000)^{1/6} \\ &= 0.3048 \\ L_{z^-} &= \underline{l}\ * (z^-\ / 33)\underline{ep} \\ &= 320.0000\ * (30.0000\ / 33)^{0.3333} \\ &= 309.9934 \\ Q &= Sqr(1\ / (1+0.63\ * ((\underline{b}+\underline{h})\ / L_{z^-})^{0.63})) \end{split}$$

$$= Sqr(1 / (1 + 0.63 * ((4.0000 + 23.2628) / 309.9934)^{0.63}))$$

$$= 0.9381$$
G = 0.925 * (1 + 1.7 * g_Q * I_z - * Q) / (1 + 1.7 * g_v * I_z -)
$$= 0.925 * (1 + 1.7 * 3.40 * 0.3048 * 0.9381) / (1 + 1.7 * 3.40 * 0.3048)$$

$$= 0.8885$$

Table Lookup Values	;
$\alpha = 7.0000$, $z_g = 1,200.00$ ft	[Table 26.9-1, page 256]
c = 0.3000, I = 320.0000, ep = 0.3333	[Table 26.9-1, page 256]
a ⁻ = 0.2500, b ⁻ = 0.4500	[Table 26.9-1, page 256]
z _{min} = 30.0000 ft	[Table 26.9-1, page 256]
$g_Q = 3.40$	[26.9.4 page 254]
$g_v = 3.40$	[26.9.4 page 254]

Seismic Code

Building Cod	de: ASCE 7-10 ground	d supported
Site Class		С
Importance Factor, I _e		1.0000
Spectral Response Acce period (% g), S _s	75.00%	
Spectral Response Acce 1 sec (% g), S ₁	75.00%	
Response Modification (Table 15.4-2, R	3.0000	
Acceleration-based Site	1.1000	
Velocity-based Site Coef	1.3000	
Long-period Transition F	12.0000	
Redundancy factor, ρ		1.0000
Risk Category (Table 1.5	-1)	III
User Defined Vertical Ac Considered	celerations	No
Hazardous, toxic, or exp	losive contents	No
V	essel Characteristics	
Heigh	nt	23.2628 ft
Weight	Operating, Corroded	8,856 lb
	Empty, Corroded	5,150 lb
Perio	d of Vibration Calcula	ition
Fundamental Period, T	Operating, Corroded	0.050 sec (f = 20.0 Hz)
	Empty, Corroded	0.050 sec (f = 20.1 Hz)

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

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

 $\mathbf{W_i}$ is the weight of the ith lumped mass, and $\mathbf{y_i}$ is its deflection when the system is treated as a cantilever beam.

	12.4.2.3 Basic Load Co	mbinations for	Allowable Stress Design				
L	Load combinations considered in accordance with ASCE section 2.4.1:						
5.	$D + P + P_s + 0.7E$	= (1.0 + 0.145	G_{DS}) $D + P + P_s + 0.7 \rho Q_E$				
8.	$0.6D + P + P_s + 0.7E = (0.6 - 0.14S_{DS})D + P + P_s + 0.7\rho Q_E$						
	Par	rameter descri	otion				
D	= Dead load						
P	= Internal or external pressure load						
P_s	Static head load						
Ε	= Seismic load	$= E_h + / - E_v$	$= \rho Q_E + -0.2 S_{DS} D$				

Seismic Shear Reports:

Operating, Corroded
Empty, Corroded
Base Shear Calculations

Seismic Shear Report: Operating, Corroded						
Component	Elevation of Bottom above Base (in)	Elastic Modulus E (106 psi)	Inertia I (ft ⁴)	Seismic Shear at Bottom (lb _f)	Bending Moment at Bottom (lb _f -ft)	
TOP HEAD	264.9979	29.0	*	103	74	
SHELL RG 2	144.9979	29.0	0.7672	592	3,856	
SHELL RG 1	24.9979	29.0	0.7672	999	12,645	
BOTTOM HEAD (top)	16.17	29.0	* 1911	1,017	13,388	
Support Skirt #1	0	29.0	0.2974	1,023	14,764	
terren A. S. mar est programme in S. H. S. Sept. M. F.	*Moment of Ine	rtia I varies over the le	ngth of the	· · · · · · · · · · · · · · · · · · ·		

Seismic Shear Report: Empty, Corroded						
Component	Elevation of Bottom above Base (in)	Elastic Modulus E (106 psi)	Inertia I (ft ⁴)	Seismic Shear at Bottom (lb _f)	Bending Moment at Bottom (lb _f -ft)	
TOP HEAD	264.9979	29.4	*	75	55	
SHELL RG 2	144.9979	29.4	0.7672	429	2,816	
SHELL RG 1	24.9979	29.4	0.7672	589	9,194	
BOTTOM HEAD (top)	16.17	29.4	*	592	9,628	
Support Skirt #1	0	29.4	0.2974	595	10,429	
	*Moment of Ine	rtia I varies over the le	ngth of the	component		

11.4.3: Maximum considered earthquake spectral response acceleration

The maximum considered earthquake spectral response acceleration at short period, S_{MS} $S_{MS} = \frac{F_e}{S_o} * \frac{S_o}{S_o} = 1.1000 * 75.00 / 100 = 0.8250$ The maximum considered earthquake spectral response acceleration at 1 s period, S_{M1}

 $S_{M1} = F_{\downarrow} * S_{\downarrow} = 1.3000 * 75.00 / 100 = 0.9750$

11.4.4: Design spectral response acceleration parameters

Design earthquake spectral response acceleration at short period, S_{DS} S_{DS} = 2 / 3 * S_{MS} = 2 / 3 * 0.8250 = 0.5500

Design earthquake spectral response acceleration at 1 s period, S_{D1}

 $S_{D1} = 2/3 * S_{M1} = 2/3 * 0.9750 = 0.6500$

11.6 Seismic Design Category

The Risk Category is III.

The mapped spectral response acceleration parameter at 1-s period, S_1 is 75.00.

This vessel is assigned to Seismic Design Category E.

12.4.2.3: Seismic Load Combinations: Vertical Term

Factor is applied to dead load.

Compressive Side: = $1.0 + 0.14 * S_{DS}$

= 1.0 + 0.14 * 0.5500

= 1.0770

Tensile Side:

 $= 0.6 - 0.14 * S_{DS}$

= 0.6 - 0.14 * 0.5500

= 0.5230

Base Shear Calculations

Operating, Corroded

Empty, Corroded

Base Shear Calculations: Operating, Corroded

Paragraph 15.4.2: \underline{T} < 0.06, so:

 $V = 0.30 * S_{DS} * W * I_{D}$

= 0.30 * 0.5500 * 8,855.5361 * 1.0000

= 1,461.16 lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E,

 $Q_{E} = V$

 $E_h = 0.7 * \rho * Q_E$ (Only 70% of seismic load considered as per Section 2.4.1)

= 0.7 * 1.0000 * 1,461.16

= 1,022.81 lb

Base Shear Calculations: Empty, Corroded

Paragraph 15.4.2: \underline{T} < 0.06, so:

$$V = 0.30 * S_{DS} * W * I_{e}$$

= 0.30 * 0.5500 * 5,150.0630 * 1.0000

= 849.76 lb

12.4.2.1 Seismic Load Combinations: Horizontal Seismic Load Effect, E_h

$$Q_{\scriptscriptstyle \square} = V$$

 $E_h = 0.7 * \rho * Q_E$ (Only 70% of seismic load considered as per Section 2.4.1)

= 0.7 * 1.0000 * 849.76

= 594.83 lb

TOP HEAD

	ASME	E Section VIII Div	vision 1, 2017 Editio	n			
Com	ponent	Ellipsoidal Head SA-516 70 (II-D p. 18, ln. 33)					
Ma	terial						
Attac	hed To		SHELL RG 2				
Impact Tested	Normalized	Fine Grain Practice	PWHT	Optimize MDMT/ Find MAWP			
No	No	No	No	No			
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)			
Internal		250	150	-20			
		Static Liq	uid Head				
Condition		P _s (psi)	H _s (in)	SG			
Test horizontal		1.71	47.375	1			
		Dimen	sions				
Outer l	Diameter		48"				
Head	d Ratio	2					
Minimum	Thickness	0.3125"					
Corrosion	Inner	0"					
	Outer	0"					
Len	gth L _{sf}		2"				
Nominal T	hickness t _{sf}	0.375"					
		Weight and	d Capacity				
		Weig	ght (lb) ¹	Capacity (US gal) ¹			
N	lew	20	60.36	75.43			
Cor	roded	20	60.36	75.43			
		Radiog	raphy				
Categor	y A joints		Seamless No RT	-			
Head to	shell seam	S	Spot UW-11(a)(5)(b) T	ype 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)	0.2967"				
Straight Flange governs MDMT	-40.4°F				

	Factor K	
K = (1/6)*[2 + (D / (2*h)) ²]	
Corroded	$K = (1/6)^{*}[2 + (47.375 / (2^{*}11.8438))^{2}]$	1
New	$K = (1/6)^{*}[2 + (47.375 / (2^{*}11.8438))^{2}]$	1

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

- $\begin{array}{lll} t & = & P^*D_0^*K \, / \, (2^*S^*E + 2^*P^*(K 0.1)) + Corrosion \\ & = & 250^*48^*1 \, / \, (2^*20,000^*1 + 2^*250^*(1 0.1)) + 0 \end{array}$
- = <u>0.2967</u>" % Extreme fiber elongation - UCS-79(d)

 $EFE = (75*t / R_f)*(1 - R_f / R_o)$

 $= (75*0.375 / 8.2413)*(1 - 8.2413 / \infty)$

= 3.4127%

The extreme fiber elongation does not exceed 5%.

Straight Flange on TOP HEAD

	ASME	Section VIII Div	ision 1, 2017 Editior	1				
Com	ponent	Cylinder						
Material		SA-516 70 (II-D p. 18, ln. 33)						
Impact Tested	Normalized	Fine Grain Practice	Optimize MDMT/ Find MAWP					
No	No	No	No	No				
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)				
Inte	ernal	250	150	-20				
		Static Liqu	uid Head					
Condition		P _s (psi) H _s (in)		SG				
Test horizontal		1.71	1					
		Dimens	sions					
Outer I	Diameter	48"						
Le	ngth	2"						
Nominal	Thickness	0.375"						
Corrosion	Inner	0"						
	Outer	0"						
		Weight and	Capacity					
		Wei	ght (lb)	Capacity (US gal)				
N	lew	3	15.18					
Cor	roded	31.76 15.18						
		Radiog	raphy					
Longitud	dinal seam	Seamless No RT						
	cumferential eam	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)	0.2986"					
Design thickness due to combined loadings + corrosion	0.1444"					
Rated MDMT	-40.4 °F					

UCS-66 Material Toughness Requirements					
Governing thickness, t _g =	0.375"				
Exemption temperature from Fig UCS-66 Curve B =	-20°F				
t _r = 250*24 / (20,000*1 + 0.4*250) =	0.2985"				
Stress ratio = $t_r^* E^* / (t_n - c) = 0.2985^* 1 / (0.375 - 0) =$	0.796				
Reduction in MDMT, T _R from Fig UCS-66.1 =	20.4°F				
MDMT = max[MDMT - T _R , -55] = max[-20 - 20.4 , -55] =	-40.4°F				
Material is exempt from impact testing at the Design MDMT of -20°F.					

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

- t = $P^*R_o / (S^*E + 0.40^*P) + Corrosion$ = $250^*24 / (20,000^*1.00 + 0.40^*250) + 0$ = 0.2986"
- % Extreme fiber elongation UCS-79(d)

EFE = $(50*t / R_f)*(1 - R_f / R_o)$ = (50*0.375 / 23.8125)*(1 - 23.8125 / ∞)= 0.7874%

The extreme fiber elongation does not exceed 5%.

Thickness Required Due to Pressure + External Loads								
Condition	Pressure P (psi) Allowable Stress Before UG-23 Stress Increase (psi)		Temperature (Corrosion ((in)	Corrosion C	020	Load Req'd Thk Due to Tension (In)	Req'd Thk Due to Compression (in)	
		St	Sc					
Operating, Hot & Corroded	250	20,000	14,898	150	0	Wind	0.1444	0.1443
						Seismic	0.1444	<u>0.1443</u>
Operating, Hot & New	250	20,000	14,898	150	0	Wind	0.1444	<u>0.1443</u>
						Seismic	0.1444	0.1443
Hot Shut Down, Corroded	0	20.000	14,898	150	0 Wind 0.0001	0.0001		
							0.0002	
Hot Shut Down, New	0	20,000	14,898	150 0 Wind <u>0.0001</u>	0.0001	<u>0.0001</u>		
						Seismic	<u>o</u>	0.0002
Empty, Corroded	0	20.000	14,898	70	0	Wind	0.0001	0.0001
		5 25,566 1.1660		Seismic	<u>o</u>	0.0001		
Empty, New	0	20,000	14,898	70	0	Wind	0.0001	<u>0.0001</u>
		,				Seismic	<u>o</u>	0.0001
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	14,898	150	0	Weight	0.0001	0.0001

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

 $A = 0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cHC} = min(B, S) = 14.898 psi$

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

 $S_{cHN} = S_{cHC}$

= <u>14,898 psi</u>

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

A = $0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cCN} = min(B, S) = 14.898 psi$

Allowable Compressive Stress, Cold and Corroded- \mathbf{S}_{cCC}

 $S_{cCC} = S_{cCN}$

= 14,898 psi

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

 $A = 0.125 / (R_0 / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 S_{cVC} = min(B, S) = <u>14.898 psi</u>

Operating, Hot & Corroded, Wind, Bottom Seam

 $t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$ (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

 $t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

 $= 360 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0'

 $t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

= $0.60*306.8 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0001"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0.1444 + 0 - (0.0001)

= 0.1444"

 $t_{wc} = W / (2*\pi*R_m*S_t*K_s*E_c)$ (Weight)

 $= 306.8 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0001"

 $t_c = |t_{mc} + t_{wc} - t_{pc}|$ (total, net tensile)

= |0 + (0.0001) - (0.1444)|

= <u>0.1443"</u>

Operating, Hot & New, Wind, Bottom Seam

 $t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$ (Pressure)

 $= 250^{2}3.625 / (2^{2}0,000^{1}.20^{0}.85 + 0.40^{2}00)$

= 0.1444"

 $t_{m} = M / (\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

 $= 360 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0

 $t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

 $= 0.60*306.8 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0001"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0.1444 + 0 - (0.0001)

= <u>0.1444"</u>

 $t_{wc} = W/(2^*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

= $306.8 / (2^*\pi^*23.8125^*20,000^*1.20^*0.85)$

= 0.0001"

 $t_c = |t_{mc} + t_{wc} - t_{pc}|$ (total, net tensile)

$$=$$
 $|0 + (0.0001) - (0.1444)|$

= 0.1443"

Hot Shut Down, Corroded, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

$$t_m = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $= 360 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_c^*K_s)$$
 (Weight)

 $= 0.60*306.8 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0001"

$$t_t = |t_p + t_m - t_w|$$
 (total, net compressive)

= |0 + 0 - (0.0001)|

= 0.0001"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 306.8 / (2 \pi^{2} 23.8125 14,898.49 1.20)$

= 0.0001"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0 + (0.0001) - (0)

= 0.0001"

Hot Shut Down, New, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

$$\dot{t}_{m} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $=360\,/\,(\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_c^*K_s)$$
 (Weight)

 $= 0.60*306.8 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0001"

$$t_t = |t_p + t_m - t_w|$$
 (total, net compressive)

= |0 + 0 - (0.0001)|

= 0.0001"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 306.8 / (2 \times \pi^2 23.8125 \times 14,898.49 \times 1.20)$

= 0.0001"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0 + (0.0001) - (0)

= 0.0001"

Empty, Corroded, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

$$t_m = M / (\pi^* R_m^2 S_c^* K_s)$$
 (bending)

= $360 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_c^*K_s)$$
 (Weight)

 $= 0.60*306.8 / (2*\pi*23.8125*14,898.49*1.20)$

$$= 0.0001" \\ t_t = |t_p + t_m - t_w| & \text{(total, net compressive)} \\ = |0 + 0 - (0.0001)| & \\ = \underline{0.0001"} \\ t_{wc} = W / (2^*\pi^*R_m^*S_c^*K_s) & \text{(Weight)} \\ = 306.8 / (2^*\pi^*23.8125^*14,898.49^*1.20) & \\ = 0.0001" \\ t_c = t_{mc} + t_{wc} - t_{pc} & \text{(total required, compressive)} \\ = 0 + (0.0001) - (0) & \\ = \underline{0.0001"} \\$$

Empty, New, Wind, Bottom Seam

$$\begin{array}{lll} t_p &= 0 \text{"} & (\text{Pressure}) \\ t_m &= M \, / \, (\pi^* R_m^{2*} S_c^{\, *} K_s) & (\text{bending}) \\ &= 360 \, / \, (\pi^* 23.8125^{2*}14,898.49^*1.20) \\ &= 0 \text{"} \\ t_w &= 0.6^* W \, / \, (2^* \pi^* R_m^{\, *} S_c^{\, *} K_s) & (\text{Weight}) \\ &= 0.60^* 306.8 \, / \, (2^* \pi^* 23.8125^*14,898.49^*1.20) \\ &= 0.0001 \text{"} \\ t_t &= |t_p + t_m - t_w| & (\text{total, net compressive}) \\ &= |0 + 0 - (0.0001)| & \\ &= 0.0001 \text{"} \\ t_{wc} &= W \, / \, (2^* \pi^* R_m^{\, *} S_c^{\, *} K_s) & (\text{Weight}) \\ &= 306.8 \, / \, (2^* \pi^* 23.8125^*14,898.49^*1.20) & \\ &= 0.0001 \text{"} \\ t_c &= t_{mc} + t_{wc} - t_{pc} & (\text{total required, compressive}) \\ &= 0 + (0.0001) - (0) & \\ &= 0.0001 \text{"} \end{array}$$

Hot Shut Down, Corroded, Weight & Eccentric Moments Only, Bottom Seam

Operating, Hot & Corroded, Seismic, Bottom Seam

$$t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$$
 (Pressure)

 $= 250^{2}3.625 / (2^{2}20,000^{1}.20^{0}.85 + 0.40^{1}|250|)$

= 0.1444"

$$t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (bending)

= $890 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

 $= 0.52*306.8 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0001"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0.1444 + 0 - (0.0001)

= 0.1444"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

= $1.08*306.8 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0001"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

= |0 + (0.0001) - (0.1444)|

= 0.1443"

Operating, Hot & New, Seismic, Bottom Seam

$$t_p = P*R / (2*S_t*K_s*E_c + 0.40*|P|)$$
 (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

$$t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (bending)

= $890 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

= $0.52*306.8 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0001"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0.1444 + 0 - (0.0001)

= 0.1444"

$$\begin{array}{lll} t_{wc} & = & (1 + 0.14^*S_{DS})^*W / (2^*\pi^*R_m^*S_t^*K_s^*E_c) & (Weight) \\ & = & 1.08^*306.8 / (2^*\pi^*23.8125^*20,000^*1.20^*0.85) \end{array}$$

= 0.0001"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

= |0 + (0.0001) - (0.1444)|

= 0.1443"

Hot Shut Down, Corroded, Seismic, Bottom Seam

$$\begin{array}{lll} t_p &= 0 \text{"} & \text{(Pressure)} \\ t_m &= M \, / \, (\pi^* R_m^{2*} S_c^* K_s) & \text{(bending)} \\ &= 890 \, / \, (\pi^* 23.8125^{2*}14,898.49^*1.20) \\ &= 0 \text{"} \\ t_w &= (0.6 \, - 0.14^* S_{DS})^* W \, / \, (2^* \pi^* R_m^* S_c^* K_s) & \text{(Weight)} \\ &= 0.52^* 306.8 \, / \, (2^* \pi^* 23.8125^*14,898.49^*1.20) \\ &= 0.0001 \text{"} \\ t_t &= |t_p + t_m - t_w| & \text{(total, net compressive)} \\ &= |0 + 0 \, - \, (0.0001)| \\ &= 0 \text{"} \\ t_{wc} &= (1 + 0.14^* S_{DS})^* W \, / \, (2^* \pi^* R_m^* S_c^* K_s) & \text{(Weight)} \\ &= 1.08^* 306.8 \, / \, (2^* \pi^* 23.8125^*14,898.49^*1.20) \\ &= 0.0001 \text{"} \\ t_c &= t_{mc} + t_{wc} \, - t_{pc} & \text{(total required, compressive)} \\ &= 0 \, + \, (0.0001) \, - \, (0) \\ &= 0.0002 \text{"} \end{array}$$

Hot Shut Down, New, Seismic, Bottom Seam

$$\begin{array}{lll} t_p &= 0" & (Pressure) \\ t_m &= M \, / \, (\pi^* R_m^{2*} S_c^* K_s) & (bending) \\ &= 890 \, / \, (\pi^* 23.8125^{2*} 14,898.49^* 1.20) \\ &= 0" & \\ t_w &= (0.6 \, - 0.14^* S_{DS})^* W \, / \, (2^* \pi^* R_m^* S_c^* K_s) & (Weight) \\ &= 0.52^* 306.8 \, / \, (2^* \pi^* 23.8125^* 14,898.49^* 1.20) \\ &= 0.0001" & \\ t_t &= |t_p + t_m - t_w| & (total, \, net \, compressive) \\ &= |0 + 0 \, - \, (0.0001)| \\ &= 0" & \\ t_{wc} &= (1 + 0.14^* S_{DS})^* W \, / \, (2^* \pi^* R_m^* S_c^* K_s) & (Weight) \\ &= 1.08^* 306.8 \, / \, (2^* \pi^* 23.8125^* 14,898.49^* 1.20) \\ &= 0.0001" & \\ t_c &= t_{mc} + t_{wc} \, - t_{pc} & (total \, required, \, compressive) \\ &= 0 \, + \, (0.0001) \, - \, (0) \\ &= 0.0002" & \end{array}$$

Empty, Corroded, Seismic, Bottom Seam

$$\begin{array}{lll} t_p &= 0 \text{"} & \text{(Pressure)} \\ t_m &= M \, / \, (\pi^* R_m^{2*} S_c^* K_s) & \text{(bending)} \\ &= 659 \, / \, (\pi^* 23.8125^{2*}14,898.49^*1.20) & \\ &= 0 \text{"} & \\ t_w &= (0.6 - 0.14^* S_{DS})^* W \, / \, (2^* \pi^* R_m^* S_c^* K_s) & \text{(Weight)} \\ &= 0.52^* 306.8 \, / \, (2^* \pi^* 23.8125^*14,898.49^*1.20) & \\ &= 0.0001 \text{"} & \\ t_t &= |t_p + t_m - t_w| & \text{(total, net compressive)} \end{array}$$

Empty, New, Seismic, Bottom Seam

SHELL RG 2

	ASME	Section VIII Div	ision 1, 2017 Editior					
Com	ponent	Cylinder SA-516 70 (II-D p. 18, ln. 33)						
Ма	terial							
Impact Tested	Normalized	Fine Grain Practice	Optimize MDMT/ Find MAWP					
No	No	No	No	No				
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)				
Inte	ernal	250	150	-20				
		Static Liqu	ıid Head					
Con	dition	P _s (psi)	H _s (in)	SG				
Test h	orizontal	1.71	47.3125	1				
		Dimens	sions					
Outer Diameter		48"						
Le	ngth	120"						
Nominal	Thickness	0.375"						
Corrosion	Inner	0"						
	Outer	0"						
		Weight and	Capacity					
		Wei	ght (lb)	Capacity (US gal)				
N	lew	1,9	900.98	910.88				
Cor	roded	1,9	910.88					
		Radiog	raphy					
Longitudinal seam		Spot UW-11(b) Type 1						
Top Circumferential seam		Spot UW-11(a)(5)(b) Type 1						
	cumferential eam	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)	0.3509"					
Design thickness due to combined loadings + corrosion	0.1453"					
Rated MDMT	-40.5 °F					

UCS-66 Material Toughness Requirements					
Governing thickness, $t_g =$	0.375"				
Exemption temperature from Fig UCS-66 Curve B =	-20°F				
$t_r = 250^*24 / (20,000^*0.85 + 0.4^*250) =$	0.3509"				
Stress ratio = $t_r^*E^* / (t_n - c) = 0.3509*0.85 / (0.375 - 0) =$	0.7953				
Reduction in MDMT, T _R from Fig UCS-66.1 =	20.5°F				
MDMT = max[MDMT - T _R , -55] = max[-20 - 20.5 , -55] =	-40.5°F				
Material is exempt from impact testing at the Design MDMT of -20°F.					

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

- t = $P^*R_o / (S^*E + 0.40^*P) + Corrosion$ = $250^*24 / (20,000^*0.85 + 0.40^*250) + 0$ = 0.3509"
- % Extreme fiber elongation UCS-79(d)

EFE = $(50*t / R_f)*(1 - R_f / R_o)$ = (50*0.375 / 23.8125)*(1 - 23.8125 / ∞)= 0.7874%

The extreme fiber elongation does not exceed 5%.

	Thickness Required Due to Pressure + External Loads							
Condition	Pressure P (psi)			Temperature (°F)	Corrosion C (in)	Load	Reg'd Thk Due to Tension (in)	Req'd Thk Due to Compression (in)
		St	Sc					
Operating, Hot & Corroded	250	20,000	14.898	150	0	Wind	<u>0.145</u>	<u>0.1427</u>
						Seismic	<u>0.1453</u>	0.1423
Operating, Hot & New	250	20,000	14,898	150	0	Wind	<u>0.145</u>	0.1427
							0.1423	
Hot Shut Down, Corroded	0	20,000	14,898	150	0	Wind	0.0005	0.002
	-					Seismic	0.0009	0.0024
Hot Shut Down, New	0	20.000	14,898	150	0	Wind	0.0005	0.002
		.,				Seismic	0.0009	0.0024
Empty, Corroded	0	20,000	14,898	70	0	Wind	0.0005	0.002
		==,===		, ,			0.002	
Empty, New	0	20,000	14,898	70	0	Wind	0.0005	0.002
		,555		. •		Seismic	0.0005	0.002
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	14,898	150	0	Weight	0.001	0.001

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

 $A = 0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cHC} = min(B, S) = 14.898 psi$

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

 $S_{cHN} = S_{cHC}$

= <u>14,898 psi</u>

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

 $A = 0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cCN} = min(B, S) = 14,898 psi$

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

 $S_{cCC} = S_{cCN}$

= 14,898 psi

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

A = $0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

 $B = 14,898 \, psi$

S = 20,000 / 1.00 = 20,000 psi

 $S_{cVC} = min(B, S) = 14.898 psi$

Operating, Hot & Corroded, Wind, Bottom Seam

 $t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$ (Pressure)

 $= \quad 250^*23.625 \, / \, (2^*20,000^*1.20^*0.85 + 0.40^*|250|)$

= 0.1444"

 $t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

= $35,975 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.001"

 $t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

 $= 0.60^{2},246.4 / (2^{2}\pi^{2}3.8125^{2}0,000^{1}.20^{0}.85)$

= 0.0004"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0.1444 + 0.001 - (0.0004)

= <u>0.145"</u>

 $t_{wc} = W/(2^*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

 $= 2,246.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0007"

 $t_c = |t_{mc} + t_{wc} - t_{pc}|$ (total, net tensile)

= |0.001 + (0.0007) - (0.1444)|

= <u>0.1427"</u>

Operating, Hot & New, Wind, Bottom Seam

 $t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$ (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

 $t_{m} = M / (\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

= $35,975 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.001"

 $t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

 $= 0.60^{2},246.4 / (2^{2}\pi^{2}3.8125^{2}0,000^{1}.20^{0}.85)$

= 0.0004"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0.1444 + 0.001 - (0.0004)

= 0.145"

 $t_{wc} = W/(2^*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

= $2,246.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0007"

 $t_c = |t_{mc} + t_{wc} - t_{pc}|$ (total, net tensile)

- = |0.001 + (0.0007) (0.1444)|
- = 0.1427"

Hot Shut Down, Corroded, Wind, Bottom Seam

 $t_p = 0$ " (Pressure)

 $t_{m} = M / (\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

 $= 35,975 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.001"

 $t_w = 0.6*W / (2*\pi*R_m*S_t*K_s*E_c)$ (Weight)

= $0.60^{\circ}2,246.4/(2^{\circ}\pi^{\circ}23.8125^{\circ}20,000^{\circ}1.20^{\circ}0.85)$

= 0.0004"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0 + 0.001 - (0.0004)

= 0.0005"

 $t_{mc} = M / (\pi^* R_m^2 S_c^* K_s)$ (bending)

 $= 35,975 / (\pi^*23.8125^2*14,898.49*1.20)$

= 0.0011"

 $t_{wc} = W / (2*\pi*R_m*S_c*K_s)$ (Weight)

 $= 2,246.4 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0008"

 $t_c = t_{mc} + t_{wc} - t_{pc}$ (total required, compressive)

= 0.0011 + (0.0008) - (0)

= 0.002"

Hot Shut Down, New, Wind, Bottom Seam

 $t_p = 0$ " (Pressure)

 $t_m^r = M / (\pi^* R_m^2 S_t^* K_s^* E_c)$ (bending)

= $35,975 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$ = 0.001"

 $t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

= $0.60^{\circ}2,246.4/(2^{\circ}\pi^{\circ}23.8125^{\circ}20,000^{\circ}1.20^{\circ}0.85)$

= 0.0004"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0 + 0.001 - (0.0004)

= 0.0005"

 $t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$ (bending)

 $= 35,975 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0011"

 $t_{wc} = W / (2*\pi*R_m*S_c*K_s)$ (Weight)

 $= 2,246.4 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0008"

 $t_c = t_{mc} + t_{wc} - t_{pc}$ (total required, compressive)

= 0.0011 + (0.0008) - (0)

= 0.002"

Empty, Corroded, Wind, Bottom Seam

$$\begin{array}{ll} t_p &= 0 \text{"} & \text{(Pressure)} \\ t_m &= M \, / \, (\pi^* R_m^{\, 2^*} S_t^{\, *} K_s^{\, *} E_c) & \text{(bending)} \\ &= 35,975 \, / \, (\pi^* 23.8125^{2^*} 20,000^* 1.20^* 0.85) \end{array}$$

= 0.001"

$$t_w = 0.6^*W / (2^*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

= $0.60^{\circ}2,246.4/(2^{\circ}\pi^{\circ}23.8125^{\circ}20,000^{\circ}1.20^{\circ}0.85)$

= 0.0004"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.001 - (0.0004)

= 0.0005"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $= 35,975 / (\pi^{*}23.8125^{2}*14,898.49*1.20)$

= 0.0011"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 2,246.4 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0008"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0011 + (0.0008) - (0)

= 0.002"

Empty, New, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_{m} = M / (\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

 $= 35,975 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.001"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

= $0.60^{\circ}2,246.4/(2^{\circ}\pi^{\circ}23.8125^{\circ}20,000^{\circ}1.20^{\circ}0.85)$

= 0.0004"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.001 - (0.0004)

= 0.0005"

$$t_{mc} = M / (\pi^* R_m^2 S_c^* K_s)$$
 (bending)

 $= 35,975 / (\pi^*23.8125^2*14,898.49*1.20)$

= 0.0011"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 2,246.4 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0008"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0011 + (0.0008) - (0)

= 0.002"

Hot Shut Down, Corroded, Weight & Eccentric Moments Only, Bottom Seam

$$t_p = 0$$
" (Pressure)
 $t_m = M / (\pi^* R_m^{2*} S_c^* K_s)$ (bending)

Operating, Hot & Corroded, Seismic, Bottom Seam

= 0.001"

$$\begin{array}{lll} t_p & = & P^*R \, / \, (2^*S_t^*K_s^*E_c + 0.40^*|P|) & & & & & & \\ & = & 250^*23.625 \, / \, (2^*20,000^*1.20^*0.85 + 0.40^*|250|) \\ & = & 0.1444^{\prime\prime\prime} & & & \\ t_m & = & M \, / \, (\pi^*R_m^{2\prime\prime}S_t^*K_s^*E_c) & & & & & \\ & = & 46,276 \, / \, (\pi^*23.8125^{2\prime\prime}20,000^*1.20^*0.85) \\ & = & 0.0013^{\prime\prime\prime} & & \\ t_w & = & (0.6 - 0.14^*S_{DS})^*W \, / \, (2^*\pi^*R_m^*S_t^*K_s^*E_c) & & & & \\ & = & 0.52^*2,246.4 \, / \, (2^*\pi^*23.8125^*20,000^*1.20^*0.85) \\ & = & 0.0004^{\prime\prime\prime} & & & & \\ t_t & = & t_p + t_m - t_w & & & \\ & = & 0.1444 + 0.0013 - (0.0004) \\ & = & 0.1453^{\prime\prime\prime} & & & \\ & = & 0.14453^{\prime\prime\prime} & & & \\ t_{wc} & = & (1 + 0.14^*S_{DS})^*W \, / \, (2^*\pi^*R_m^*S_t^*K_s^*E_c) & & & & \\ & = & 0.0008^{\prime\prime\prime} & & & & \\ t_c & = & |t_{mc} + t_{wc} - t_{pc}| & & & \\ & = & |0.0013 + (0.0008) - (0.1444)| \\ & = & 0.1423^{\prime\prime\prime\prime} & & & \\ \end{array}$$

Operating, Hot & New, Seismic, Bottom Seam

$$\begin{array}{lll} t_p & = & P^*R \, / \, (2^*S_t^*K_s^*E_c + 0.40^*|P|) & & & & & & & & \\ & = & 250^*23.625 \, / \, (2^*20,000^*1.20^*0.85 + 0.40^*|250|) & & & & \\ & = & 0.1444^{\prime\prime\prime} & & & & & \\ t_m & = & M \, / \, (\pi^*R_m^{2*}S_t^*K_s^*E_c) & & & & & & \\ & = & 46,276 \, / \, (\pi^*23.8125^{2*}20,000^*1.20^*0.85) & & & & \\ & = & 0.0013^{\prime\prime\prime} & & & & & \\ t_w & = & (0.6 - 0.14^*S_{DS})^*W \, / \, (2^*\pi^*R_m^*S_t^*K_s^*E_c) & & & & & & \\ & = & 0.52^*2,246.4 \, / \, (2^*\pi^*23.8125^*20,000^*1.20^*0.85) & & & & \\ & = & 0.0004^{\prime\prime\prime} & & & & & & \\ t_t & = & t_p + t_m - t_w & & & & & \\ \end{array} \label{eq:total_tot$$

$$= 0.1444 + 0.0013 - (0.0004)$$

= 0.1453"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

= $1.08^{2},246.4/(2^{\pi}23.8125^{20},000^{1}.20^{0.85})$

= 0.0008"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

= [0.0013 + (0.0008) - (0.1444)]

= 0.1423"

Hot Shut Down, Corroded, Seismic, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_{m} = M / (\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

= $46,276 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.0013"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

 $= 0.52*2,246.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0004"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.0013 - (0.0004)

= 0.0009"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $= 46,276 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0015"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 1.08^{2},246.4 / (2^{\pi}23.8125^{14},898.49^{1.20})$

= 0.0009"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0015 + (0.0009) - (0)

= 0.0024"

Hot Shut Down, New, Seismic, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_m^p = M / (\pi^* R_m^{2*} S_t^* K_s^* E_c)$ (bending)

= $46,276 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.0013"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

 $= 0.52*2,246.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0004"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.0013 - (0.0004)

= 0.0009"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $= 46,276 / (\pi^{*}23.8125^{2*}14,898.49^{*}1.20)$

= 0.0015"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

$$= 1.08*2,246.4 / (2*\pi*23.8125*14,898.49*1.20)$$

$$= 0.0009"$$

$$t_{c} = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)
$$= 0.0015 + (0.0009) - (0)$$

$$= 0.0024"$$

Empty, Corroded, Seismic, Bottom Seam

Empty, New, Seismic, Bottom Seam

$$\begin{array}{lll} t_{m} &= 0 \text{"} & (\text{Pressure}) \\ t_{m} &= M \, / \, (\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c}) & (\text{bending}) \\ &= 33,793 \, / \, (\pi^{*}23.8125^{2*}20,000^{*}1.20^{*}0.85) \\ &= 0.0009 \text{"} \\ t_{w} &= (0.6 \, - 0.14^{*}S_{DS})^{*}W \, / \, (2^{*}\pi^{*}R_{m}^{*}S_{t}^{*}K_{s}^{*}E_{c}) & (\text{Weight}) \\ &= 0.52^{*}2,246.4 \, / \, (2^{*}\pi^{*}23.8125^{*}20,000^{*}1.20^{*}0.85) \\ &= 0.0004^{"} \\ t_{t} &= t_{p} + t_{m} - t_{w} & (\text{total required, tensile}) \\ &= 0 + 0.0009 - (0.0004) \\ &= 0.0005^{"} \\ t_{mc} &= M \, / \, (\pi^{*}R_{m}^{2*}S_{c}^{*}K_{s}) & (\text{bending}) \\ &= 33,793 \, / \, (\pi^{*}23.8125^{2*}14,898.49^{*}1.20) \\ &= 0.0011^{"} \\ t_{wc} &= (1 + 0.14^{*}S_{DS})^{*}W \, / \, (2^{*}\pi^{*}R_{m}^{*}S_{c}^{*}K_{s}) & (\text{Weight}) \\ &= 1.08^{*}2,246.4 \, / \, (2^{*}\pi^{*}23.8125^{*}14,898.49^{*}1.20) \\ &= 0.0009^{"} \\ t_{c} &= t_{mc} + t_{wc} - t_{pc} & (\text{total required, compressive}) \\ &= 0.0011 + (0.0009) - (0) \end{array}$$

SHELL RG 1

	ASME	Section VIII Div	ision 1, 2017 Editior					
Com	ponent	Cylinder SA-516 70 (II-D p. 18, ln. 33)						
Ma	terial							
Impact Tested	Normalized	Fine Grain Practice	Optimize MDMT/ Find MAWP					
No	No	No	No	No				
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)				
Inte	ernal	250	150	-20				
		Static Liqu	ıid Head					
Con	dition	P _s (psi)	H _s (in)	SG				
Operating		1.73	48	1				
Test horizontal		1.71	47.3125	1				
		Dimens	sions					
Outer I	Diameter	48"						
Le	ngth	120"						
Nominal	Thickness	0.375"						
Corrosion	Inner	0"						
	Outer	0"						
		Weight and	Capacity					
		Wei	ght (lb)	Capacity (US gal)				
N	lew	1,8	374.07	910.88				
Cor	roded	1,8	910.88					
		Radiog	raphy					
Longitudinal seam		Spot UW-11(b) Type 1						
	umferential eam	Spot UW-11(a)(5)(b) Type 1						
	cumferential eam	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)	0.3533"					
Design thickness due to combined loadings + corrosion	0.1478"					
Rated MDMT	-39.9 °F					

UCS-66 Material Toughness Requirements					
Governing thickness, $t_g =$	0.375"				
Exemption temperature from Fig UCS-66 Curve B =	-20°F				
$t_r = 251.73*24 / (20,000*0.85 + 0.4*251.73) =$	0.3533"				
Stress ratio = $t_r^*E^* / (t_n - c) = 0.3533^*0.85 / (0.375 - 0) =$	0.8008				
Reduction in MDMT, T _R from Fig UCS-66.1 =	19.9°F				
MDMT = max[MDMT - T _R , -55] = max[-20 - 19.9 , -55] =	-39.9°F				
Material is exempt from impact testing at the Design MDMT of -20°F.					

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

- t = $P*R_o / (S*E + 0.40*P) + Corrosion$ = 251.73*24 / (20,000*0.85 + 0.40*251.73) + 0= 0.3533"
- % Extreme fiber elongation UCS-79(d)
- EFE = $(50*t/R_f)*(1 R_f/R_o)$ = $(50*0.375/23.8125)*(1 - 23.8125/\infty)$ = 0.7874%

The extreme fiber elongation does not exceed 5%.

Thickness Required Due to Pressure + External Loads								
Condition	Pressure P (I III STREET		Temperature (°F)	Corrosion C	Load	Req'd Thk Due to Tension (in)	Req'd Thk Due to Compression (in)
		St	Sc					
Operating, Hot & Corroded	250	20,000	14.898	150	0	Wind	0.1474	0.139
						Seismic	<u>0.1478</u>	<u>0.1386</u>
Operating, Hot & New	250	20,000	14,898	150	0 Wind	Wind	0.1474	<u>0.139</u>
						Seismic	0.1478	0.1386
Hot Shut Down, Corroded	0	20,000	14,898	150	0	Wind	0.003	0.0062
		,				Seismic <u>0.0034</u>	0.0066	
Hot Shut Down, New	0 2	20,000	14,898	150	0	Wind	0.003	0.0062
		,				Seismic	<u>0.0034</u>	<u>0.0066</u>
Empty, Corroded	0	20,000	14,898	70	0	Wind	0.003	<u>0.0062</u>
						Seismic	0.0022	0.0053
Empty, New	0	20.000	14,898	70	0	Wind	0.003	0.0062
						Seismic	0.0022	0.0053
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	14,898	150	0	Weight	0.0015	0.0027

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

 $A = 0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cHC} = min(B, S) = 14.898 psi$

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

 $S_{cHN} = S_{cHC}$

= <u>14,898 psi</u>

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

A = $0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cCN} = min(B, S) = 14,898 psi$

Allowable Compressive Stress, Cold and Corroded- \mathbf{S}_{cCC}

 $S_{cCC} = S_{cCN}$

= <u>14.898 psi</u>

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

 $A = 0.125 / (R_0 / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cVC} = min(B, S) = 14.898 psi$

Operating, Hot & Corroded, Wind, Bottom Seam

 $t_n = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$ (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

 $t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

= $142,347 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.0039"

 $t_w = 0.6*W / (2*\pi*R_m*S_t*K_s*E_c)$ (Weight)

 $= 0.60*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0009"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0.1444 + 0.0039 - (0.0009)

= <u>0.1474"</u>

 $t_{wc} = W/(2^*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

= $4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0015"

 $t_c = |t_{mc} + t_{wc} - t_{pc}|$ (total, net tensile)

= [0.0039 + (0.0015) - (0.1444)]

= 0.139"

Operating, Hot & New, Wind, Bottom Seam

 $t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$ (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

 $t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

 $= 142,347 / (\pi^{*}23.8125^{2}*20,000^{*}1.20^{*}0.85)$

= 0.0039"

 $t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

 $= 0.60^{*}4,638.7 / (2^{*}\pi^{*}23.8125^{*}20,000^{*}1.20^{*}0.85)$

= 0.0009"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0.1444 + 0.0039 - (0.0009)

= <u>0.1474"</u>

 $t_{wc} = W/(2^*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

= $4,638.7 / (2^*\pi^*23.8125^*20,000^*1.20^*0.85)$

= 0.0015"

 $t_c = |t_{mc} + t_{wc} - t_{pc}|$ (total, net tensile)

- = [0.0039 + (0.0015) (0.1444)]
- = 0.139"

Hot Shut Down, Corroded, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_m = M / (\pi^* R_m^2 S_t^* K_s^* E_c)$ (bending)

= $142,347 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.0039"

 $t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

= $0.60*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0009"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0 + 0.0039 - (0.0009)

= 0.003"

 $t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$ (bending)

 $= 142,347 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0045"

 $t_{wc} = W / (2*\pi*R_m*S_c*K_s)$ (Weight)

 $= 4,638.7 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0017"

 $t_c = t_{mc} + t_{wc} - t_{pc}$ (total required, compressive)

= 0.0045 + (0.0017) - (0)

= 0.0062"

Hot Shut Down, New, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_m = M / (\pi^* R_m^2 S_t^* K_s^* E_c)$ (bending)

= $142,347 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.0039"

 $t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$ (Weight)

 $= 0.60*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0009"

 $t_t = t_p + t_m - t_w$ (total required, tensile)

= 0 + 0.0039 - (0.0009)

= 0.003"

 $t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$ (bending)

= $142,347 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0045"

 $t_{wc} = W / (2*\pi*R_m*S_c*K_s)$ (Weight)

 $= 4,638.7 / (2 \times \pi^2 23.8125 \times 14,898.49 \times 1.20)$

= 0.0017"

 $t_c = t_{mc} + t_{wc} - t_{pc}$ (total required, compressive)

= 0.0045 + (0.0017) - (0)

= 0.0062"

Empty, Corroded, Wind, Bottom Seam

$$\begin{array}{ll} t_p &= 0 \text{"} & \text{(Pressure)} \\ t_m &= M \, / \, (\pi^* R_m^{2*} S_t^* K_s^* E_c) & \text{(bending)} \end{array}$$

= $142,347 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.0039"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

 $= 0.60^*4,638.7 / (2^*\pi^*23.8125^*20,000^*1.20^*0.85)$

= 0.0009"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.0039 - (0.0009)

= 0.003"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $= 142,347 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0045"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 4,638.7 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0017"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0045 + (0.0017) - (0)

= 0.0062"

Empty, New, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_m^r = M / (\pi^* R_m^{2*} S_t^* K_s^* E_c)$ (bending)

 $= 142,347 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.0039"

$$t_{w} = 0.6^{*}W / (2^{*}\pi^{*}R_{m}^{*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (Weight)

 $= 0.60*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0009"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.0039 - (0.0009)

= 0.003"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

= $142,347 / (\pi^*23.8125^2*14,898.49*1.20)$

= 0.0045"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 4,638.7 / (2 \pi^2 23.8125 14,898.49 1.20)$

= 0.0017"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0045 + (0.0017) - (0)

= 0.0062"

Hot Shut Down, Corroded, Weight & Eccentric Moments Only, Bottom Seam

$$t_p = 0$$
" (Pressure)
 $t_m = M / (\pi^* R_m^{2*} S_c^* K_s)$ (bending)

=
$$15,258 / (\pi^*23.8125^{2*}14,898.49^*1.00)$$

= 0.0006"

$$t_{w} = W / (2*\pi*R_{m}*S_{c}*K_{s})$$
 (Weight)

 $=4,638.7 \ / \ (2^*\pi^*23.8125^*14,898.49^*1.00)$

= 0.0021"

$$t_t = |t_p + t_m - t_w|$$

= |0 + 0.0006 - (0.0021)|

= 0.0015"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

(total, net compressive)

= 0.0006 + (0.0021) - (0)

= 0.0027"

Operating, Hot & Corroded, Seismic, Bottom Seam

$$t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$$
 (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

$$t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (bending)

= $151,745 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.0042"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

= $0.52*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0.1444 + 0.0042 - (0.0008)

= <u>0.1478"</u>

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

 $= 1.08^{4},638.7 / (2^{*}\pi^{*}23.8125^{*}20,000^{*}1.20^{*}0.85)$

0.0016"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

= |0.0042 + (0.0016) - (0.1444)|

= <u>0.1386"</u>

Operating, Hot & New, Seismic, Bottom Seam

$$t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$$
 (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

$$t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (bending)

 $= 151,745 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.0042"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

 $= 0.52*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

$$= 0.1444 + 0.0042 - (0.0008)$$

= 0.1478"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

= $1.08*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0016"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

= |0.0042 + (0.0016) - (0.1444)|

= 0.1386"

Hot Shut Down, Corroded, Seismic, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_{m} = M / (\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$ (bending)

= $151,745 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.0042"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

 $= 0.52*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0008"

$$t_t = t_o + t_m - t_w$$
 (total required, tensile)

= 0 + 0.0042 - (0.0008)

= 0.0034"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

= $151,745 / (\pi^*23.8125^2*14,898.49*1.20)$

= 0.0048"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 1.08*4,638.7 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0019"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0048 + (0.0019) - (0)

= 0.0066"

Hot Shut Down, New, Seismic, Bottom Seam

$$t_p = 0$$
" (Pressure)

$$t_m^p = M / (\pi^* R_m^{2*} S_t^* K_s^* E_c)$$
 (bending)

= $151,745 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.0042"

$$t_w = (0.6 - 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

 $= 0.52^*4,638.7 \, / \, (2^*\pi^*23.8125^*20,000^*1.20^*0.85)$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.0042 - (0.0008)

= 0.0034"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

= $151,745 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

_ n nn48"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

$$t_c = t_{mc} + t_{wc} - t_{pc}$$

= 0.0048 + (0.0019) - (0)

= 0.0066"

Empty, Corroded, Seismic, Bottom Seam

$$\begin{array}{ll} t_p &= 0 \text{"} & \text{(Pressure)} \\ t_m &= M \, / \, (\pi^* R_m^{2*} S_t^* K_s^* E_c) & \text{(bending)} \\ &= 110,326 \, / \, (\pi^* 23.8125^{2*} 20,000^* 1.20^* 0.85) \end{array}$$

= 0.003"

$$\begin{array}{ll} t_w &= (0.6 \text{ - } 0.14\text{^*}S_{DS})\text{^*}W \, / \, (2\text{^*}\pi\text{^*}R_m\text{^*}S_t\text{^*}K_s\text{^*}E_c) \\ &= 0.52\text{^*}4,638.7 \, / \, (2\text{^*}\pi\text{^*}23.8125\text{^*}20,000\text{^*}1.20\text{^*}0.85) \end{array} \tag{Weight)}$$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)
= 0 + 0.003 - (0.0008)

(total required, compressive)

= 0.0022"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

= $110,326 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0035"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

= $1.08^{4},638.7 / (2^{\pi}23.8125^{14},898.49^{1.20})$

= 0.0019"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0035 + (0.0019) - (0)

= <u>0.0053"</u>

Empty, New, Seismic, Bottom Seam

$$\begin{array}{ll} t_p &= 0 \text{"} & \text{(Pressure)} \\ t_m &= \text{M} \, / \, (\pi^* R_m^{\ 2^*} S_t^{\ *} K_s^{\ *} E_c) & \text{(bending)} \end{array}$$

= $110,326 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.003"

$$t_w = (0.6 - 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

= $0.52*4,638.7 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.003 - (0.0008)

= 0.0022"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

= $110,326 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0035"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 1.08^*4,638.7 \, / \, (2^*\pi^*23.8125^*14,898.49^*1.20)$

= 0.0019"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0035 + (0.0019) - (0)

Straight Flange on BOTTOM HEAD

	ASME	Section VIII Div	ision 1, 2017 Editior	า				
Component Material		Cylinder						
		SA-516 70 (II-D p. 18, ln. 33)						
Impact Tested	Normalized	Fine Grain Practice	Optimize MDMT/ Find MAWP					
No	No	No	No	No				
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)				
Internal		250	150	-20				
		Static Liqu	ıid Head					
Condition		P _s (psi)	H _s (in)	SG				
Operating		1.8	50	1				
Test horizontal		1.71	47.3125	1				
		Dimens	sions					
Outer Diameter		48"						
Length		2"						
Nominal Thickness		0.375"						
Corrosion	Inner	0"						
	Outer	0"						
		Weight and	Capacity					
		Wei	ght (lb)	Capacity (US gal)				
New		3	15.18					
Corroded		3	15.18					
		Radiogi	raphy					
Longitudinal seam		Seamless No RT						
Top Circumferential seam		Spot UW-11(a)(5)(b) Type 1						

Results Summary						
Governing condition	Internal pressure					
Minimum thickness per UG-16	0.0625" + 0" = 0.0625"					
Design thickness due to internal pressure (t)	0.3007"					
Design thickness due to combined loadings + corrosion	0.1478"					
Rated MDMT	-39.8 °F					

UCS-66 Material Toughness Requirements					
Governing thickness, $t_g =$					
Exemption temperature from Fig UCS-66 Curve B =					
t _r = 251.8*24 / (20,000*1 + 0.4*251.8) =					
Stress ratio = $t_r^* E^* / (t_n - c) = 0.3007*1 / (0.375 - 0) =$	0.8017				
Reduction in MDMT, T _R from Fig UCS-66.1 =					
MDMT = max[MDMT - T _R , -55] = max[-20 - 19.8 , -55] =					
Material is exempt from impact testing at the Design MDMT of -20°F.					

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

- = $P^*R_o / (S^*E + 0.40^*P) + Corrosion$ = $251.8^*24 / (20,000^*1.00 + 0.40^*251.8) + 0$
 - = 0.3007"

% Extreme fiber elongation - UCS-79(d)

 $(50*t/R_f)*(1 - R_f/R_o)$ EFE =

(50*0.375 / 23.8125)*(1 - 23.8125 / ∞)

0.7874%

The extreme fiber elongation does not exceed 5%.

Thickness Required Due to Pressure + External Loads									
Condition	Pressure P (Allowable Stress Before UG-23 Stress Increase (psl)		Temperature (°F)	Corrosion C (in)	Load	Req'd Thk Due to Tension (in)	Req'd Thk Due to Compression (in)	
		St	Sc						
Operating, Hot & Corroded	250	20,000	14,898	150	0	Wind	<u>0.1475</u>	0.1389	
						Seismic	0.1478	<u>0.1385</u>	
Operating, Hot & New	250	20,000	14,898	150	0	Wind	<u>0.1475</u>	0.1389	
						Seismic	0.1478	<u>0.1385</u>	
Hot Shut Down, Corroded	0	20,000	14,898	150	0	Wind	0.0031	0.0063	
						Seismic	0.0034	0.0067	
Hot Shut Down, New	0	20,000	14,898	150	0	Wind	<u>0.0031</u>	0.0063	
						Seismic	<u>0.0034</u>	0.0067	
Empty, Corroded	0	20,000	14,898	70	0	Wind	<u>0.0031</u>	0.0063	
						Seismic	0.0023	0.0054	
Empty, New	0	20,000	14,898	70	0	Wind	0.0031	0.0063	
						Seismic	0.0023	0.0054	
Hot Shut Down, Corroded, Weight & Eccentric Moments Only	0	20,000	14,898	150	0	Weight	<u>0.0015</u>	0.0027	

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

 $A = 0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cHC} = min(B, S) = 14,898 psi$

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

 $S_{cHN} = S_{cHC}$

= 14,898 psi

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

 $A = 0.125 / (R_0 / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 $S_{cCN} = min(B, S) = 14.898 psi$

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

 $S_{cCC} = S_{cCN}$

= 14,898 psi

Allowable Compressive Stress, Vacuum and Corroded- $\mathbf{S}_{\text{cVC}}\text{,}$ (table CS-2)

A = $0.125 / (R_o / t)$

= 0.125 / (24 / 0.375)

= 0.001953

B = 14,898 psi

S = 20,000 / 1.00 = 20,000 psi

 S_{cVC} = min(B, S) = <u>14.898 psi</u>

Operating, Hot & Corroded, Wind, Bottom Seam

$$t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$$
 (Pressure)

 $= 250^{2}3.625 / (2^{2}0,000^{1}.20^{0}.85 + 0.40^{2}00)$

= 0.1444"

$$t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (bending)

= $144,377 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.004"

$$t_w = 0.6*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

= $0.60^{4},670.4 / (2^{2}\pi^{2}3.8125^{2}0,000^{1}.20^{0}.85)$

= 0.0009"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0.1444 + 0.004 - (0.0009)

= <u>0.1475"</u>

$$t_{wc} = W/(2^*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

 $= 4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0015"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

= |0.004 + (0.0015) - (0.1444)|

= <u>0.1389"</u>

Operating, Hot & New, Wind, Bottom Seam

$$t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$$
 (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

$$t_{m} = M / (\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (bending)

 $= 144,377 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.004"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

= $0.60*4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0009"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0.1444 + 0.004 - (0.0009)

= <u>0.1475"</u>

$$t_{wc} = W/(2^*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

 $= 4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0015"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

- = [0.004 + (0.0015) (0.1444)]
- = 0.1389"

Hot Shut Down, Corroded, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_{m} = M / (\pi^* R_{m}^{2*} S_{t}^{*} K_{s}^{*} E_{c})$ (bending)

= $144,377 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.004"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

= $0.60^{4},670.4/(2^{\pi}23.8125^{20},000^{1.20}0.85)$

= 0.0009"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.004 - (0.0009)

= 0.0031"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

= $144,377 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0045"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 4,670.4 / (2 \pi^2 23.8125 14,898.49 1.20)$

= 0.0017"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0045 + (0.0017) - (0)

= 0.0063"

Hot Shut Down, New, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

$$t_m^r = M / (\pi^* R_m^{2*} S_t^* K_s^* E_c)$$
 (bending)

 $= 144,377 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.004"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

 $= 0.60^*4,670.4 \ / \ (2^*\pi^*23.8125^*20,000^*1.20^*0.85)$

= 0.0009"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.004 - (0.0009)

= 0.0031"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

= $144,377 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0045"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 4,670.4 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0017"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0045 + (0.0017) - (0)

= 0.0063"

Empty, Corroded, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)
 $t_m = M / (\pi^* R_m^{2*} S_t^* K_s^* E_c)$ (bending)

 $= 144,377 \, / \, (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.004"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

= $0.60^{4},670.4/(2^{\pi}23.8125^{20},000^{1.20}0.85)$

= 0.0009"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.004 - (0.0009)

= 0.0031"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $= 144,377 \, / \, (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0045"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 4,670.4 / (2 \times \pi^2 23.8125 \times 14,898.49 \times 1.20)$

= 0.0017"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0045 + (0.0017) - (0)

= 0.0063"

Empty, New, Wind, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_m = M / (\pi^* R_m^2 S_t^* K_s^* E_c)$ (bending)

= $144,377 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.004"

$$t_w = 0.6*W / (2*\pi^*R_m^*S_t^*K_s^*E_c)$$
 (Weight)

= $0.60^{4},670.4 / (2^{4}\pi^{2}3.8125^{2}0,000^{1}.20^{0}.85)$

= 0.0009"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.004 - (0.0009)

= 0.0031"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $= 144,377 / (\pi^{*}23.8125^{2*}14,898.49^{*}1.20)$

= 0.0045"

$$t_{wc} = W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

 $= 4,670.4 / (2 \times \pi^2 23.8125 \times 14,898.49 \times 1.20)$

= 0.0017"

$$t_c = t_{mc} + t_{wc} - t_{oc}$$
 (total required, compressive)

= 0.0045 + (0.0017) - (0)

= 0.0063"

Hot Shut Down, Corroded, Weight & Eccentric Moments Only, Bottom Seam

$$t_p = 0$$
" (Pressure)
 $t_m = M / (\pi^* R_m^{2*} S_c^* K_s)$ (bending)

$$= 15,258 / (\pi^*23.8125^{2*}14,898.49^*1.00)$$

= 0.0006"

$$t_w = W / (2^*\pi^*R_m^*S_c^*K_s)$$
 (Weight)

 $=4,670.4 \ / \ (2^*\pi^*23.8125^*14,898.49^*1.00)$

= 0.0021"

$$t_t = |t_p + t_m - t_w|$$
 (total, net compressive)

= |0 + 0.0006 - (0.0021)|

= 0.0015"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0006 + (0.0021) - (0)

= 0.0027"

Operating, Hot & Corroded, Seismic, Bottom Seam

$$t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$$
 (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

$$t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (bending)

 $= 153,753 / (\pi^{2}3.8125^{2}20,000^{1}.20^{0}.85)$

= 0.0042"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

 $= 0.52*4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0.1444 + 0.0042 - (0.0008)

= <u>0.1478"</u>

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

= $1.08*4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0016"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

= [0.0042 + (0.0016) - (0.1444)]

= 0.1385"

Operating, Hot & New, Seismic, Bottom Seam

$$t_p = P^*R / (2^*S_t^*K_s^*E_c + 0.40^*|P|)$$
 (Pressure)

= 250*23.625 / (2*20,000*1.20*0.85 + 0.40*|250|)

= 0.1444"

$$t_{m} = M/(\pi^{*}R_{m}^{2*}S_{t}^{*}K_{s}^{*}E_{c})$$
 (bending)

 $= 153,753 / (\pi^*23.8125^2*20,000*1.20*0.85)$

= 0.0042"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

 $= 0.52*4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

$$= 0.1444 + 0.0042 - (0.0008)$$

= 0.1478"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

 $= 1.08*4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0016"

$$t_c = |t_{mc} + t_{wc} - t_{pc}|$$
 (total, net tensile)

= |0.0042 + (0.0016) - (0.1444)|

= 0.1385"

Hot Shut Down, Corroded, Seismic, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_m = M / (\pi^* R_m^{2*} S_t^* K_s^* E_c)$ (bending)

 $= 153,753 / (\pi^*23.8125^{2*}20,000^*1.20^*0.85)$

= 0.0042"

$$t_w = (0.6 - 0.14 * S_{DS}) * W / (2 * \pi * R_m * S_t * K_s * E_c)$$
 (Weight)

= $0.52*4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.0042 - (0.0008)

= 0.0034"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

 $= 153,753 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

= 0.0048"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

= $1.08*4,670.4 / (2*\pi*23.8125*14,898.49*1.20)$

= 0.0019"

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)

= 0.0048 + (0.0019) - (0)

= 0.0067"

Hot Shut Down, New, Seismic, Bottom Seam

$$t_p = 0$$
" (Pressure)

 $t_m = M / (\pi^* R_m^{2*} S_t^* K_s^* E_c)$ (bending) = 153,753 / ($\pi^* 23.8125^{2*} 20,000^* 1.20^* 0.85$)

- n nn42'

$$t_w = (0.6 - 0.14*S_{DS})*W / (2*\pi*R_m*S_t*K_s*E_c)$$
 (Weight)

= $0.52*4,670.4 / (2*\pi*23.8125*20,000*1.20*0.85)$

= 0.0008"

$$t_t = t_p + t_m - t_w$$
 (total required, tensile)

= 0 + 0.0042 - (0.0008)

= 0.0034"

$$t_{mc} = M / (\pi^* R_m^{2*} S_c^* K_s)$$
 (bending)

= $153,753 / (\pi^*23.8125^{2*}14,898.49^*1.20)$

– 0 0048"

$$t_{wc} = (1 + 0.14*S_{DS})*W / (2*\pi*R_m*S_c*K_s)$$
 (Weight)

$$= 1.08^*4,670.4 / (2^*\pi^*23.8125^*14,898.49^*1.20)$$

$$= 0.0019"$$

$$t_c = t_{mc} + t_{wc} - t_{pc}$$
 (total required, compressive)
$$= 0.0048 + (0.0019) - (0)$$

$$= 0.0067"$$

Empty, Corroded, Seismic, Bottom Seam

$$\begin{array}{lll} t_p &= 0 \\[-2pt] t_m &= M / (\pi^* R_m^2 ^* S_t ^* K_s ^* E_c) & (bending) \\[-2pt] &= 111,508 / (\pi^* 23.8125^2 ^* 20,000^* 1.20^* 0.85) \\[-2pt] &= 0.0031 \\[-2pt] t_w &= (0.6 - 0.14 ^* S_{DS}) ^* W / (2^* \pi^* R_m ^* S_t ^* K_s ^* E_c) & (Weight) \\[-2pt] &= 0.52 ^* 4,670.4 / (2^* \pi^* 23.8125^* 20,000^* 1.20^* 0.85) \\[-2pt] &= 0.0008 \\[-2pt] t_t &= t_p + t_m - t_w & (total \ required, \ tensile) \\[-2pt] &= 0 + 0.0031 - (0.0008) \\[-2pt] &= 0.0023 \\[-2pt] t_{mc} &= M / (\pi^* R_m^2 ^* S_c ^* K_s) & (bending) \\[-2pt] &= 111,508 / (\pi^* 23.8125^2 ^* 14,898.49 ^* 1.20) \\[-2pt] &= 0.0035 \\[-2pt] t_{wc} &= (1 + 0.14 ^* S_{DS}) ^* W / (2^* \pi^* R_m ^* S_c ^* K_s) & (Weight) \\[-2pt] &= 1.08 ^* 4,670.4 / (2^* \pi^* 23.8125^* 14,898.49 ^* 1.20) \\[-2pt] &= 0.0019 \\[-2pt] t_c &= t_{mc} + t_{wc} - t_{pc} & (total \ required, \ compressive) \\[-2pt] &= 0.0035 + (0.0019) - (0) \\[-2pt] &= 0.0054 \\[-2pt] \end{array}$$

Empty, New, Seismic, Bottom Seam

BOTTOM HEAD

	ASMI	E Section VIII Div	vision 1, 2017 Editio	n		
Component Material		Ellipsoidal Head SA-516 70 (II-D p. 18, In. 33)				
Impact Tested	Normalized	Fine Grain Practice	Optimize MDMT/ Find MAWP			
No	No	No	No	No		
		Design Pressure (psi)	Design Temperature (°F)	Design MDMT (°F)		
Int	ernal	250	150	-20		
		Static Liq	uid Head			
Con	dition	P _s (psi)	H _s (in)	SG		
Operating		2.23	61.8438	1		
Test horizontal		1.71	47.375	1		
		Dimen	sions			
Outer	Diameter		48"			
Head	d Ratio	2				
Minimum	Thickness	0.3125"				
Corrosion	Inner	0"				
	Outer	0"				
Len	gth L _{sf}	2"				
Nominal T	hickness t _{sf}	0.375"				
		Weight and	l Capacity			
		Weig	ght (lb) ¹	Capacity (US gal) ¹		
New		263.8		75.43		
Corroded		263.8 75.43				
		Radiog	raphy			
Categor	y A joints	Seamless No RT				
Head to	shell seam	Spot UW-11(a)(5)(b) Type 1				

¹ includes straight flange

Results Summary					
Governing condition	internal pressure				
Minimum thickness per UG-16	0.0625" + 0" = 0.0625"				
Design thickness due to internal pressure (t)	0.2993"				
Straight Flange governs MDMT	-39.8°F				

Factor K						
$K = (1/6)^*[2 + (D / (2^*h))^2]$						
Corroded	K = (1/6)*[2 + (47.375 / (2*11.8438)) ²]	1				
New	K = (1/6)*[2 + (47.375 / (2*11.8438)) ²]	1				

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

- $P^*D_o^*K / (2^*S^*E + 2^*P^*(K 0.1)) + Corrosion$ 252.23*48*1 / (2*20,000*1 + 2*252.23*(1 0.1)) + 0
 - 0.2993"

% Extreme fiber elongation - UCS-79(d)

 $EFE = (75*t / R_f)*(1 - R_f / R_o)$

- $(75*0.375 / 8.2413)*(1 8.2413 / \infty)$
- 3.4127%

The extreme fiber elongation does not exceed 5%.

Support Skirt #1

ASME	Section V	III Divisio	n 1, 2017 Editi	on	
Compone	ent	Support Skirt			
Skirt is Attacl	hed To		BOTTOM HEA	AD .	
Skirt Attachme	nt Offset	8.8279	" down from the	top seam	
Material		SA-5	16 70 (II-D p. 1	8, In. 33)	
		Impact Tested ¹	Normalized	Fine Grain Practice	
		No	No	No	
	Desi	gn Temper	ature		
Interna	I		150°F		
		Dimension	s		
Inner Diameter	Тор	39.5"			
	Botttom	39.5"			
Length (includ ring thickn		16.17"			
Nominal Thic	kness	0.25"			
Corrosion	Inner	0"			
	Outer	0"			
		Weight			
New			138.45 lb	*	
Corroded		138.45 lb			
	Jo	int Efficier	псу		
Тор		0.55			
Bottom		0.8			

¹Impact testing requirements are not checked for supports

Skirt design thickness, largest of the following + corrosion = 0.0156 in

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

The skirt thickness of 0.25 in is adequate.

Results Summary							
Loading	Condition	Tensile or Compressive Side	Governing Skirt Location	Temperature (°F)	Allowable Stress (psi)	Calculated Stress/E (psi)	Required thickness (in)
	operating, corroded	Tensile	top	150	20,000	586.46	0.0073
Wind	Compressive	bottom		13,976.44	823.99	0.0147	
empty, corroded	Tensile	top	70	20,000	715.94	0.0089	
	Compressive	bottom		13,976.44	705.3	0.0126	
	operating, corroded	Tensile	top	150	20,000	679.2	0.0085
Seismic	Compressive	bottom		13,976.44	872.82	0.0156	
empty, corroded		Tensile	top	70	20,000	527.74	0.0066
	,	Compressive	bottom		13,976.44	577.32	0.0103

Loading due to wind, operating & corroded

Windward side (tensile)

Required thickness, tensile stress at base:

- $t = -0.6*W / (\pi^*D^*S_{,*}E) + 48*M / (\pi^*D^{2*}S_{,*}E)$
 - = $-0.6*8,747.54 / (\pi*39.75*20,000*0.8) + 48*14,059.1 / (\pi*39.75^2*20,000*0.8)$
 - = 0.0059 in

Required thickness, tensile stress at the top:

- $t = -0.6*W_t / (\pi^*D_t^*S_t^*E) + 48*M_t / (\pi^*D_t^{2*}S_t^*E)$
 - = $-0.6*8,609.09 / (\pi*39.75*20,000*0.55) + 48*12,616.8 / (\pi*39.752*20,000*0.55)$
 - = 0.0073 in

Leeward side (compressive)

Required thickness, compressive stress at base:

- $t = W / (\pi^*D^*S_c^*E_c) + 48^*M / (\pi^*D^2^*S_c^*E_c)$
 - = $8,747.54 / (\pi^*39.75^*13,976^*1) + 48^*14,059.1 / (\pi^*39.75^2*13,976^*1)$
 - = 0.0147 in

Required thickness, compressive stress at the top:

- $t = W_t / (\pi^*D_t^*S_c^*E_c) + 48^*M_t / (\pi^*D_t^{2*}S_c^*E_c)$
 - = $8,609.09 / (\pi^*39.75^*13,976^*1) + 48^*12,616.8 / (\pi^*39.75^2*13,976^*1)$
 - = 0.0137 in

Loading due to wind, empty & corroded

Windward side (tensile)

Required thickness, tensile stress at base:

- $t = -0.6*W / (\pi^*D^*S_{,*}E) + 48*M / (\pi^*D^{2*}S_{,*}E)$
 - = $-0.6*5,042.06 / (\pi*39.75*20,000*0.8) + 48*14,059.1 / (\pi*39.75^2*20,000*0.8)$
 - = 0.007 in

Required thickness, tensile stress at the top:

- $t = -0.6*W_t / (\pi^*D_t^*S_t^*E) + 48*M_t / (\pi^*D_t^{2*}S_t^*E)$
 - = $-0.6*4,903.62 / (\pi*39.75*20,000*0.55) + 48*12,616.8 / (\pi*39.75^2*20,000*0.55)$
 - = 0.0089 in

Leeward side (compressive)

Required thickness, compressive stress at base:

- $t = W / (\pi^*D^*S_c^*E_c) + 48^*M / (\pi^*D^2^*S_c^*E_c)$
 - = $5,042.06 / (\pi^*39.75^*13,976^*1) + 48^*14,059.1 / (\pi^*39.75^2*13,976^*1)$
 - = 0.0126 in

Required thickness, compressive stress at the top:

- $t = W_t / (\pi^*D_t^*S_c^*E_c) + 48^*M_t / (\pi^*D_t^{2*}S_c^*E_c)$
 - = $4,903.62 / (\pi^*39.75^*13,976^*1) + 48^*12,616.8 / (\pi^*39.75^2*13,976^*1)$
 - = 0.0115 in

Loading due to seismic, operating & corroded

Tensile side

Required thickness, tensile stress at base:

- $t = -(0.6 0.14*S_{DS})*W / (\pi*D*S_{t}*E) + 48*M / (\pi*D^{2}*S_{t}*E)$
 - = $-(0.6 0.14*0.55)*8,747.54 / (\pi*39.75*20,000*0.8) + 48*14,763.9 / (\pi*39.752*20,000*0.8)$
 - = 0.0066 in

Required thickness, tensile stress at the top:

- $t = -(0.6 0.14*S_{DS})*W_t / (\pi^*D_t^*S_t^*E) + 48*M_t / (\pi^*D_t^{2*}S_t^*E)$
 - $= \begin{array}{l} -(0.6 0.14^*0.55)^*8,609.09 \, / \, (\pi^*39.75^*20,000^*0.55) \, + \, 48^*13,386.6 \, / \\ (\pi^*39.75^{2*}20,000^*0.55) \end{array}$
 - = 0.0085 in

Compressive side

Required thickness, compressive stress at base:

- $t = (1 + 0.14 * S_{DS}) * W / (\pi * D * S_c * E_c) + 48 * M / (\pi * D^2 * S_c * E_c)$
 - $= \frac{(1+0.14^{*}0.55)^{*}8,747.54 \, / \, (\pi^{*}39.75^{*}13,976^{*}1) \, + \, 48^{*}14,763.9 \, /}{(\pi^{*}39.75^{2*}13,976^{*}1)}$

 - = 0.0156 in

Required thickness, compressive stress at the top:

```
 \begin{array}{lll} t &=& (1+0.14^*S_{DS})^*W_t\,/\,(\pi^*D_t^*S_c^*E_c) + 48^*M_t\,/\,(\pi^*D_t^{2*}S_c^*E_c) \\ &=& (1+0.14^*0.55)^*8,609.09\,/\,(\pi^*39.75^*13,976^*1) + 48^*13,386.6\,/\\ &=& (\pi^*39.75^{2*}13,976^*1) \\ &=& 0.0146 \ in \end{array}
```

Loading due to seismic, empty & corroded

Tensile side

Required thickness, tensile stress at base:

```
 \begin{array}{lll} t &=& -(0.6 - 0.14 ^{*}S_{DS})^{*}W \: / \: (\pi^{*}D^{*}S_{t}^{*}E) \: + \: 48^{*}M \: / \: (\pi^{*}D^{2*}S_{t}^{*}E) \\ &=& -(0.6 - 0.14 ^{*}0.55)^{*}5,042.06 \: / \: (\pi^{*}39.75 ^{*}20,000 ^{*}0.8) \: + \: 48^{*}10,428.9 \: / \: (\pi^{*}39.75 ^{2*}20,000 ^{*}0.8) \\ &=& 0.005 \text{ in} \end{array}
```

Required thickness, tensile stress at the top:

```
 \begin{array}{ll} t & = & -(0.6 - 0.14^*S_{DS})^*W_t \, / \, (\pi^*D_t^*S_t^*E) \, + \, 48^*M_t \, / \, (\pi^*D_t^{2^*}S_t^*E) \\ & = & -(0.6 - 0.14^*0.55)^*4,903.62 \, / \, (\pi^*39.75^*20,000^*0.55) \, + \, 48^*9,628 \, / \\ & = & \frac{-(0.6 - 0.14^*0.55)^*4,903.62 \, / \, (\pi^*39.75^*20,000^*0.55) \, + \, 48^*9,628 \, / \\ & = & \frac{-(0.6 - 0.14^*S_{DS})^*M_t \, / \, (\pi^*D_t^{2^*}S_t^*E) \, / \, (\pi^*39.75^*20,000^*0.55) \, + \, 48^*9,628 \,
```

Compressive side

Required thickness, compressive stress at base:

```
 \begin{array}{ll} t &=& (1+0.14^*S_{DS})^*W \, / \, (\pi^*D^*S_c{}^*E_c) \, + \, 48^*M \, / \, (\pi^*D^2{}^*S_c{}^*E_c) \\ &=& (1+0.14^*0.55)^*5,042.06 \, / \, (\pi^*39.75^*13,976^*1) \, + \, 48^*10,428.9 \, / \\ &=& (\pi^*39.75^2{}^*13,976^*1) \\ &=& 0.0103 \text{ in} \end{array}
```

Required thickness, compressive stress at the top:

```
 \begin{array}{ll} t &=& (1+0.14^*S_{DS})^*W_t\,/\,(\pi^*D_t^*S_c^*E_c) + 48^*M_t\,/\,(\pi^*D_t^{2*}S_c^*E_c) \\ &=& \frac{(1+0.14^*0.55)^*4,903.62\,/\,(\pi^*39.75^*13,976^*1) + 48^*9,628\,/}{(\pi^*39.75^{2*}13,976^*1)} \\ &=& 0.0097 \text{ in} \end{array}
```

Skirt Buckling Check per ASCE 15.7.10.5

4.4.12.2.b Allowable Axial Co	mpressive Membrane Str	ess
$M_x = L / (R_o^* t)^{0.5}$		(4.4.124)
cbar = 2.64	for M _x ≤ 1.5	(4.4.69)
cbar = 3.13 / M _x ^{0.42}	for 1.5 < M _x < 15	(4.4.70)
cbar = 1	for M _x ≥ 15	(4.4.71)
$C_x = min[409*cbar / (389 + D_o / t), 0.9]$	for D _o / t < 1247	(4.4.67)
C _x = 0.25*cbar	for $1247 \le D_0 / t \le 2000$	(4.4.68)
$F_{xe} = C_x * E_y * t / D_o$		(4.4.66)
$F_{xa2} = F_{xe} / FS$		(4.4.65)
$F_{xa1} = S_y / FS$	for D _o / t ≤ 135	(4.4.62)
$F_{xa1} = 466 * S_y / [FS*(331 + D_o / t)]$	for 135 < D _o / t < 600	(4.4.63)
$F_{xa1} = 0.5 * S_y / FS$	for $600 \le D_0 / t \le 2000$	(4.4.64)
$F_{xa} = min[F_{xa1}, F_{xa2}]$		(4.4.61)
$\lambda_{c} = K_{u}^{*}L_{u} / (\pi^{*}r_{g})^{*}(F_{xa}^{*}FS / E_{y})^{0.5}$		(4.4.125)
New / Co	orroded	
D _o / t = 40 / (0.875*0.25) =		160
$M_x = 16.17 / (20^*0.875^*0.25)^{0.5} =$	7.2314	
cbar = 3.13 / M _x ^{0.42} =		1.3635
$C_x = min[409*1.3635 / (389 + 40 / (0.875)]$	*0.25)) , 0.9] =	0.9
Operating Ho	t & Corroded	
F _{xe} = 0.9*29.03E+06*0.875*0.25 / 40 =		163,298 psi
F _{xa1} = 466*35,700 / [1*(331 + 40 / 0.875*0	33,882 psi	
F _{xa2} = 163,298 / 1 =	163,298 psi	
F _{xa} = min[33,882 , 163,298] =		33,882 psi
$\lambda_{c} = 2.1*279.1542 / (\pi*14.054)*(33,882*1)$	/ 29.03E+06) ^{0.5} =	0.4536
Operating	Hot & New	
F _{xe} = 0.9*29.03E+06*0.875*0.25 / 40 =		163,298 psi
F _{xa1} = 466*35,700 / [1*(331 + 40 / 0.875*0	33,882 psi	
F _{xa2} = 163,298 / 1 =	163,298 psi	
F _{xa} = min[33,882 , 163,298] =	33,882 psi	
$\lambda_{c} = 2.1*279.1542 / (\pi*14.054)*(33,882*1)$	0.4536	
Empty Cold	& Corroded	
F _{xe} = 0.9*29.4E+06*0.875*0.25 / 40 =		165,375 psi
F _{xa1} = 466*38,000 / [1*(331 + 40 / 0.875*0	36,065 psi	

F _{xa2} = 165,375 / 1 =	165,375 psi
F _{xa} = min[36,065 , 165,375] =	36,065 psi
$\lambda_c = 2.1*279.1542 / (\pi^*14.054)^*(36,065*1 / 29.4E+06)^{0.5} =$	0.465
Empty Cold & New	
F _{xe} = 0.9*29.4E+06*0.875*0.25 / 40 =	165,375 psi
F _{xa1} = 466*38,000 / [1*(331 + 40 / 0.875*0.25)] =	36,065 psi
F _{xa2} = 165,375 / 1 =	165,375 psi
F _{xa} = min[36,065 , 165,375] =	36,065 psi
$\lambda_c = 2.1*279.1542 / (\pi*14.054)*(36,065*1 / 29.4E+06)^{0.5} =$	0.465

4.4.12.2.c Com	pressive Bending Stress	
$\gamma = S_y^* D_o / (E_y^* t)$		(4.4.78)
$F_{ba} = F_{xa}$	for $135 \le D_o / t \le 2000$	(4.4.74)
$F_{ba} = 466*S_y / [FS*(331 + D_o / t)]$	for 100 ≤ D _o / t < 135	(4.4.75)
$F_{ba} = 1.081*S_y / FS$	for $D_o / t < 100$ and $\gamma \ge 0.11$	(4.4.76)
$F_{ba} = S_y^* (1.4 - 2.9^* \gamma) / FS$	for $D_0 / t < 100$ and $\gamma < 0.11$	(4.4.77)
Operatin	g Hot & Corroded	
$D_o / t = 40 / (0.875*0.25) =$		160
γ = 35,700*40 / (29.03E+06*0.875*	(0.25) =	0.1968
$F_{ba} = F_{xa} =$	33,882 psi	
	ting Hot & New	
$D_o / t = 40 / (0.875*0.25) =$		160
$\gamma = 35,700*40 / (29.03E+06*0.875*)$	0.1968	
$F_{ba} = F_{xa} =$	33,882 psi	
Empty (Cold & Corroded	
D _o / t = 40 / (0.875*0.25) =		160
γ = 38,000*40 / (29.4E+06*0.875*0	0.25) =	0.2068
$F_{ba} = F_{xa} =$		36,065 psi
Emp	ty Cold & New	
$D_o / t = 40 / (0.875^*0.25) =$		160
γ = 38,000*40 / (29.4E+06*0.875*0.25) =		0.2068
$F_{ba} = F_{xa} =$		36,065 psi

4.4.12.2.d Allow	able Shear Stress	
$C_{v} = 4.454$	for M _x ≤ 1.5	(4.4.81)
$C_v = (9.64 / M_x^2)*(1 + 0.0239*M_x^3)^{0.5}$	for 1.5 < M _x < 26	(4.4.82)
$C_v = 1.492 / M_x^{0.5}$	for $26 \le M_x < 4.347*(D_o / t)$	(4.4.83)
$C_v = 0.716*(t / D_o)^{0.5}$	for $M_x \ge 4.347^*(D_o / t)$	(4.4.84)
$\alpha_{\rm v} = 0.8$	for D _o / t ≤ 500	(4.4.85)
$\alpha_{\rm v} = 1.389 - 0.218*\log_{10}({\rm D_o}/{\rm t})$	for D _o / t > 500	(4.4.86)
$\eta_v = 1$	for $F_{ve} / S_{y} \le 0.48$	(4.4.87)
$\eta_{v} = 0.43*(S_{y} / F_{ve}) + 0.1$	for 0.48 < F _{ve} / S _y < 1.7	(4.4.88)
$\eta_{\rm v} = 0.6^{\star}({\rm S_y}/{\rm F_{ve}})$	for $F_{ve} / S_y \ge 1.7$	(4.4.89)
$F_{ve} = \alpha_v^* C_v^* E_y^* (t / D_o)$		(4.4.80)
$F_{va} = \eta_v^* F_{ve} / FS$		(4.4.79)
Operating H	ot & Corroded	
$D_o / t = 40 / (0.875*0.25) =$		160
$M_x = 16.17 / (20*0.875*0.25)^{0.5} =$		7.2314
F _{ve} / S _y = 84,777 / 35,700 =		2.3747
$C_v = (9.64 / 7.2314^2)*(1 + 0.0239*7.2314^2)$	0.5841	
$\alpha_{\rm v} = 0.8 =$	0.8	
$\eta_v = 0.6*(35,700 / 84,777) =$		0.2527
F _{ve} = 0.8*0.5841*29.03E+06*(0.875*0.2	5 / 40) =	84,777 psi
F _{va} = 0.2527*84,777 / 1 =	21,420 psi	
Operating	Hot & New	
D _o / t = 40 / (0.875*0.25) =		160
$M_x = 16.17 / (20*0.875*0.25)^{0.5} =$	7.2314	
$F_{ve} / S_{y} = 84,777 / 35,700 =$		2.3747
$C_v = (9.64 / 7.2314^2)*(1 + 0.0239*7.2314^2)$	1 ³) ^{0.5} =	0.5841
$\alpha_{v} = 0.8 =$		0.8
$\eta_{v} = 0.6*(35,700 / 84,777) =$		0.2527
$F_{ve} = 0.8*0.5841*29.03E+06*(0.875*0.28)$	5 / 40) =	84,777 psi
F _{va} = 0.2527*84,777 / 1 =	21,420 psi	
Empty Cole	d & Corroded	
$D_o / t = 40 / (0.875^*0.25) =$		160
$M_x = 16.17 / (20*0.875*0.25)^{0.5} =$		7.2314
F _{ve} / S _y = 85,856 / 38,000 =		2.2594
$C_v = (9.64 / 7.2314^2)^*(1 + 0.0239^*7.2314^2)^*$	1 ³) ^{0.5} =	0.5841
$\alpha_{\rm v} = 0.8 =$		0.8

0.2656
85,856 psi
22,800 psi
160
7.2314
2.2594
0.5841
0.8
0.2656
85,856 psi
22,800 psi

4.4.12.2.i Axial	Compression, Bending Moment, and Shear	
$f_b = M/S$		(4.4.119)
$f_a = F / A$		(4.4.120)
$f_v = V*sin[\phi] / A$		(4.4.122)
$K_s = 1 - (f_v / F_{va})^2$		(4.4.105)
$F_e = \pi^{2*} E_y / (K_u^* L_u / r_g)^2$		(4.4.110)
$\Delta = C_m / (1 - f_a *FS / F_e)$		(4.4.109)
$F_{ca} = F_{xa}^*[1 - 0.74^*(\lambda_c - 0.15)]^{0.3}$	for $0.15 < \lambda_c < 1.2$	(4.4.72)
$f_a / (K_s^* F_{ca}) + 8^* \Delta^* f_b / (9^* K_s^* F_{ba}) \le 1$	for $f_a / (K_s^* F_{ca}) \ge 0.2$	(4.4.112)
$f_a / (2^*K_s^*F_{ca}) + \Delta^*f_b / (K_s^*F_{ba}) \le 1$	for $f_a / (K_s^* F_{ca}) < 0.2$	(4.4.113)
	New / Corroded	
$r_g = 0.25*(40^2 + 39.5^2)^{0.5} =$		14.054"
$A = \pi^*(40^2 - 39.5^2) / 4 =$		
$S = \pi^*(40^4 - 39.5^4) / (32^*40) =$		308.3177 in ³
	Operating Hot & Corroded	
	f _b = 246,556.7 / 308.3177 =	800 psi
	f _a = 8,747.54 / 31.22 =	280 psi
	f _v = 1,461.16*sin[90] / 31.22 =	47 psi
Seismic ASCE 15.7.10.5	$K_s = 1 - (47 / 21,420)^2 =$	1
	$F_e = \pi^{2*}29.03E + 06 / (2.1*279.1542 / 14.054)^2 =$	164,677 psi
	Δ = 1 / (1 - 280*1 / 164,677) =	1.0017
	$F_{ca} = 33,882*[1 - 0.74*(0.4536 - 0.15)]^{0.3} =$	31,392 psi
	$f_a / (K_s * F_{ca}) = 280 / (1*31,392) =$	0.0089

	280 / (2*1*31,392) + 1.0017*800 / (1*33,882) =	0.0281
	Combined load check passes.	
	Operating Hot & New	
	f _b = 246,556.7 / 308.3177 =	800 psi
	f _a = 8,747.54 / 31.22 =	280 psi
	f _v = 1,461.16*sin[90] / 31.22 =	47 psi
Seismic ASCE 15.7.10.5	$K_s = 1 - (47 / 21,420)^2 =$	1
	$F_e = \pi^{2*}29.03E+06 / (2.1*279.1542 / 14.054)^2 =$	164,677 psi
	Δ = 1 / (1 - 280*1 / 164,677) =	1.0017
	$F_{ca} = 33,882*[1 - 0.74*(0.4536 - 0.15)]^{0.3} =$	31,392 psi
	$f_a / (K_s^* F_{ca}) = 280 / (1*31,392) =$	0.0089
	280 / (2*1*31,392) + 1.0017*800 / (1*33,882) =	0.0281
	Combined load check passes.	
	Empty Cold & Corroded	
	f _b = 172,241.8 / 308.3177 =	559 psi
	f _a = 5,042.06 / 31.22 =	162 psi
	f _v = 849.76*sin[90] / 31.22 =	27 psi
Seismic ASCE 15.7.10.5	K _s = 1 - (27 / 22,800) ² =	1
	$F_e = \pi^{2*}29.4E+06 / (2.1*279.1542 / 14.054)^2 =$	166,771 psi
	Δ = 1 / (1 - 162*1 / 166,771) =	1.001
	$F_{ca} = 36,065*[1 - 0.74*(0.465 - 0.15)]^{0.3} =$	33,305 psi
	$f_a / (K_s * F_{ca}) = 162 / (1*33,305) =$	0.0048
	162 / (2*1*33,305) + 1.001*559 / (1*36,065) =	0.0179
	Combined load check passes.	
	Empty Cold & New	
	f _b = 172,241.8 / 308.3177 =	559 psi
	f _a = 5,042.06 / 31.22 =	162 psi
	f _v = 849.76*sin[90] / 31.22 =	27 psi
Seismic ASCE 15.7.10.5	K _s = 1 - (27 / 22,800) ² =	1
	$F_e = \pi^{2*}29.4E+06 / (2.1*279.1542 / 14.054)^2 =$	166,771 psi
	Δ = 1 / (1 - 162*1 / 166,771) =	1.001
	$F_{ca} = 36,065*[1 - 0.74*(0.465 - 0.15)]^{0.3} =$	33,305 psi
	$f_a / (K_s * F_{ca}) = 162 / (1*33,305) =$	0.0048
	162 / (2*1*33,305) + 1.001*559 / (1*36,065) =	0.0179
	Combined load check passes.	

Skirt Base Ring #1

Inputs				
Base configuration	single base plate without gussets			
Base plate material	SA-516-70			
Base plate allowable stress, S _p	20,000 psi			
Foundation compressive strength	1,658 psi			
Concrete ultimate 28-day strength	3,000 psi			
Bolt circle, BC	44.125"			
Base plate inner diameter, D _I	34.625"			
Base plate outer diameter, D _o	46.625"			
Base plate thickness, t _b	0.5"			
Anchor Bolts	5			
Material				
Allowable stress, S _b	20,000 psi			
Bolt size and type	0.75" coarse threaded			
Number of bolts, N	. 4			
Corrosion allowance (applied to root radius)	0"			
Anchor bolt clearance	0.375"			
Bolt root area (corroded), A _b	0.3 in ²			
Diameter of anchor bolt holes, d _b	1.125"			
Initial bolt preload	0% (0 psi)			
Bolt at 0°	No			

	Results Summary							
Load	Vessel condition	Base V (lb _f)	Base M (lb _f -ft)	W (lb)	Required bolt area (in²)	t _r Base (in)	Foundation bearing stress (psi)	
Wind	operating, corroded	1,098.4	14,059.1	8,855.5	0.1248	0.3689	82.67	
Wind	operating, new	1,098.4	14,059.1	8,855.5	0.1248	0.3689	82.67	
Wind	empty, corroded	1,098.4	14,059.1	5,150.1	0.1525	0.3627	79.94	
Wind	empty, new	1,098.4	14,059.1	5,150.1	0.1525	0.3627	<u>79.94</u>	
Seismic	operating, corroded	1,022.8	14,763.9	8,855.5	0.1429	0.3995	<u>96.99</u>	
Seismic	operating, new	1,022.8	14,763.9	8,855.5	0.1429	0.3995	96.99	
Seismic	empty, corroded	594.8	10,428.9	5,150.1	0.1081	0.3314	66.72	
Seismic	empty, new	594.8	10,428.9	5,150.1	0.1081	0.3314	66.72	

Anchor bolt load (operating, corroded + Wind)

Required area per bolt = P / $S_b = 0.1248$ in²

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, operating, corroded + Wind)

Base plate width, t_c: Average base plate diameter, d: 40.625 Base plate elastic modulus, E_s: 29.0E+06psi

Base plate yield stress, S_v: 38,000

$$E_c = 57,000*Sqr(3,000) = 3,122,019 \text{ psi}$$

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

$$\begin{aligned} t_s &= (N^*A_b) / (\pi^*d) \\ &= (4^*0.302) / (\pi^*40.625) \\ &= 0.0095 \text{ in} \end{aligned}$$

From table 12.4 for k = 0.15839:

$$K_1 = 2.7533, \quad K_2 = 1.0792$$
 $L_1 = 13.8762, \quad L_2 = 26.2443, \quad L_3 = 5.1241$

Total tensile force on bolting

$$\begin{split} T &= \left(12^*M - 0.6^*W \ ^*(L_1 + L_3)\right) \ / \ (L_2 + L_3) \\ &= \left(12^*14,059.1 - 0.6^*8,855.54 \ ^*(13.8762 + 5.1241)\right) \ / \ (26.2443 + 5.1241) \\ &= 2,159.97 \ lb_f \end{split}$$

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

$$f_s = T / (t_s * (d / 2) * K_1)$$

```
= 2,159.97 / (0.0095 * (40.625 / 2) * 2.7533)
= 4,080 psi
```

Total compressive load on foundation

```
C_c = T + W + Bolt Preload
= 2,159.97 + 8,855.54 + 0
= 11,015.51 lb<sub>f</sub>
```

Foundation bearing stress

$$\begin{split} &f_c = C_c \, / \, (((t_c - t_s) + n^*t_s)^* (d \, / \, 2)^* K_2) \\ &= 11,015.51 \, / \, (((6 - 0.0095) + 9.2889^*0.0095)^* (40.625 \, / \, 2)^*1.0792) \\ &= \underline{83} \, \text{psi} \end{split}$$

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 4,080 / (9.2889*83))
= 0.15839

Base plate required thickness (operating, corroded + Wind)

$$\begin{aligned} t_r &= (3^* f_c^* L^2 / S_p)^{0.5} \\ &= (3^* 83^* 3.3125^2 / 20,000)^{0.5} \\ &= \underline{0.3689} \text{ in} \end{aligned}$$

The base plate thickness is satisfactory.

Anchor bolt load (operating, new + Wind)

Required area per bolt = $P / S_h = 0.1248 \text{ in}^2$

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, operating, new + Wind)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_v : 38,000 psi

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

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

$$t_s = (N^*A_b) / (\pi^*d)$$

= $(4^*0.302) / (\pi^*40.625)$
= 0.0095 in

From table 12.4 for k = 0.15839:

$$K_1 = 2.7533$$
, $K_2 = 1.0792$
 $L_1 = 13.8762$, $L_2 = 26.2443$, $L_3 = 5.1241$

Total tensile force on bolting

```
T = (12*M - 0.6*W *(L<sub>1</sub> + L<sub>3</sub>)) / (L<sub>2</sub> + L<sub>3</sub>)
= (12*14,059.1 - 0.6*8,855.54 *(13.8762 + 5.1241)) / (26.2443 + 5.1241)
= 2,159.97 lb<sub>f</sub>
```

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

$$\begin{split} f_s &= T / (t_s * (d / 2) * K_1) \\ &= 2,159.97 / (0.0095 * (40.625 / 2) * 2.7533) \\ &= 4,080 \text{ psi} \end{split}$$

Total compressive load on foundation

$$C_c = T + W + Bolt Preload$$

= 2,159.97 + 8,855.54 + 0
= 11,015.51 lb_f

Foundation bearing stress

```
f_c = C_c / (((t_c - t_s) + n^*t_s)^*(d / 2)^*K_2)
= 11,015.51 / (((6 - 0.0095) + 9.2889*0.0095)*(40.625 / 2)*1.0792)
= 83 psi
```

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 4,080 / (9.2889*83))
= 0.15839

Base plate required thickness (operating, new + Wind)

$$t_r = (3*f_c*L^2 / S_p)^{0.5}$$

= $(3*83*3.3125^2 / 20,000)^{0.5}$
= 0.3689 in

The base plate thickness is satisfactory.

Anchor bolt load (empty, corroded + Wind)

```
P = -0.6*W / N + 48 * M / (N*BC)
= -0.6*5,150.06 / 4 + 48 * 14,059.1 / (4*44.125)
= 3,050.94 lb<sub>f</sub>
```

Required area per bolt = $P / S_b = 0.1525 \text{ in}^2$

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, empty, corroded + Wind)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_y : 38,000 psi

$$E_c = 57,000*Sqr(3,000) = 3,122,019 \text{ psi}$$

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

$$t_s = (N^*A_b) / (\pi^*d)$$

= (4*0.302) / (\pi*40.625)
= 0.0095 in

From table 12.4 for k = 0.105318:

$$K_1 = 2.8747$$
, $K_2 = 0.875$
 $L_1 = 16.0325$, $L_2 = 27.7418$, $L_3 = 3.4132$

Total tensile force on bolting

```
T = (12*M - 0.6*W *(L<sub>1</sub> + L<sub>3</sub>)) / (L<sub>2</sub> + L<sub>3</sub>)
= (12*14,059.1 - 0.6*5,150.06 *(16.0325 + 3.4132)) / (27.7418 + 3.4132)
= 3,486.49 lb<sub>f</sub>
```

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

$$\begin{split} f_s &= T \, / \, (t_s \, ^* \, (d \, / \, 2) \, ^* \, K_1) \\ &= 3,486.49 \, / \, (0.0095 \, ^* \, (40.625 \, / \, 2) \, ^* \, 2.8747) \\ &= 6,308 \, psi \end{split}$$

Total compressive load on foundation

$$C_c = T + W + Bolt Preload$$

= 3,486.49 + 5,150.06 + 0
= 8,636.55 lb_f

Foundation bearing stress

$$\begin{split} &f_c = C_c \, / \, (((t_c - t_s) \, + \, n^*t_s)^* (d \, / \, 2)^* K_2) \\ &= 8,636.55 \, / \, (((6 \, - \, 0.0095) \, + \, 9.2889^* 0.0095)^* (40.625 \, / \, 2)^* 0.875) \\ &= \underline{80} \, \text{psi} \end{split}$$

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 6,308 / (9.2889*80))
= 0.105318

Base plate required thickness (empty, corroded + Wind)

```
\begin{array}{l} t_r = (3^*f_c^*L^2 / S_p)^{0.5} \\ = (3^*80^*3.3125^2 / 20,000)^{0.5} \\ = \underline{0.3627} \text{ in} \end{array}
```

The base plate thickness is satisfactory.

Anchor bolt load (empty, new + Wind)

Required area per bolt = $P / S_b = 0.1525 \text{ in}^2$

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, empty, new + Wind)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_v : 38,000 psi

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

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

 $t_s = (N^*A_b) / (\pi^*d)$ = (4*0.302) / (\pi*40.625) = 0.0095 in

From table 12.4 for k = 0.105318:

$$K_1 = 2.8747, K_2 = 0.875$$

 $L_1 = 16.0325, L_2 = 27.7418, L_3 = 3.4132$

Total tensile force on bolting

$$T = (12*M - 0.6*W *(L1 + L3)) / (L2 + L3)$$

$$= (12*14,059.1 - 0.6*5,150.06 *(16.0325 + 3.4132)) / (27.7418 + 3.4132)$$

$$= 3,486.49 lbf$$

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

$$f_s = T / (t_s * (d / 2) * K_1)$$

= 3,486.49 / (0.0095 * (40.625 / 2) * 2.8747)
= 6,308 psi

Total compressive load on foundation

$$C_c = T + W + Bolt Preload$$

= 3,486.49 + 5,150.06 + 0
= 8,636.55 lb_f

Foundation bearing stress

$$f_c = C_c / (((t_c - t_s) + n^*t_s)^*(d / 2)^*K_2)$$
= 8,636.55 / (((6 - 0.0095) + 9.2889*0.0095)*(40.625 / 2)*0.875)
= 80 psi

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 6,308 / (9.2889*80))
= 0.105318

Base plate required thickness (empty, new + Wind)

$$\begin{aligned} t_r &= (3^* f_c^* L^2 / S_p)^{0.5} \\ &= (3^* 80^* 3.3125^2 / 20,000)^{0.5} \\ &= \underline{0.3627} \text{ in} \end{aligned}$$

The base plate thickness is satisfactory.

Anchor bolt load (operating, corroded + Seismic)

$$\begin{split} P &= -(0.6 - 0.14^*S_{DS})^*W / N + 48 * M / (N^*BC) \\ &= -(0.6 - 0.14^*0.55)^*8,855.54 / 4 + 48 * 14,763.9 / (4^*44.125) \\ &= 2,857.26 \ lb_f \end{split}$$

Required area per bolt = $P/S_h = 0.1429$ in²

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, operating, corroded + Seismic)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_v : 38,000 psi

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

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

$$t_s = (N^*A_b) / (\pi^*d)$$

= (4*0.302) / (\pi*40.625)
= 0.0095 in

From table 12.4 for k = 0.145484:

$$K_1 = 2.7824$$
, $K_2 = 1.0328$
 $L_1 = 14.4005$, $L_2 = 26.6126$, $L_3 = 4.7087$

Total tensile force on bolting

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

$$= (12*14,763.9 - (0.6 - 0.14*0.55)*8,855.54 *(14.4005 + 4.7087)) / (26.6126 + 4.7087)$$

$$= 2,830.78 lb_4$$

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

$$\begin{split} &f_s = T / (t_s * (d / 2) * K_1) \\ &= 2,830.78 / (0.0095 * (40.625 / 2) * 2.7824) \\ &= 5,292 \text{ psi} \end{split}$$

Total compressive load on foundation

$$C_c = T + (1 + 0.14*S_{DS})*W + Bolt Preload$$

= 2,830.78 + (1 + 0.14*0.55)*8,855.54 + 0
= 12,368.2 lb_f

Foundation bearing stress

$$\begin{split} &f_c = C_c \, / \, (((t_c - t_s) \, + \, n^*t_s)^*(d \, / \, 2)^*K_2) \\ &= 12,368.2 \, / \, (((6 \, - \, 0.0095) \, + \, 9.2889^*0.0095)^*(40.625 \, / \, 2)^*1.0328) \\ &= \underline{97} \, \text{psi} \end{split}$$

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 5,292 / (9.2889*97))

= 0.145484

Base plate required thickness (operating, corroded + Seismic)

$$\begin{split} t_r &= (3^* f_c^* L^2 / S_p)^{0.5} \\ &= (3^* 97^* 3.3125^2 / 20,000)^{0.5} \\ &= \underline{0.3995} \text{ in} \end{split}$$

The base plate thickness is satisfactory.

Anchor bolt load (operating, new + Seismic)

$$\begin{split} P &= -(0.6 - 0.14*S_{DS})*W / N + 48 * M / (N*BC) \\ &= -(0.6 - 0.14*0.55)*8,855.54 / 4 + 48 * 14,763.9 / (4*44.125) \\ &= 2,857.26 \ lb_f \end{split}$$

Required area per bolt = P / $S_b = 0.1429$ in²

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, operating, new + Seismic)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_v : 38,000 psi

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

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

$$t_s = (N^*A_b) / (\pi^*d)$$

= (4*0.302) / (\pi*40.625)
= 0.0095 in

From table 12.4 for k = 0.145484:

$$K_1 = 2.7824$$
, $K_2 = 1.0328$
 $L_1 = 14.4005$, $L_2 = 26.6126$, $L_3 = 4.7087$

Total tensile force on bolting

$$\begin{split} T &= \left(12^*\text{M} - (0.6 - 0.14^*\text{S}_{DS})^*\text{W} \ ^*(\text{L}_1 + \text{L}_3)\right) \ / \ (\text{L}_2 + \text{L}_3) \\ &= \left(12^*14,763.9 - (0.6 - 0.14^*0.55)^*8,855.54 \ ^*(14.4005 + 4.7087)\right) \ / \ (26.6126 + 4.7087) \\ &= 2,830.78 \ \text{lb}_{\text{f}} \end{split}$$

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

$$f_s = T / (t_s * (d / 2) * K_1)$$
= 2,830.78 / (0.0095 * (40.625 / 2) * 2.7824)
= 5,292 psi

Total compressive load on foundation

$$C_c = T + (1 + 0.14*S_{DS})*W + Bolt Preload$$

= 2,830.78 + (1 + 0.14*0.55)*8,855.54 + 0
= 12,368.2 lb_f

Foundation bearing stress

$$\begin{split} &f_c = C_c \, / \, (((t_c - t_s) + n^* t_s)^* (d \, / \, 2)^* K_2) \\ &= 12,368.2 \, / \, (((6 - 0.0095) + 9.2889^* 0.0095)^* (40.625 \, / \, 2)^* 1.0328) \\ &= \underline{97} \, \text{psi} \end{split}$$

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 5,292 / (9.2889*97))
= 0.145484

Base plate required thickness (operating, new + Seismic)

$$\begin{array}{l} t_r = (3^*f_c^*L^2 / S_p)^{0.5} \\ = (3^*97^*3.3125^2 / 20,000)^{0.5} \\ = \underline{0.3995} \text{ in} \end{array}$$

The base plate thickness is satisfactory.

Anchor bolt load (empty, corroded + Seismic)

$$P = -(0.6 - 0.14*S_{DS})*W / N + 48 * M / (N*BC)$$

= -(0.6 - 0.14*0.55)*5,150.06 / 4 + 48 * 10,428.9 / (4*44.125)
= 2,162.81 lb_f

Required area per bolt = P / $S_b = 0.1081$ in²

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, empty, corroded + Seismic)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_v : 38,000 psi

 $E_c = 57,000*Sqr(3,000) = 3,122,019 \text{ psi}$

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

$$t_s = (N^*A_b) / (\pi^*d)$$

= $(4^*0.302) / (\pi^*40.625)$
= 0.0095 in

From table 12.4 for k = 0.125674:

$$K_1 = 2.8276,$$
 $K_2 = 0.9579$
 $L_1 = 15.2053,$ $L_2 = 27.173,$ $L_3 = 4.0703$

Total tensile force on bolting

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

$$= (12*10,428.9 - (0.6 - 0.14*0.55)*5,150.06 *(15.2053 + 4.0703)) / (27.173 + 4.0703)$$

$$= 2,343.8 lb_f$$

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

```
f_s = T / (t_s * (d / 2) * K_1)
= 2,343.8 / (0.0095 * (40.625 / 2) * 2.8276)
= 4,311 psi
```

Total compressive load on foundation

$$C_c = T + (1 + 0.14*S_{DS})*W + Bolt Preload$$

= 2,343.8 + (1 + 0.14*0.55)*5,150.06 + 0
= 7,890.42 lb_f

Foundation bearing stress

$$f_c = C_c / (((t_c - t_s) + n^*t_s)^*(d / 2)^*K_2)$$
= 7,890.42 / (((6 - 0.0095) + 9.2889*0.0095)*(40.625 / 2)*0.9579)
= $\underline{67}$ psi

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 4,311 / (9.2889*67))
= 0.125674

Base plate required thickness (empty, corroded + Seismic)

$$t_r = (3*f_c*L^2 / S_p)^{0.5}$$

= $(3*67*3.3125^2 / 20,000)^{0.5}$
= 0.3314 in

The base plate thickness is satisfactory.

Anchor bolt load (empty, new + Seismic)

$$P = -(0.6 - 0.14*S_{DS})*W / N + 48 * M / (N*BC)$$

= -(0.6 - 0.14*0.55)*5,150.06 / 4 + 48 * 10,428.9 / (4*44.125)
= 2,162.81 lb_f

Required area per bolt = P / $S_h = 0.1081$ in²

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, empty, new + Seismic)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_v : 38,000 psi

$$E_c = 57,000*Sqr(3,000) = 3,122,019 \text{ psi}$$

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

$$\begin{aligned} t_s &= (N^*A_b) \ / \ (\pi^*d) \\ &= (4^*0.302) \ / \ (\pi^*40.625) \\ &= 0.0095 \ in \end{aligned}$$

From table 12.4 for k = 0.125674:

$$K_1 = 2.8276, K_2 = 0.9579$$

 $L_1 = 15.2053, L_2 = 27.173, L_3 =$

Total tensile force on bolting

```
\begin{split} T &= (12^*M - (0.6 - 0.14^*S_{DS})^*W \ ^*(L_1 + L_3)) \ / \ (L_2 + L_3) \\ &= (12^*10,428.9 - (0.6 - 0.14^*0.55)^*5,150.06 \ ^*(15.2053 + 4.0703)) \ / \ (27.173 + 4.0703) \\ &= 2,343.8 \ lb_f \end{split}
```

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

$$\begin{split} &f_s = T \ / \ (t_s^* \ (d \ / \ 2) \ ^* \ K_1) \\ &= 2,343.8 \ / \ (0.0095 \ ^* \ (40.625 \ / \ 2) \ ^* \ 2.8276) \\ &= 4,311 \ psi \end{split}$$

Total compressive load on foundation

$$C_c = T + (1 + 0.14*S_{DS})*W + Bolt Preload$$

= 2,343.8 + (1 + 0.14*0.55)*5,150.06 + 0
= 7,890.42 lb_f

Foundation bearing stress

$$\begin{split} &f_c = C_c \, / \, (((t_c - t_s) + n^*t_s)^*(d \, / \, 2)^*K_2) \\ &= 7,890.42 \, / \, (((6 - 0.0095) + 9.2889^*0.0095)^*(40.625 \, / \, 2)^*0.9579) \\ &= \underline{67} \, \text{psi} \end{split}$$

As $f_c \le 1,658$ psi the base plate width is satisfactory.

Base plate required thickness (empty, new + Seismic)

$$\begin{array}{l} t_r = (3^*f_c^*L^2 / S_p)^{0.5} \\ = (3^*67^*3.3125^2 / 20,000)^{0.5} \\ = \underline{0.3314} \text{ in} \end{array}$$

The base plate thickness is satisfactory.

Foundation bearing stress

$$\begin{split} &f_c = C_c \: / \: (((t_c - t_s) \: + \: n^*t_s)^*(d \: / \: 2)^*K_2) \\ &= \: 12,368.2 \: / \: (((6 \: - \: 0.0095) \: + \: 9.2889^*0.0095)^*(40.625 \: / \: 2)^*1.0328) \\ &= \: \underline{97} \: psi \end{split}$$

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 5,292 / (9.2889*97))
= 0.145484

Base plate required thickness (operating, new + Seismic)

$$\begin{array}{l} t_r = (3^*f_c^*L^2 / S_p)^{0.5} \\ = (3^*97^*3.3125^2 / 20,000)^{0.5} \\ = \underline{0.3995} \text{ in} \end{array}$$

The base plate thickness is satisfactory.

Anchor bolt load (empty, corroded + Seismic)

$$\begin{split} P &= -(0.6 - 0.14^*S_{DS})^*W \ / \ N + 48 \ ^*M \ / \ (N^*BC) \\ &= -(0.6 - 0.14^*0.55)^*5,150.06 \ / \ 4 + 48 \ ^*10,428.9 \ / \ (4^*44.125) \\ &= 2,162.81 \ lb_f \end{split}$$

Required area per bolt = $P / S_b = 0.1081$ in²

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, empty, corroded + Seismic)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_v : 38,000 psi

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

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

$$t_s = (N^*A_b) / (\pi^*d)$$

= (4*0.302) / (\pi*40.625)
= 0.0095 in

From table 12.4 for k = 0.125674:

$$K_1 = 2.8276,$$
 $K_2 = 0.9579$ $L_1 = 15.2053,$ $L_2 = 27.173,$ $L_3 = 4.0703$

Total tensile force on bolting

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

$$= (12*10,428.9 - (0.6 - 0.14*0.55)*5,150.06 *(15.2053 + 4.0703)) / (27.173 + 4.0703)$$

$$= 2,343.8 | b_t$$

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

```
f_s = T / (t_s * (d / 2) * K_1)
= 2,343.8 / (0.0095 * (40.625 / 2) * 2.8276)
= 4,311 psi
```

Total compressive load on foundation

$$C_c = T + (1 + 0.14*S_{DS})*W + Bolt Preload$$

= 2,343.8 + (1 + 0.14*0.55)*5,150.06 + 0
= 7,890.42 lb_f

Foundation bearing stress

$$\begin{split} &f_c = C_c \, / \, (((t_c - t_s) + n^*t_s)^* (d \, / \, 2)^* K_2) \\ &= 7,890.42 \, / \, (((6 - 0.0095) + 9.2889^* 0.0095)^* (40.625 \, / \, 2)^* 0.9579) \\ &= \underline{67} \, \text{psi} \end{split}$$

As $f_c \le 1,658$ psi the base plate width is satisfactory.

$$k = 1 / (1 + f_s / (n^*f_c))$$

= 1 / (1 + 4,311 / (9.2889*67))
= 0.125674

Base plate required thickness (empty, corroded + Seismic)

$$\begin{array}{l} t_r = (3^* f_c^* L^2 / S_p)^{0.5} \\ = (3^* 67^* 3.3125^2 / 20,000)^{0.5} \\ = \underline{0.3314} \text{ in} \end{array}$$

The base plate thickness is satisfactory.

Anchor bolt load (empty, new + Seismic)

$$\begin{split} P &= -(0.6 - 0.14*S_{DS})*W / N + 48 * M / (N*BC) \\ &= -(0.6 - 0.14*0.55)*5,150.06 / 4 + 48 * 10,428.9 / (4*44.125) \\ &= 2,162.81 \ lb_f \end{split}$$

Required area per bolt = $P / S_h = 0.1081$ in²

The area provided (0.302 in²) by the specified anchor bolt is adequate.

Support calculations (Jawad & Farr chapter 12, empty, new + Seismic)

Base plate width, t_c : 6 in Average base plate diameter, d: 40.625 in Base plate elastic modulus, E_s : 29.0E+06 psi Base plate yield stress, S_y : 38,000 psi

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

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

$$t_s = (N^*A_b) / (\pi^*d)$$

= (4*0.302) / (\pi*40.625)
= 0.0095 in

From table 12.4 for k = 0.125674:

$$K_1 = 2.8276, K_2 = 0.9579$$

 $L_1 = 15.2053, L_2 = 27.173, L_3 =$

Total tensile force on bolting

```
\begin{split} T &= (12^*M - (0.6 - 0.14^*S_{DS})^*W \ ^*(L_1 + L_3)) \ / \ (L_2 + L_3) \\ &= (12^*10,428.9 - (0.6 - 0.14^*0.55)^*5,150.06 \ ^*(15.2053 + 4.0703)) \ / \ (27.173 + 4.0703) \\ &= 2,343.8 \ lb_f \end{split}
```

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

$$f_s = T / (t_s * (d / 2) * K_1)$$

= 2,343.8 / (0.0095 * (40.625 / 2) * 2.8276)
= 4,311 psi

Total compressive load on foundation

$$C_c = T + (1 + 0.14*S_{DS})*W + Bolt Preload$$

= 2,343.8 + (1 + 0.14*0.55)*5,150.06 + 0
= 7,890.42 lb_f

Foundation bearing stress

$$\begin{split} &f_c = C_c \: / \: (((t_c - t_s) + n^*t_s)^* (d \: / \: 2)^* K_2) \\ &= 7,890.42 \: / \: (((6 - 0.0095) + 9.2889^* 0.0095)^* (40.625 \: / \: 2)^* 0.9579) \\ &= \underline{67} \: psi \end{split}$$

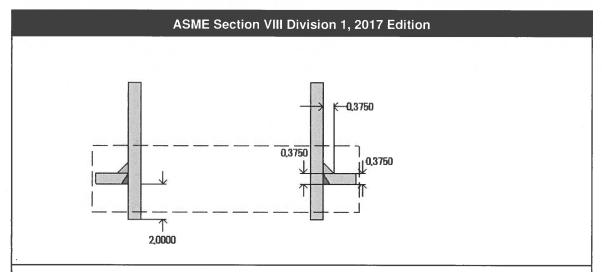
As $f_c \le 1,658$ psi the base plate width is satisfactory.

Base plate required thickness (empty, new + Seismic)

```
\begin{array}{l} t_r = (3^* f_c^* L^2 / S_p)^{0.5} \\ = (3^* 67^* 3.3125^2 / 20,000)^{0.5} \\ = \underline{0.3314} \text{ in} \end{array}
```

The base plate thickness is satisfactory.

INLET (C1)



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

Note: Tourid inside edges per OG-76(c)	
Location and Orient	
Located on	SHELL RG 2
Orientation	270°
Nozzle center line offset to datum line	147"
End of nozzle to shell center	30"
Passes through a Category A joint	No
Nozzle	
Description	NPS 6 Sch 80 (XS)
Access opening	No
Material specification	SA-106 B Smls pipe (II-D p. 14, ln. 10)
Inside diameter, new	5.761"
Pipe nominal wall thickness	0.432"
Pipe minimum wall thickness ¹	0.378"
Corrosion allowance	0"
Projection available outside vessel, Lpr	2.5"
Internal projection, h _{new}	2"
Projection available outside vessel to flange face, Lf	6"
Local vessel minimum thickness	0.375"
Liquid static head included	0 psi
Longitudinal joint efficiency	1
Welds	
Inner fillet, Leg ₄₁	0.375"
Lower fillet, Leg ₄₃	0"
Nozzle to vessel groove weld	0.375"

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

ASME B16.5-2013 Flange				
Description	NPS 6 Class 150 WN A105			
Bolt Material SA-193 B7 Bolt <= 2 1/2 (II-D 388, In. 32)				
Blind included	No			
Rated MDMT	-32.3°F			
Liquid static head	0 psi			
MAWP rating	272.5 psi @ 150°F			
MAP rating	285 psi @ 70°F			
Hydrotest rating	450 psi @ 70°F			
PWHT performed	No			
Impact Tested	No			
Circumferential joint radiography	None UW-11(c) Type 1			
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 At Intersection				
Governing thickness, t _g =	0.375"			
Exemption temperature from Fig UCS-66 Curve B =	-20°F			
$t_r = 250^*24 / (20,000^*1 + 0.4^*250) =$	0.2985"			
Stress ratio = $t_r^*E^* / (t_n - c) = 0.2985*1 / (0.375 - 0) =$	0.796			
Reduction in MDMT, T _R from Fig UCS-66.1 =	20.4°F			
MDMT = max[MDMT - T _R , -55] = max[-20 - 20.4 , -55] =	-40.4°F			

Material is exempt from impact testing at the Design MDMT of -20°F.

UCS-66 Material Toughness Requirements Nozzle				
t _r = 250*2.8805 / (17,100*1 - 0.6*250) =	0.0425"			
Stress ratio = $t_r^*E^* / (t_n - c) = 0.0425^*1 / (0.378 - 0) =$	0.1124			
Stress ratio \leq 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-45 Summary (in)		
For P = 250 psi @ 150 °F The opening is adequately reinforced					The nozzle passes UG-45			
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
1.7571	1.8683	0.4311	0.6244	0.6926		0.1202	0.245	0.378

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 250 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R = MAX(d, R_n + (t_n - C_n) + (t - C))$$

$$= MAX(5.761, 2.8805 + (0.432 - 0) + (0.375 - 0))$$

= 5.761 in

Outer Normal Limit of reinforcement per UG-40

$$L_{H} = MIN(2.5*(t - C), 2.5*(t_{n} - C_{n}) + t_{e})$$

$$= MIN(2.5*(0.375 - 0), 2.5*(0.432 - 0) + 0)$$

= 0.9375 in

Inner Normal Limit of reinforcement per UG-40

$$L_1 = MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C))$$

$$= MIN(2, 2.5*(0.375 - 0), 2.5*(0.432 - 0 - 0))$$

= 0.9375 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

= 0.0425 in

Required thickness t, from UG-37(a)

$$t_r = P^*R_o / (S^*E + 0.4^*P)$$

$$=$$
 250*24 / (20,000*1 + 0.4*250)

= 0.2985 in

Required thickness t, per Interpretation VIII-1-07-50

$$t_r = P^*R_o / (S^*E + 0.4^*P)$$

$$=$$
 250*24 / (20,000*0.85 + 0.4*250)

= 0.3509 in

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 $S_n / S_v = 0.855$

$$A = d^*t_r^*F + 2^*t_n^*t_r^*F^*(1 - f_{r1})$$

= 1.7571 in²

Area available from FIG. UG-37.1

 A_1 = larger of the following= 0.4311 in²

$$= d^*(E_1^*t - F^*t_r) - 2^*t_n^*(E_1^*t - F^*t_r)^*(1 - f_{r1})$$

 $= 0.4311 \text{ in}^2$

$$= 2^{*}(t + t_{n})^{*}(E_{1}^{*}t - F^{*}t_{r}) - 2^{*}t_{n}^{*}(E_{1}^{*}t - F^{*}t_{r})^{*}(1 - f_{r1})$$

 $= 0.1139 \text{ in}^2$

 A_2 = smaller of the following= 0.6244 in²

$$=$$
 5*(t_n - t_{rn})*f_{r2}*t

$$=$$
 5*(0.432 - 0.0425)*0.855*0.375

 $= 0.6244 \text{ in}^2$

$$=$$
 5*(t_n - t_{rn})*f_{r2}*t_n

$$=$$
 5*(0.432 - 0.0425)*0.855*0.432

 $= 0.7193 \text{ in}^2$

 A_3 = smaller of the following= 0.6926 in²

$$= 5*t*ti*fr2$$

 $= 0.6926 \text{ in}^2$

$$=$$
 5*t_i*t_i*f_{r2}

 $= 0.7978 \text{ in}^2$

 $= 2*h*t_i*f_{r2}$

= 2*2*0.432*0.855

 $= 1.4774 \text{ in}^2$

 $A_{41} = Leg^{2*}f_{r2}$

 $= 0.375^{2*}0.855$

= <u>0.1202</u> in²

Area = $A_1 + A_2 + A_3 + A_{41}$

= 0.4311 + 0.6244 + 0.6926 + 0.1202

 $= 1.8683 \text{ in}^2$

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 = 0.375 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

$$t_{a \text{ UG-27}} = P^*R_n / (S_n^*E - 0.6^*P) + \text{Corrosion}$$

= 250*2.8805 / (17,100*1 - 0.6*250) + 0

= 0.0425 in

 $t_a = max[t_{a \cup G-27}, t_{a \cup G-22}]$

 $= \max[0.0425, 0]$

= 0.0425 in

 $t_{b1} = P^*R_o / (S^*E + 0.4^*P) + Corrosion$

= 250*24 / (20,000*1 + 0.4*250) + 0

= 0.2985 in

 $t_{b1} = max[t_{b1}, t_{b \cup G16}]$

= max[0.2985 , 0.0625]

= 0.2985 in

 $t_b = min[t_{b3}, t_{b1}]$

= min[0.245, 0.2985]

= 0.245 in

 $t_{UG-45} = max[t_a, t_b]$

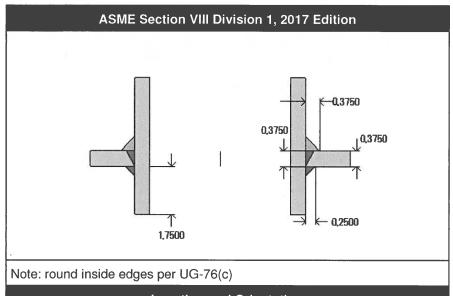
= max[0.0425 , 0.245]

= 0.245 in

Available nozzle wall thickness new, $t_{\rm n} = 0.875 {^*}0.432 = 0.378$ in

The nozzle neck thickness is adequate.

WATER OUTLET (C2)



Location and Orie	ntation			
Located on	SHELL RG 1			
Orientation	90°			
Nozzle center line offset to datum line	0"			
End of nozzle to shell center	25"			
Passes through a Category A joint	No			
Nozzle				
Description	NPS 3 Class 3000 - threaded			
Access opening	No			
Material specification	SA-105 (II-D p. 18, ln. 19)			
Inside diameter, new	3.5"			
Nominal wall thickness	0.375"			
Corrosion allowance	0"			
Projection available outside vessel, Lpr	1"			
Internal projection, h _{new}	1.75"			
Local vessel minimum thickness	0.375"			
Liquid static head included	1.69 psi			
Longitudinal joint efficiency	1			
Welds				
Inner fillet, Leg ₄₁	0.375"			
Lower fillet, Leg ₄₃	0.25"			
Nozzle to vessel groove weld	0.375"			

UCS-66 Material Toughness Requirements Nozzle				
$t_r = 251.69*1.75 / (20,000*1 - 0.6*251.69) =$	0.0222"			
Stress ratio = $t_r^* E^* / (t_n - c) = 0.0222^* 1 / (0.375 - 0) =$	0.0592			
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.				

UG-37 Area Calculation Summary (in²)						UG-44 Summary (in)		
For P = 251.69 psi @ 150 °F						The nozzk		
A required	A available	A ₁	A ₂	A ₃	A5	A welds	t _{req}	t _{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)						0.0625	0.375	

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 251.69 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R$$
 = MAX(d, $R_n + (t_n - C_n) + (t - C)$)
= MAX(3.5, 1.75 + (0.375 - 0) + (0.375 - 0))

= 3.5 in

Outer Normal Limit of reinforcement per UG-40

$$\begin{array}{rcl} \mathsf{L_H} & = & \mathsf{MIN}(2.5^*(\mathsf{t} - \mathsf{C}), \, 2.5^*(\mathsf{t_n} - \mathsf{C_n}) + \mathsf{t_e}) \\ & = & \mathsf{MIN}(2.5^*(0.375 - 0), \, 2.5^*(0.375 - 0) + 0) \end{array}$$

= 0.9375 in

Inner Normal Limit of reinforcement per UG-40

$$\begin{array}{lll} \mathsf{L_1} & = & \mathsf{MIN}(\mathsf{h}, \, 2.5^*(\mathsf{t} \, - \, \mathsf{C}), \, 2.5^*(\mathsf{t_i} \, - \, \mathsf{C_n} \, - \, \mathsf{C})) \\ & = & \mathsf{MIN}(1.75, \, 2.5^*(0.375 \, - \, \mathsf{0}), \, 2.5^*(0.375 \, - \, \mathsf{0} \, - \, \mathsf{0})) \\ & = & 0.9375 \ \mathsf{in} \end{array}$$

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

$$t_{rn}$$
 = $P^*R_n / (S_n^*E - 0.6^*P)$
= 251.6875*1.75 / (20,000*1 - 0.6*251.6875)
= 0.0222 in

Required thickness t, from UG-37(a)

$$t_r$$
 = P*R_o / (S*E + 0.4*P)
= 251.6875*24 / (20,000*1 + 0.4*251.6875)
= 0.3005 in

Required thickness t, per Interpretation VIII-1-07-50

```
t_r = P^*R_o / (S^*E + 0.4^*P)
= 251.6875*24 / (20,000*0.85 + 0.4*251.6875)
= 0.3532 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 = 0.375 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.

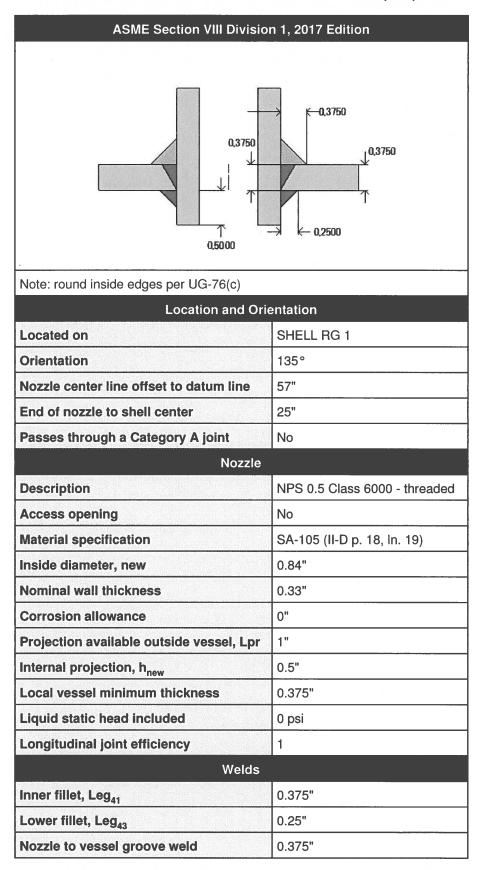
Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-44 Thickness Check - ASME B16.11 Coupling

```
\begin{array}{lll} t_{a\;App\;1\text{-}1} &=& P^*R_o\:/\:(S_n^*E + 0.4^*P) + Corrosion \\ &=& 251.6875^*2.125\:/\:(20,000^*1 + 0.4^*251.6875) + 0 \\ &=& 0.0266\;in \\ \\ t_{a\;UG\text{-}44} &=& \max[\:t_{a\;App\;1\text{-}1}\:,\:t_{b\;UG16}\:] \\ &=& \max[\:0.0266\:,\:0.0625\:] \\ &=& 0.0625\;in \end{array}
```

Available nozzle wall thickness new, $t_n = 0.375$ in

GAUGE GLASS (C3B)



UCS-66 Material Toughness Requirements Nozzle						
$t_r = 250^*0.42 / (20,000^*1 - 0.6^*250) =$	0.0053"					
Stress ratio = $t_r^*E^*/(t_n - c) = 0.0053*1/(0.33 - 0) =$	0.016					
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.						

UG-37 Area Calculation Summary (in²)						UG- Sumn (in	nary	
	For P = 250 psi @ 150 °F						The no passes l	SAME STATE OF THE PARTY OF THE
A required 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	0.33	

UG-41 Weld Failure Path Analysis Summary

The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary						
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status			
Nozzle to shell fillet (Leg ₄₁)	0.231	0.2625	weld size is adequate			

Calculations for internal pressure 250 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R = MAX(d, R_n + (t_n - C_n) + (t - C))$$

$$= MAX(0.84, 0.42 + (0.33 - 0) + (0.375 - 0))$$

= 1.125 in

Outer Normal Limit of reinforcement per UG-40

$$L_{H} = MIN(2.5*(t - C), 2.5*(t_{n} - C_{n}) + t_{e})$$

$$= MIN(2.5*(0.375 - 0), 2.5*(0.33 - 0) + 0)$$

= 0.825 in

Inner Normal Limit of reinforcement per UG-40

$$L_1 = MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C))$$

$$= MIN(0.5, 2.5*(0.375 - 0), 2.5*(0.33 - 0 - 0))$$

= 0.5 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

$$=$$
 250*0.42 / (20,000*1 - 0.6*250)

= 0.0053 in

Required thickness t, from UG-37(a)

$$t_r = P^*R_o / (S^*E + 0.4^*P)$$

$$=$$
 250*24 / (20,000*1 + 0.4*250)

= 0.2985 in

Required thickness t, per Interpretation VIII-1-07-50

$$t_r$$
 = $P^*R_o / (S^*E + 0.4^*P)$
= $250^*24 / (20,000^*0.85 + 0.4^*250)$
= 0.3509 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 = 0.33 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = \frac{0.231}{0.2625} in t_{c(actual)} = 0.7*Leg = 0.7*0.375 = 0.2625 in
```

The fillet weld size is satisfactory.

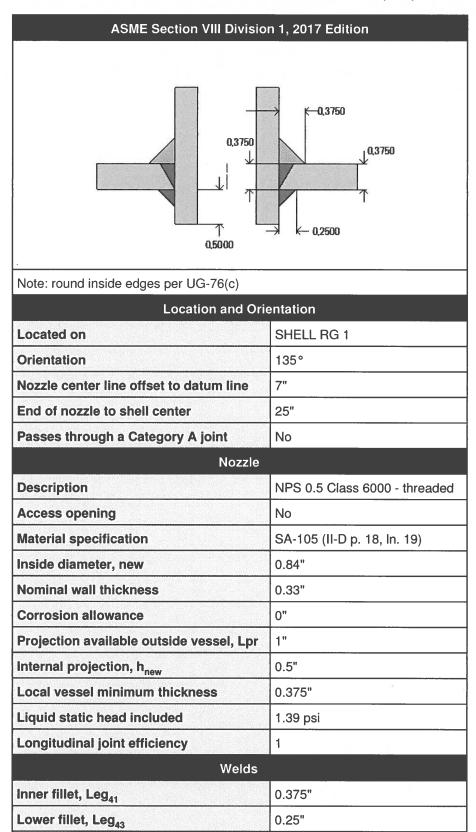
Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-44 Thickness Check - ASME B16.11 Coupling

$$\begin{array}{lll} t_{a\; App\; 1\text{--}1} & = & P^*R_o\,/\,(S_n^*E + 0.4^*P) + Corrosion \\ & = & 250^*0.75\,/\,(20,000^*1 + 0.4^*250) + 0 \\ & = & 0.0093\; in \\ \\ t_{a\; UG\text{--}44} & = & \max[\,t_{a\; App\; 1\text{--}1}\,\,,\,t_{b\; UG\text{--}16}\,] \\ & = & \max[\,0.0093\,\,,\,0.0625\,] \\ & = & 0.0625\; in \end{array}$$

Available nozzle wall thickness new, $t_n = 0.33$ in

GAUGE GLASS (C3A)



0.375"

Nozzle to vessel groove weld

UCS-66 Material Toughness Requirements Nozzle						
t _r = 251.39*0.42 / (20,000*1 - 0.6*251.39) =	0.0053"					
Stress ratio = $t_r^* E^* / (t_n - c) = 0.0053*1 / (0.33 - 0) = 0.0053*1 / (0$						
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.						

UG-37 Area Calculation Summary (in²)						UG- Summ (in	nary	
	For P = 251.39 psi @ 150 °F						The no passes l	TOWN SHALLS THE STATE OF
A required	A required 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	0.33	

UG-41 Weld Failure Path Analysis Summary

The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary						
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status			
Nozzle to shell fillet (Leg ₄₁)	0.231	0.2625	weld size is adequate			

Calculations for internal pressure 251.39 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R = MAX(d, R_n + (t_n - C_n) + (t - C))$$

$$= MAX(0.84, 0.42 + (0.33 - 0) + (0.375 - 0))$$

= 1.125 in

Outer Normal Limit of reinforcement per UG-40

$$L_{H} = MIN(2.5*(t - C), 2.5*(t_{n} - C_{n}) + t_{e})$$

$$= MIN(2.5*(0.375 - 0), 2.5*(0.33 - 0) + 0)$$

= 0.825 ir

Inner Normal Limit of reinforcement per UG-40

$$L_1 = MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C))$$

$$= MIN(0.5, 2.5*(0.375 - 0), 2.5*(0.33 - 0 - 0))$$

= 0.5 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

$$=$$
 251.3869*0.42 / (20,000*1 - 0.6*251.3869)

= 0.0053 in

Required thickness t_r from UG-37(a)

$$t_r = P^*R_o / (S^*E + 0.4^*P)$$

= 0.3002 in

Required thickness t, per Interpretation VIII-1-07-50

```
t_r = P^*R_o / (S^*E + 0.4^*P)
= 251.3869*24 / (20,000*0.85 + 0.4*251.3869)
= 0.3528 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 = 0.33 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = 0.231 in t_{c(actual)} = 0.7*Leg = 0.7*0.375 = 0.2625 in
```

The fillet weld size is satisfactory.

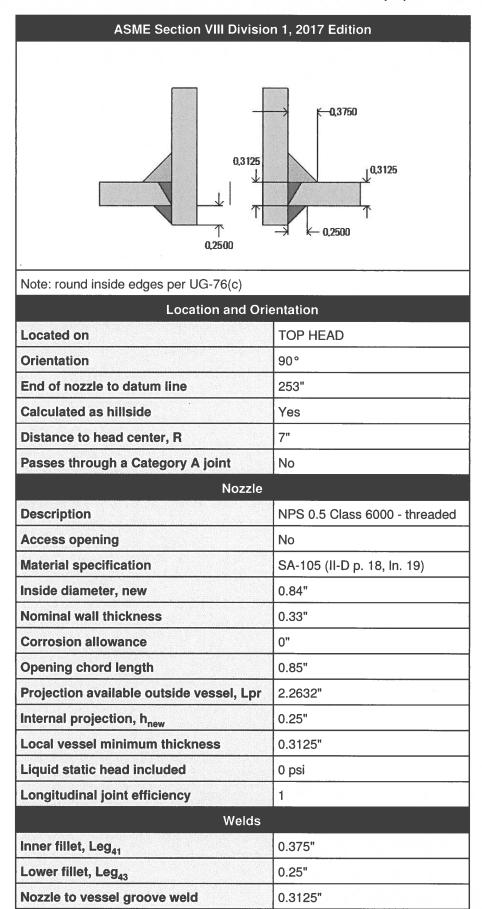
Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-44 Thickness Check - ASME B16.11 Coupling

```
\begin{array}{lll} t_{a\;App\;1\text{-}1} &=& P^*R_o\;/\;(S_n^*E + 0.4^*P) + Corrosion \\ &=& 251.3869^*0.75\;/\;(20,000^*1 + 0.4^*251.3869) + 0 \\ &=& 0.0094\;in \\ \\ t_{a\;UG\text{-}44} &=& \max[\;t_{a\;App\;1\text{-}1}\;,\;t_{b\;UG16}\;] \\ &=& \max[\;0.0094\;,\;0.0625\;] \\ &=& 0.0625\;in \end{array}
```

Available nozzle wall thickness new, $t_n = 0.33$ in

SUPPLY GAS (C4)



UCS-66 Material Toughness Requirements Nozzle At Intersection					
Governing thickness, $t_g =$	0.3125"				
Exemption temperature from Fig UCS-66 Curve B =	-20°F				
$t_r = 250^*0.9^*48 / (2^*20,000^*1 + 0.8^*250) =$	0.2687"				
Stress ratio = $t_r^* E^* / (t_n - c) = 0.2687^* 1 / (0.3125 - 0) =$	0.8597				
Reduction in MDMT, T _R from Fig UCS-66.1 =	14°F				
MDMT = max[MDMT - T _R , -55] = max[-20 - 14 , -55] =	-34°F				
Material is exempt from impact testing at the Design MDMT of -20°F.					

UCS-66 Material Toughness Requirements Nozzle					
$t_r = 250^*0.42 / (20,000^*1 - 0.6^*250) =$	0.0053"				
Stress ratio = $t_r^* E^* / (t_n - c) = 0.0053*1 / (0.33 - 0) =$	0.016				
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.					

UG-37 Area Calculation Summary (in²)							UG- Sumn (in	nary	
	For P = 250 psl @ 150 °F							The nozzle passes UG-44	
A required							t _{req}	t _{min}	
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							0.0625	0.33	

UG-41 Weld Failure Path Analysis Summary

The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary						
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status			
Nozzle to shell fillet (Leg ₄₁)	0.2188	0.2625	weld size is adequate			

Calculations for internal pressure 250 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R = MAX(d, R_n + (t_n - C_n) + (t - C))$$

$$= MAX(0.85, 0.425 + (0.33 - 0) + (0.3125 - 0))$$

= 1.0675 in

Outer Normal Limit of reinforcement per UG-40

$$L_H = MIN(2.5*(t - C), 2.5*(t_n - C_n) + t_e)$$

$$= MIN(2.5*(0.3125 - 0), 2.5*(0.33 - 0) + 0)$$

= 0.7813 in

Inner Normal Limit of reinforcement per UG-40

$$L_1 = MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C))$$

$$= MIN(0.25, 2.5*(0.3125 - 0), 2.5*(0.33 - 0 - 0))$$

= 0.25 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

$$=$$
 250*0.42 / (20,000*1 - 0.6*250)

= 0.0053 in

Required thickness t, from UG-37(a)(c)

$$t_r = P^*K_1^*D_0 / (2^*S^*E + 0.8^*P)$$

$$=$$
 250*0.9*48 / (2*20,000*1 + 0.8*250)

= 0.2687 in

Required thickness t, per Interpretation VIII-1-07-50

```
t_r = P^*D_o^*K / (2^*S^*E + 2^*P^*(K - 0.1))
= 250^*48^*1 / (2^*20,000^*1 + 2^*250^*(1 - 0.1))
= 0.2967"
```

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 = 0.3125 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = 0.2188 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.

$$\begin{array}{lll} t_{a\; App\; 1\text{--}1} & = & P^*R_o\,/\,(S_n^*E + 0.4^*P) + \text{Corrosion} \\ & = & 250^*0.75\,/\,(20,000^*1 + 0.4^*250) + 0 \\ & = & 0.0093\; \text{in} \\ \\ t_{a\; UG\text{--}44} & = & \max[\,t_{a\; App\; 1\text{--}1}\,\,,\,t_{b\; UG\text{16}}\,] \\ & = & \max[\,0.0093\,\,,\,0.0625\,] \\ & = & 0.0625\; \text{in} \end{array}$$

Available nozzle wall thickness new, $t_n = 0.33$ in

DRAIN (C5)

ASME Section VIII Division 1, 2017 Edition -0,3750 0,3125 0,3125 Note: round inside edges per UG-76(c) **Location and Orientation** Located on **BOTTOM HEAD** 90° Orientation End of nozzle to datum line -19.5625" Calculated as hillside No 0" Distance to head center, R Passes through a Category A joint No Nozzle **Description** NPS 2 Sch 80 (XS) **Access opening Material specification** SA-106 B Smls pipe (II-D p. 14, In. 10) 1.939" Inside diameter, new Pipe nominal wall thickness 0.218" Pipe minimum wall thickness¹ 0.1908" 0" **Corrosion allowance** Projection available outside vessel, Lpr 2.4211" Local vessel minimum thickness 0.3125" Liquid static head included 2.32 psi Longitudinal joint efficiency 1 Welds 0.375" Inner fillet, Leg₄₁ Nozzle to vessel groove weld 0.3125"

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

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

UG-37 Area Calculation Summary (in²)					nary	UG-45 Summary (in)		
For P = 252.32 psi @ 150 °F					le passes -45			
A A A A A A A A A A A A A A A A A A A					treq	t _{min}		
This nozzle is exempt from area calculations per UG-36(c)(3)(a)						0.1348	0.1908	

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)	<u>0.1526</u>	0.2625	weld size is adequate		

Calculations for internal pressure 252.32 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R$$
 = MAX(d, R_n + (t_n - C_n) + (t - C))
= MAX(1.939, 0.9695 + (0.218 - 0) + (0.3125 - 0))
= 1.939 in

Outer Normal Limit of reinforcement per UG-40

$$\begin{array}{lll} \mathsf{L_H} & = & \mathsf{MIN}(2.5^*(\mathsf{t} - \mathsf{C}), \, 2.5^*(\mathsf{t_n} - \mathsf{C_n}) + \mathsf{t_e}) \\ & = & \mathsf{MIN}(2.5^*(0.3125 - 0), \, 2.5^*(0.218 - 0) + 0) \\ & = & 0.545 \; \mathsf{in} \end{array}$$

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

$$t_{rn}$$
 = P*R_n / (S_n*E - 0.6*P)
= 252.3192*0.9695 / (17,100*1 - 0.6*252.3192)
= 0.0144 in

Required thickness t, from UG-37(a)(c)

$$t_r = P^*K_1^*D_0 / (2^*S^*E + 0.8^*P)$$

= 252.3192*0.9*48 / (2*20,000*1 + 0.8*252.3192)
= 0.2711 in

Required thickness t, per Interpretation VIII-1-07-50

$$t_r = P^*D_o^*K / (2^*S^*E + 2^*P^*(K - 0.1))$$

= 252.32*48*1 / (2*20,000*1 + 2*252.32*(1 - 0.1))
= 0.2994"

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 = 0.218 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = 0.1526 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).

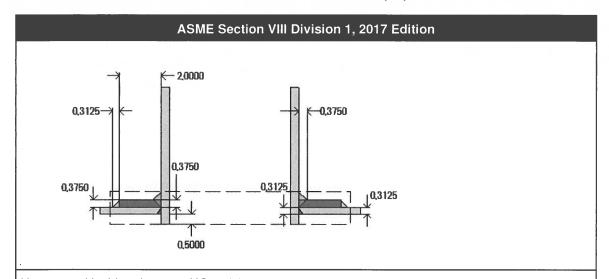
UG-45 Nozzle Neck Thickness Check

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

```
P^*R_n / (S_n^*E - 0.6^*P) + Corrosion
t_{a \cup G-27} =
                252.3305*0.9695 / (17,100*1 - 0.6*252.3305) + 0
               0.0144 in
ta
               \max[t_{a \cup G-27}, t_{a \cup G-22}]
                max[ 0.0144 , 0 ]
                0.0144 in
                0.2994 in
t_{b1}
t_{b1}
               \max[t_{b1}, t_{b \cup G16}]
               max[ 0.2994, 0.0625]
                0.2994 in
               min[t_{b3}, t_{b1}]
               min[ 0.1348 , 0.2994 ]
               0.1348 in
          = \max[t_a, t_b]
t<sub>UG-45</sub>
               max[ 0.0144 , 0.1348 ]
                0.1348 in
```

Available nozzle wall thickness new, $t_n = 0.875*0.218 = 0.1908$ in

GAS OUTLET (C6)



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

Location and Orientation					
Located on	TOP HEAD				
Orientation	0°				
End of nozzle to datum line	259"				
Calculated as hillside	No				
Distance to head center, R	0"				
Passes through a Category A joint	No				
Nozzle					
Description	NPS 6 Sch 80 (XS)				
Access opening	No				
Material specification	SA-106 B Smls pipe (II-D p. 14, ln. 10)				
Inside diameter, new	5.761"				
Pipe nominal wall thickness	0.432"				
Pipe minimum wall thickness ¹	0.378"				
Corrosion allowance	0"				
Projection available outside vessel, Lpr	4.4601"				
Internal projection, h _{new}	0.5"				
Projection available outside vessel to flange face, Lf	7.9601"				
Local vessel minimum thickness	0.3125"				
Liquid static head included	0 psi				
Longitudinal joint efficiency	1				
Reinforcing Pa	d				
Material specification	SA-516 70 (II-D p. 18, ln. 33)				
Diameter, D _p	10.625"				

Thickness, t _e	0.375"
Is split	Yes
Butt welds tested to confirm full penetration	Yes
Joint efficiency	1
Welds	;
Inner fillet, Leg ₄₁	0.375"
Outer fillet, Leg ₄₂	0.3125"
Lower fillet, Leg ₄₃	0"
Nozzle to vessel groove weld	0.3125"
Pad groove weld	0.375"

 $^{^{1}\}mbox{Pipe}$ minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

ASME B16.5-2013 Flange				
Description	NPS 6 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 272.5 psi @ 150°F				
MAP rating	285 psi @ 70°F			
Hydrotest rating	450 psi @ 70°F			
PWHT performed	No			
Impact Tested No				
Circumferential joint radiography	None UW-11(c) Type 1			
No	tes			

Flange rated MDMT per UCS-66(b)(1)(b) = -32.3 $^{\circ}$ F (Coincident ratio = 0.8772) Bolts rated MDMT per Fig UCS-66 note (c) = -55 $^{\circ}$ F

UCS-66 Material Toughness Requirements Nozzle At Intersection				
Governing thickness, t _g =	0.375"			
Exemption temperature from Fig UCS-66 Curve B =	-20°F			
$t_r = 250^*0.9^*48 / (2^*20,000^*1 + 0.8^*250) =$	0.2687"			
Stress ratio = $t_r^* E^* / (t_n - c) = 0.2687^*1 / (0.3125 - 0) =$	0.8597			
Reduction in MDMT, T _R from Fig UCS-66.1 =	14°F			
$MDMT = max[MDMT - T_R, -55] = max[-20 - 14, -55] =$	-34°F			
Material is exempt from impact testing at the Design MDMT of -20°F.				

UCS-66 Material Toughness Requirements Nozzle					
$t_r = 250^*2.8805 / (17,100^*1 - 0.6^*250) =$	0.0425"				
Stress ratio = $t_r^* E^* / (t_n - c) = 0.0425^* 1 / (0.378 - 0) =$	0.1124				
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 =	0.375"			
Exemption temperature from Fig UCS-66 Curve B =	-20°F			
$t_r = 250^*0.9^*48 / (2^*20,000^*1 + 0.8^*250) =$	0.2687"			
Stress ratio = $t_r^*E^*/(t_n - c) = 0.2687*1/(0.3125 - 0) =$	0.8597			
Reduction in MDMT, T _R from Fig UCS-66.1 =	14°F			
$MDMT = max[MDMT - T_R, -55] = max[-20 - 14, -55] =$	-34°F			
Material is exempt from impact testing at the Design MDMT of -20°F.				

UG-37 Area Calculation Summary (in²)							UG-45 Summary (in)	
For P = 250 psi @ 150 °F The opening is adequately reinforced						The nozzle passes UG-45		
A required available A ₁ A ₂ A ₃ A ₅ A welds						t _{req}	t _{min}	
1.5814	2.8547	0.2471	0.5203	0.3694	1.5	0.2179	0.245	0.378

	UG-41 \	Weld Failure	Path Analy	ysis Sumı	mary (lb _f)	
	All fai	lure paths are stro	onger than the a	applicable wel	d 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
27.333.87	44,764	101.415.81	24.814.2	138.585	56.768.2	99,242.42

UW-16 Weld Sizing Summary						
Weld description Required weld size (in) Status						
Nozzle to pad fillet (Leg ₄₁)	0.25	0.2625	weld size is adequate			
Pad to shell fillet (Leg ₄₂)	0.1562	0.2188	weld size is adequate			

Calculations for internal pressure 250 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R = MAX(d, R_n + (t_n - C_n) + (t - C))$$

= MAX(5.761, 2.8805 + (0.432 - 0) + (0.3125 - 0))

= 5.761 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*(0.3125 - 0), 2.5*(0.432 - 0) + 0.375)

= 0.7813 in

Inner Normal Limit of reinforcement per UG-40

$$L_1 = MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C))$$

= MIN(0.5, 2.5*(0.3125 - 0), 2.5*(0.432 - 0 - 0))

= 0.5 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

= 250*2.8805 / (17,100*1 - 0.6*250)

= 0.0425 in

Required thickness t, from UG-37(a)(c)

 $t_r = P^*K_1^*D_0 / (2^*S^*E + 0.8^*P)$

= 250*0.9*48 / (2*20,000*1 + 0.8*250)

= 0.2687 in

Required thickness t, per Interpretation VIII-1-07-50

 $t_r = P^*D_o^*K / (2^*S^*E + 2^*P^*(K - 0.1))$

 $= 250^{4}8^{1}/(2^{2}0,000^{1}+2^{2}50^{1}(1-0.1))$

= 0.2967"

Area required per UG-37(c)

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

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

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

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

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

 $A = d^*t_r^*F + 2^*t_n^*t_r^*F^*(1 - f_{r1})$

= 5.761*0.2687*1 + 2*0.432*0.2687*1*(1 - 0.855)

 $= 1.5814 \text{ in}^2$

Area available from FIG. UG-37.1

 A_1 = larger of the following= 0.2471 in²

- $= d^*(E_1^*t F^*t_r) 2^*t_n^*(E_1^*t F^*t_r)^*(1 f_{r1})$
- = 5.761*(1*0.3125 1*0.2687) 2*0.432*(1*0.3125 1*0.2687)*(1 0.855)
- $= 0.2471 \text{ in}^2$
- $= 2^{*}(t + t_{n})^{*}(E_{1}^{*}t F^{*}t_{r}) 2^{*}t_{n}^{*}(E_{1}^{*}t F^{*}t_{r})^{*}(1 f_{r1})$
- = 2*(0.3125 + 0.432)*(1*0.3125 1*0.2687) 2*0.432*(1*0.3125 1*0.2687)*(1 0.855)
- $= 0.0598 in^2$

 A_2 = smaller of the following= 0.5203 in²

- = 5*(t_n t_{rn})*f_{r2}*t
- = 5*(0.432 0.0425)*0.855*0.3125
- $= 0.5203 \text{ in}^2$
- $= 2^*(t_n t_m)^*(2.5^*t_n + t_e)^*f_{r2}$
- = 2*(0.432 0.0425)*(2.5*0.432 + 0.375)*0.855
- $= 0.9691 in^2$

 A_3 = smaller of the following= 0.3694 in²

- $= 5*t*t_i*f_{r2}$
- = 5*0.3125*0.432*0.855
- $= 0.5771 \text{ in}^2$
- = 5*t_i*t_i*f_{r2}
- = 5*0.432*0.432*0.855
- $= 0.7978 \text{ in}^2$
- $= 2*h*t_i*f_{r2}$
- = 2*0.5*0.432*0.855
- $= 0.3694 \text{ in}^2$

$$A_{41} = Leg^{2*}f_{r3}$$

- $= 0.375^{2*}0.855$
- $= 0.1202 \text{ in}^2$

$$A_{42} = Leg^{2*}f_{r4}$$

- $= 0.3125^{2*}1$
- $= 0.0977 \text{ in}^2$

$$A_5 = (D_p - d - 2^*t_n)^*t_e^*f_{r4}^*E_p$$

- = (10.625 5.761 2*0.432)*0.375*1*1
- $= 1.5 \text{ in}^2$

Area =
$$A_1 + A_2 + A_3 + A_{41} + A_{42} + A_5$$

- = 0.2471 + 0.5203 + 0.3694 + 0.1202 + 0.0977 + 1.5
- $= 2.8547 \text{ in}^2$

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 = 0.375 in

$$t_{c(min)}$$
 = lesser of 0.25 or 0.7* t_{min} = $\underline{0.25}$ in

$$t_{c(actual)} = 0.7*Leg = 0.7*0.375 = 0.2625 in$$

Outer fillet:
$$t_{min}$$
 = lesser of 0.75 or t_{e} or $t = 0.3125$ in

$$t_{w(min)} = 0.5 t_{min} = 0.1562 in$$

$$t_{w(actual)} = 0.7*Leg = 0.7*0.3125 = 0.2188 in$$

UG-45 Nozzle Neck Thickness Check

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

$$t_{a \text{ UG-27}} = P^*R_n / (S_n^*E - 0.6^*P) + Corrosion$$

= 250*2.8805 / (17,100*1 - 0.6*250) + 0

0.0425 in

 $\max[t_{a \cup G-27}, t_{a \cup G-22}]$

max[0.0425, 0]

0.0425 in

0.2967 in t_{b1}

 $\max[t_{b1}, t_{bUG16}]$ t_{b1}

max[0.2967, 0.0625]

0.2967 in

 $min[t_{b3}, t_{b1}]$

min[0.245, 0.2967]

0.245 in

t_{UG-45} $\max[t_a, t_b]$

max[0.0425, 0.245]

0.245 in

Available nozzle wall thickness new, $t_n = 0.875*0.432 = 0.378$ 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

Upper groove weld in tension: 0.74*20,000 = 14,800 psi

Strength of welded joints:

(1) Inner fillet weld in shear

 $(\pi/2)$ *Nozzle OD*Leg*S_i = $(\pi/2)$ *6.625*0.375*8,379 = 32,698.6 lb_f

(2) Outer fillet weld in shear

 $(\pi / 2)$ *Pad OD*Leg*S_o = $(\pi / 2)$ *10.625*0.3125*9,800 = 51,112.24 lb_f

(3) Nozzle wall in shear

 $(\pi / 2)$ *Mean nozzle dia* t_n * $S_n = (\pi / 2)$ *6.193*0.432* $11,970 = 50,303.58 lb_f$

(4) Groove weld in tension

 $(\pi / 2)^*$ Nozzle OD* $t_w^*S_g = (\pi / 2)^*6.625^*0.3125^*14,800 = 48,130.18 lb_f$

(6) Upper groove weld in tension

 $(\pi / 2)$ *Nozzle OD* t_w * $S_q = (\pi / 2)$ *6.625*0.375* $14,800 = 57,756.22 lb_f$

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

$$W = (A - A_1 + 2^*t_n^*f_{r1}^*(E_1^*t - F^*t_r))^*S_v$$

(1.5814 - 0.2471 + 2*0.432*0.855*(1*0.3125 - 1*0.2687))*20,000

27,333.87 lb,

$$W_{1-1} = (A_2 + A_5 + A_{41} + A_{42}) S_v$$

= (0.5203 + 1.5 + 0.1202 + 0.0977)*20,000

 $= 44.764 \text{ lb}_{t}$

$$W_{2-2} = (A_2 + A_3 + A_{41} + A_{43} + 2^*t_n^*t^*f_{r1})^*S_v$$

(0.5203 + 0.3694 + 0.1202 + 0 + 2*0.432*0.3125*0.855)*20,000

24,814.2 lb_f

$$W_{3-3} = (A_2 + A_3 + A_5 + A_{41} + A_{42} + A_{43} + 2*t_n*t*f_{r1})*S_v$$

(0.5203 + 0.3694 + 1.5 + 0.1202 + 0.0977 + 0 + 2*0.432*0.3125*0.855)*20,000

56,768.2 lb,

Load for path 1-1 lesser of W or $W_{1-1} = 27,333.87 lb_f$

Path 1-1 through (2) & (3) = 51,112.24 + 50,303.58 = 101.415.81 lb,

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 $W_{2-2} = 24,814.2 lb_f$

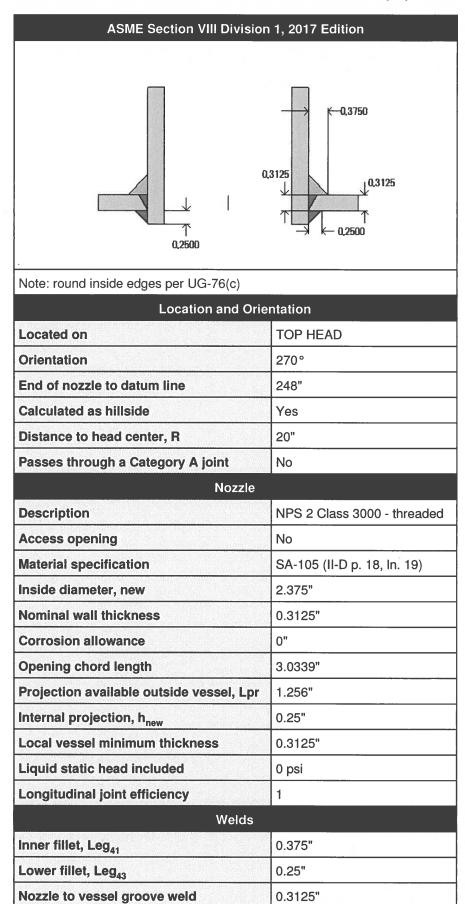
Path 2-2 through (1), (4), (6) = 32,698.6 + 48,130.18 + 57,756.22 = 138.585 lb_f Path 2-2 is stronger than W₂₋₂ so it is acceptable per UG-41(b)(1).

Load for path 3-3 lesser of W or $W_{3-3} = 27,333.87 \text{ lb}_f$

Path 3-3 through (2), (4) = $51,112.\overline{24} + 48,130.18 = \underline{99.242.42}$ lb_f

Path 3-3 is stronger than W so it is acceptable per UG-41(b)(2).

SAFETY HEAD (C7)



UCS-66 Material Toughness Requirements Nozzle					
$t_r = 250*1.1875 / (20,000*1 - 0.6*250) =$	0.015"				
Stress ratio = $t_r^*E^* / (t_n - c) = 0.015*1 / (0.3125 - 0) =$	0.0479				
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.					

UG-37	' Area Ca	Calculation Summary (in²)				mary	UG-44 Summary (in)		
	For P = 250 psi @ 150 °F						le passes -44		
A required	A available	A ₁	A ₂	А3	A 5	A welds	t _{req}	t _{min}	
This nozzle is exempt from area calculations per UG-36(c)(3)(a)					0.0625	0.3125			

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)	0.2188	0.2625	weld size is adequate			

Calculations for internal pressure 250 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R$$
 = MAX(d, R_n + (t_n - C_n) + (t - C))
= MAX(3.0339, 1.517 + (0.3125 - 0) + (0.3125 - 0))
= 3.0339 in

Outer Normal Limit of reinforcement per UG-40

$$\begin{array}{lll} \mathsf{L_H} & = & \mathsf{MIN}(2.5^*(\mathsf{t} - \mathsf{C}), \, 2.5^*(\mathsf{t_n} - \mathsf{C_n}) + \mathsf{t_e}) \\ & = & \mathsf{MIN}(2.5^*(0.3125 - 0), \, 2.5^*(0.3125 - 0) + 0) \\ & = & 0.7813 \ \mathsf{in} \end{array}$$

Inner Normal Limit of reinforcement per UG-40

$$\begin{array}{lll} \mathsf{L_I} & = & \mathsf{MIN}(\mathsf{h}, \, 2.5^*(\mathsf{t} - \mathsf{C}), \, 2.5^*(\mathsf{t_i} - \mathsf{C_n} - \mathsf{C})) \\ & = & \mathsf{MIN}(0.25, \, 2.5^*(0.3125 - 0), \, 2.5^*(0.3125 - 0 - 0)) \\ & = & 0.25 \; \mathsf{in} \end{array}$$

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

$$\begin{array}{rcl} t_{rn} & = & P^*R_n \, / \, (S_n^*E - 0.6^*P) \\ & = & 250^*1.1875 \, / \, (20,000^*1 - 0.6^*250) \\ & = & 0.015 \ in \end{array}$$

Required thickness t, from UG-37(a)

$$t_r$$
 = $P^*D_o^*K / (2^*S^*E + 2^*P^*(K - 0.1))$
= $250^*48^*1 / (2^*20,000^*1 + 2^*250^*(1 - 0.1))$
= 0.2967 "

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 = 0.3125 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = 0.2188 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).

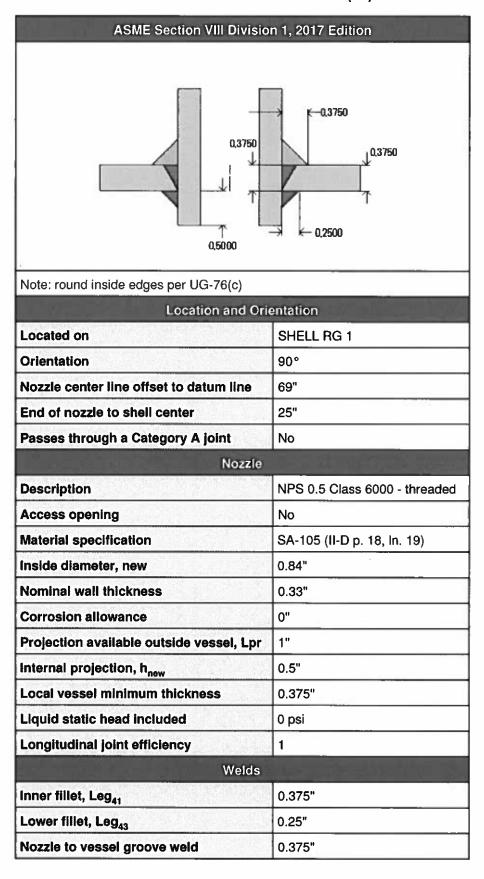
UG-44 Thickness Check - ASME B16.11 Coupling

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

$$\begin{array}{lll} t_{a\;App\;1\text{-}1} & = & P^*R_o \, / \, (S_n^*E + 0.4^*P) \, + \, \text{Corrosion} \\ & = & 250^*1.5 \, / \, (20,000^*1 + 0.4^*250) \, + \, 0 \\ & = & 0.0187 \; \text{in} \\ \\ t_{a\;UG\text{-}44} & = & \max[\,\,t_{a\;App\;1\text{-}1} \, \, , \, t_{b\;UG16} \,] \\ & = & \max[\,\,0.0187 \, \, , \, 0.0625 \,] \\ & = & 0.0625 \; \text{in} \end{array}$$

Available nozzle wall thickness new, $t_n = 0.3125$ in

PI (C8)



UCS-66 Material Toughness Requirements Nozzle				
$t_r = 250*0.42 / (20,000*1 - 0.6*250) =$	0.0053"			
Stress ratio = $t_r^*E^* / (t_n - c) = 0.0053*1 / (0.33 - 0) =$	0.016			
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.				

UG-37	' Area Ca	alcu (in		on S	umi	mary	UG- Sumn (in	nary
	For P = 2	250 ps	si @ 1	50 °F			The no passes (
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	treq	t _{min}
	zzle is ex tions per						0.0625	0.33

UG-41 Weld Failure Path Analysis Summary

The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-16 Weld Sizing Summary							
Weld description	Required weld throat size (in)	Actual weld throat size (in)	Status				
Nozzle to shell fillet (Leg ₄₁)	0.231	0.2625	weld size is adequate				

Calculations for internal pressure 250 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_{R} = MAX(d, R_n + (t_n - C_n) + (t - C))$$

$$= MAX(0.84, 0.42 + (0.33 - 0) + (0.375 - 0))$$

= 1.125 in

Outer Normal Limit of reinforcement per UG-40

$$L_{H} = MIN(2.5*(t - C), 2.5*(t_{n} - C_{n}) + t_{e})$$

$$= MIN(2.5*(0.375 - 0), 2.5*(0.33 - 0) + 0)$$

= 0.825 in

Inner Normal Limit of reinforcement per UG-40

$$L_i = MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C))$$

$$= MIN(0.5, 2.5*(0.375 - 0), 2.5*(0.33 - 0 - 0))$$

= 0.5 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

$$=$$
 250*0.42 / (20,000*1 - 0.6*250)

= 0.0053 in

Required thickness t, from UG-37(a)

$$t_r = P^*R_o / (S^*E + 0.4^*P)$$

= 0.2985 in

Required thickness t, per Interpretation VIII-1-07-50

 t_r = P^*R_o / ($S^*E + 0.4^*P$) = 250^*24 / ($20,000^*0.85 + 0.4^*250$) = 0.3509 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 = 0.33 in $t_{c(min)}$ = lesser of 0.25 or 0.7* t_{min} = 0.231 in $t_{c(actual)}$ = 0.7*Leg = 0.7*0.375 = 0.2625 in

The fillet weld size is satisfactory.

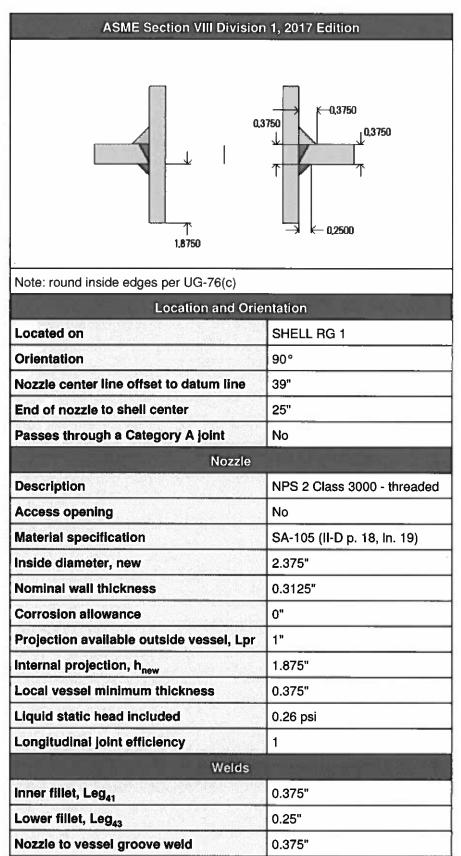
Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (c-e).

UG-44 Thickness Check - ASME B16.11 Coupling

 $\begin{array}{lll} t_{a\;App\;1-1} &=& P^*R_o\,/\,(S_n^*E + 0.4^*P) + Corrosion \\ &=& 250^*0.75\,/\,(20,000^*1 + 0.4^*250) + 0 \\ &=& 0.0093\;in \\ \\ t_{a\;UG-44} &=& \max[\,t_{a\;App\;1-1}\,\,,\,t_{b\;UG16}\,] \\ &=& \max[\,0.0093\,\,,\,0.0625\,] \\ &=& 0.0625\;in \end{array}$

Available nozzle wall thickness new, $t_n = 0.33$ in

WATER LLC (C10)



UCS-66 Material Toughness Requirements Nozzle					
$t_r = 250.26*1.1875 / (20,000*1 - 0.6*250.26) =$	0.015"				
Stress ratio = $t_r^*E^* / (t_n - c) = 0.015^*1 / (0.3125 - 0) =$					
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)							-44 ary (in)	
For P = 250.26 psi @ 150 °F							le passes -44	
A required	A avallable	A ₁	A ₂	Аз	A ₅	A welds	treq	t _{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)						0.0625	0.3125	

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 Actual weld throat size (in) Status						
Nozzie to shell fillet (Leg ₄₁)	0.2188	0.2625	weld size is adequate			

Calculations for internal pressure 250.26 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_{R} = MAX(d_{1} R_{n} + (t_{n} - C_{n}) + (t - C))$$

$$= MAX(2.375, 1.1875 + (0.3125 - 0) + (0.375 - 0))$$

= 2.375 in

Outer Normal Limit of reinforcement per UG-40

$$L_{H} = MIN(2.5*(t - C), 2.5*(t_{n} - C_{n}) + t_{e})$$

$$= MIN(2.5*(0.375 - 0), 2.5*(0.3125 - 0) + 0)$$

= 0.7813 in

Inner Normal Limit of reinforcement per UG-40

$$L_1 = MIN(h, 2.5*(t - C), 2.5*(t_i - C_n - C))$$

= 0.7813 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

= 0.015 in

Required thickness t, from UG-37(a)

$$t_r = P^*R_o / (S^*E + 0.4^*P)$$

$$=$$
 250.2594*24 / (20,000*1 + 0.4*250.2594)

= 0.2988 in

Required thickness t, per Interpretation VIII-1-07-50

```
t_r = P*R<sub>o</sub> / (S*E + 0.4*P)
= 250.2594*24 / (20,000*0.85 + 0.4*250.2594)
= 0.3512 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 = 0.3125 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = 0.2188 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).

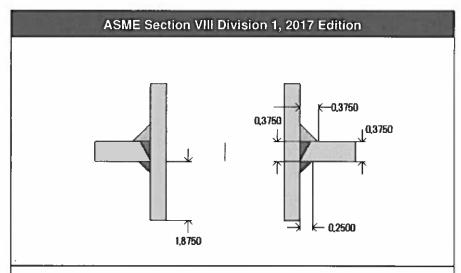
UG-44 Thickness Check - ASME B16.11 Coupling

```
\begin{array}{lll} t_{a \, App \, 1 \cdot 1} &=& P^*R_o \, / \, (S_n^*E + 0.4^*P) \, + \, Corrosion \\ &=& 250.2594^*1.5 \, / \, (20,000^*1 + 0.4^*250.2594) \, + \, 0 \\ &=& 0.0187 \, in \\ \\ t_{a \, UG-44} &=& \max[ \, t_{a \, App \, 1 \cdot 1} \, , \, t_{b \, UG16} \, ] \\ &=& \max[ \, 0.0187 \, , \, 0.0625 \, ] \\ &=& 0.0625 \, in \end{array}
```

Available nozzle wall thickness new, $t_n = 0.3125$ in

The nozzle neck thickness is adequate.

RELIEF (C13)



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

Location and Orientation						
Located on	SHELL RG 2					
Orientation	90°					
Nozzle center line offset to datum line	221"					
End of nozzle to shell center	25"					
Passes through a Category A joint	No					
Nozzle						
Description	NPS 2 Class 3000 - threaded					
Access opening	No					
Material specification	SA-105 (II-D p. 18, ln. 19)					
Inside diameter, new	2.375"					
Nominal wall thickness	0.3125"					
Corrosion allowance	0"					
Projection available outside vessel, Lpr	1"					
Internal projection, h _{new}	1.875"					
Local vessel minimum thickness	0.375"					
Liquid static head included	0 psi					
Longitudinal joint efficiency	1					
Welds						
Inner fillet, Leg ₄₁	0.375"					
Lower fillet, Leg ₄₃	0.25"					
Nozzle to vessel groove weld	0.375"					

UCS-66 Material Toughness Requirements Nozzle					
t _y = 250*1.1875 / (20,000*1 - 0.6*250) =	0.015"				
Stress ratio = $t_r *E^* / (t_n - c) = 0.015*1 / (0.3125 - 0) =$	0.0479				
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 = 250 psi @ 150 °F							le passes i-44	
A required	A available	A ₁	A ₂	Аз	A ₅	A welds	t _{req} t _{min}		
This nozzle is exempt from area calculations per UG-36(c)(3)(a)						0.0625	0.3125		

UG-41 Weld Failure Path Analysis Summary

The nozzle is exempt from weld strength calculations per UW-15(b)(2)

UW-	16 Weld Sizi	ng Summary	
Weld description	Required weld throat size (In)	Actual weld throat size (in)	Status
Nozzie to shell fillet (Leg ₄₁)	0.2188	0.2625	weld size is adequate

Calculations for internal pressure 250 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_R = MAX(d, R_n + (t_n - C_n) + (t - C))$$

$$= MAX(2.375, 1.1875 + (0.3125 - 0) + (0.375 - 0))$$

= 2.375 in

Outer Normal Limit of reinforcement per UG-40

$$L_{H} = MIN(2.5*(t - C), 2.5*(t_{n} - C_{n}) + t_{e})$$

$$= MIN(2.5*(0.375 - 0), 2.5*(0.3125 - 0) + 0)$$

= 0.7813 in

Inner Normal Limit of reinforcement per UG-40

$$L_1 = MIN(h, 2.5*(t - C), 2.5*(t_i - C_0 - C))$$

= 0.7813 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

= 0.015 in

Required thickness t, from UG-37(a)

$$t_r = P^*R_o / (S^*E + 0.4^*P)$$

$$=$$
 250*24 / (20,000*1 + 0.4*250)

= 0.2985 in

Required thickness t, per Interpretation VIII-1-07-50

```
t_r \simeq P^*R_o / (S^*E + 0.4^*P)
= 250*24 / (20,000*0.85 + 0.4*250)
= 0.3509 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 = 0.3125 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = 0.2188 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).

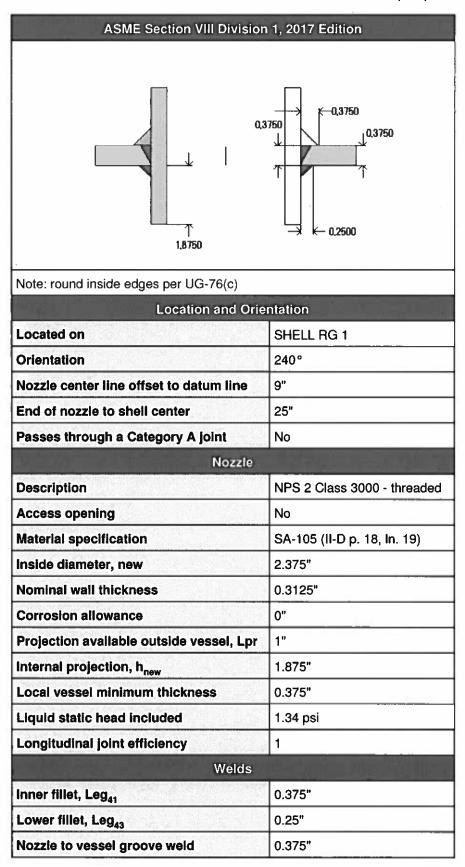
UG-44 Thickness Check - ASME B16.11 Coupling

$$\begin{array}{rcl} t_{a\;App\;1\cdot1} &=& P^*R_o\,/\,(S_n^{\;*E}\,+\,0.4^*P)\,+\,\text{Corrosion}\\ &=& 250^*1.5\,/\,(20,000^*1\,+\,0.4^*250)\,+\,0\\ &=& 0.0187\;\text{in} \\ \\ t_{a\;UG\cdot44} &=& \max[\,t_{a\;App\;1\cdot1}\,\,,\,t_{b\;UG16}\,]\\ &=& \max[\,0.0187\,\,,\,0.0625\,]\\ &=& 0.0625\;\text{in} \end{array}$$

Available nozzle wall thickness new, $t_n = 0.3125$ in

The nozzle neck thickness is adequate.

WATER LEVEL LOW (C14)



UCS-66 Material Toughness Requirements Nozzle					
$t_r = 251.34*1.1875 / (20,000*1 - 0.6*251.34) =$	0.015"				
Stress ratio = $t_r^*E^* / (t_n - c) = 0.015*1 / (0.3125 - 0) =$	0.0481				
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 = 251.34 psi @ 150 °F							le passes -44	
A required	A avallable	A ₁	A ₂	A3	A5	A welds	t _{req}	ŧ _{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)						0.0625	0.3125	

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			
Nozzie to shell fillet (Leg ₄₁)	0.2188	0.2625	weld size is adequate			

Calculations for Internal pressure 251.34 psi @ 150 °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 + (0.3125 - 0) + (0.375 - 0))
= 2.375 in

Outer Normal Limit of reinforcement per UG-40

$$\begin{array}{lll} \mathsf{L}_{\mathsf{H}} & = & \mathsf{MIN}(2.5^{\star}(\mathsf{t} - \mathsf{C}), \, 2.5^{\star}(\mathsf{t}_{\mathsf{n}} - \mathsf{C}_{\mathsf{n}}) + \mathsf{t}_{\mathsf{e}}) \\ & = & \mathsf{MIN}(2.5^{\star}(0.375 - 0), \, 2.5^{\star}(0.3125 - 0) + 0) \\ & = & 0.7813 \ \mathsf{in} \end{array}$$

Inner Normal Limit of reinforcement per UG-40

$$\begin{array}{lll} \mathsf{L}_{\mathsf{i}} & = & \mathsf{MIN}(\mathsf{h}, \, 2.5^*(\mathsf{t} - \mathsf{C}), \, 2.5^*(\mathsf{t}_{\mathsf{i}} - \mathsf{C}_{\mathsf{n}} - \mathsf{C})) \\ & = & \mathsf{MIN}(1.875, \, 2.5^*(0.375 - 0), \, 2.5^*(0.3125 - 0 - 0)) \\ & = & 0.7813 \; \mathsf{in} \end{array}$$

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

$$t_{rn}$$
 = P*R_n / (S_n*E - 0.6*P)
= 251.3424*1.1875 / (20,000*1 - 0.6*251.3424)
= 0.015 in

Required thickness t, from UG-37(a)

$$t_r$$
 = $P^*R_o / (S^*E + 0.4^*P)$
= $251.3424^*24 / (20,000^*1 + 0.4^*251.3424)$
= 0.3001 in

Required thickness t, per Interpretation VIII-1-07-50

```
t_r = P^*R_o / (S^*E + 0.4^*P)
= 251.3424*24 / (20,000*0.85 + 0.4*251.3424)
= 0.3528 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 = 0.3125 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = 0.2188 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).

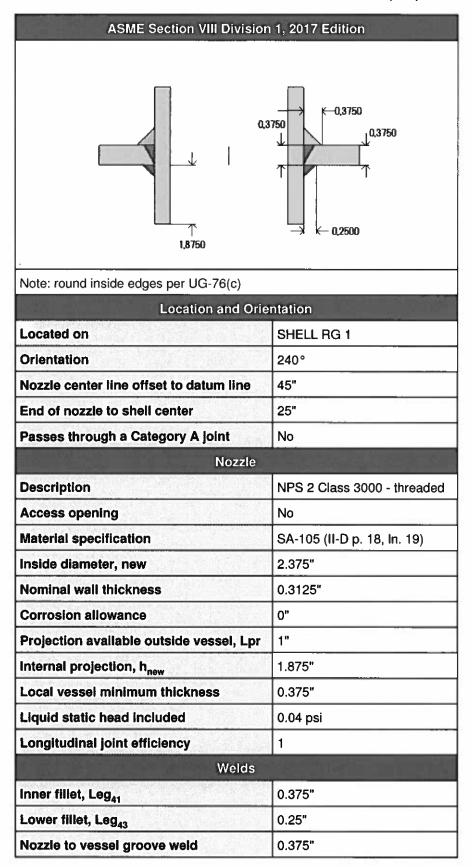
UG-44 Thickness Check - ASME B16.11 Coupling

```
\begin{array}{lll} t_{a\;App\;1-1} &=& P^*R_o\,/\,(S_n^*E + 0.4^*P) + Corrosion \\ &=& 251.3424^*1.5\,/\,(20,000^*1 + 0.4^*251.3424) + 0 \\ &=& 0.0188\;in \\ \\ t_{a\;UG-44} &=& \max[\,t_{a\;App\;1-1}\,\,,\,t_{b\;UG16}\,] \\ &=& \max[\,0.0188\,\,,\,0.0625\,] \\ &=& 0.0625\;in \end{array}
```

Available nozzle wall thickness new, $t_n = 0.3125$ in

The nozzle neck thickness is adequate.

OIL LEVEL HIGH (C15)



UCS-66 Material Toughness Requirements Nozzle					
$t_r = 250.04^*1.1875 / (20,000^*1 - 0.6^*250.04) =$	0.015"				
Stress ratio = $t_r^*E^* / (t_n - c) = 0.015*1 / (0.3125 - 0) =$	0.0479				
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 = 250.04 psi @ 150 °F							le passes -44	
A required	A avallable	A ₁	A ₂	A3	A5	A welds	t _{req}	t _{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)						0.0625	0.3125	

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)	0.2188	0.2625	weld size is adequate			

Calculations for internal pressure 250.04 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_{R} = MAX(d, R_{n} + (t_{n} - C_{n}) + (t - C))$$

$$= MAX(2.375, 1.1875 + (0.3125 - 0) + (0.375 - 0))$$

= 2.375 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*(0.3125 - 0) + 0)

= 0.7813 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(1.875, 2.5*(0.375 - 0), 2.5*(0.3125 - 0 - 0))

= 0.7813 in

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

$$t_{rn} = P^*R_n / (S_n^*E - 0.6^*P)$$

= 250.0429*1.1875 / (20,000*1 - 0.6*250.0429)

= 0.015 in

Required thickness t, from UG-37(a)

$$t_r = P^*R_0 / (S^*E + 0.4^*P)$$

= 250.0429*24 / (20,000*1 + 0.4*250.0429)

= 0.2986 in

Required thickness t, per Interpretation VIII-1-07-50

```
t_r = P^*R_o / (S^*E + 0.4^*P)
= 250.0429*24 / (20,000*0.85 + 0.4*250.0429)
= 0.3509 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 = 0.3125 in t_{c(min)} = lesser of 0.25 or 0.7*t_{min} = 0.2188 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).

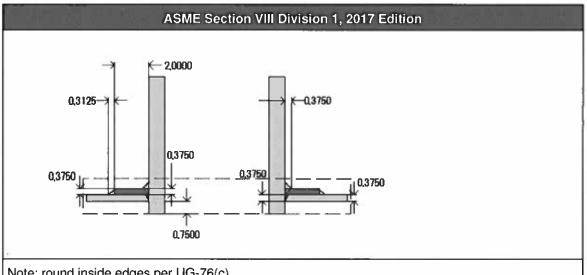
UG-44 Thickness Check - ASME B16.11 Coupling

```
\begin{array}{lll} t_{a\;App\;1-1} &=& P^*R_o\,/\,(S_n^*E + 0.4^*P) + Corrosion \\ &=& 250.0429^*1.5\,/\,(20,000^*1 + 0.4^*250.0429) + 0 \\ &=& 0.0187\;in \\ \\ t_{a\;UG-44} &=& \max[\,t_{a\;App\;1-1}\,\,,\,t_{b\;UG16}\,] \\ &=& \max[\,0.0187\,\,,\,0.0625\,] \\ &=& 0.0625\;in \end{array}
```

Available nozzle wall thickness new, $t_n = 0.3125$ in

The nozzle neck thickness is adequate.

MANWAY (M1)



Note: round inside edges per UG-76(c)	
Location and Orient	lation
Located on	SHELL RG 1
Orientation	180°
Nozzle center line offset to datum line	9"
End of nozzle to shell center	30"
Passes through a Category A joint	No
Nozzle	
Description	NPS 18 Sch 80
Access opening	Yes
Material specification	SA-106 B Smls pipe (II-D p. 14, In. 10)
Inside diameter, new	16.124"
Pipe nominal wall thickness	0.938"
Pipe minimum wall thickness¹	0.8208"
Corrosion allowance	0"
Projection available outside vessel, Lpr	5.062"
Internal projection, h _{new}	0.75"
Projection available outside vessel to flange face, Lf	6"
Local vessel minimum thickness	0.375"
Liquid static head included	1.59 psi
Longitudinal joint efficiency	1
Reinforcing Page	
Material specification	SA-516 70 (II-D p. 18, ln. 33)
Diameter, D _p	22"
Thickness, t _e	0.375"

Is split	Yes
Butt welds tested to confirm full penetration	No
Butt welds located at least 45° from long seam	Yes
Joint efficiency	1
Welds	
Inner fillet, Leg ₄₁	0.375"
Outer fillet, Leg ₄₂	0.3125"
Lower fillet, Leg ₄₃	O"
Nozzle to vessel groove weld	0.375"
Pad groove weld	0.375"

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

ASME B16.5-2013 Flange	
Description	NPS 18 Class 150 SO A105
Bolt Material	SA-193 B7 Bolt <= 2 1/2 (II-D p. 388, in. 32)
Blind included	Yes
Rated MDMT	-31.8°F
Liquid static head	1.3 psi
MAWP rating	272.5 psi @ 150°F
MAP rating	285 psi @ 70°F
Hydrotest rating	450 psi @ 70°F
External fillet weld leg (UW-21)	0.85" (0.85" min)
Internal fillet weld leg (UW-21)	0.938" (0.25" min)
PWHT performed	No
Impact Tested	No
UW-21 Flange Welds	
$X_{min} = min[1.4^*t_n, g_0] = [1.4^*0.938, 0.85] =$	0.85"
External Leg _{min} = $X_{min} + C_0 / 0.7 = 0.85 + 0 / 0.7 =$	0.85"
Internal Leg _{min} = min[t _n , 0.25" + C _i / 0.7] = min[0.938, 0.25 + 0 / 0.7] =	0.25"
Notes	
Flange rated MDMT per UCS-66(b)(1)(b) = -31.8 $^{\circ}$ F (Coincident ratio = 0.8 Bolts rated MDMT per Fig UCS-66 note (c) = -55 $^{\circ}$ F	3818)

UCS-66 Material Toughness Requirements Nozzle At Intersection		
Governing thickness, t _g =	0.375"	
Exemption temperature from Fig UCS-66 Curve B =	-20°F	
t _r = 251.59*24 / (20,000*1 + 0.4*251.59) =		
Stress ratio = $t_r^*E^*/(t_n - c) = 0.3004*1/(0.375 - 0) =$		
Reduction in MDMT, T _R from Fig UCS-66.1 =		
MDMT = max[MDMT - T _R , -55] = max[-20 - 19.9 , -55] =		
Material is exempt from impact testing at the Design MDMT of -20°		

UCS-66 Material Toughness Requirements Nozzle		
t _r = 251.59*8.062 / (17,100*1 - 0.6*251.59) =	0.1197"	
Stress ratio = $t_r^* E^- / (t_n - c) = 0.1197^*1 / (0.8208 - 0) =$	0.1458	
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 =	0.375"
Exemption temperature from Fig UCS-66 Curve B =	-20°F
t _r = 251.59*24 / (20,000*1 + 0.4*251.59) =	
Stress ratio = $t_r^*E^*/(t_n - c) = 0.3004*1/(0.375 - 0) =$ Reduction in MDMT, T_R from Fig UCS-66.1 =	
Material is exempt from impact testing at the Design MDMT of -20	

Reinforcement Calculations for Internal Pressure

·	UG-37 Area Calculation Summary (in²)						UG-45 Summary (in)	
	For P = 251.59 psi @ 150 °F The opening is adequately reinforced				The nozzle passes UG-45			
A required	A available	A ₁	A ₂	A3	A 5	A welds	treq	t _{min}
4.9254	<u>5.4153</u>	1.1826	1.3118	1.203	1.5	0.2179	0.1197	0.8208

	UG-4	1 Weld Failu	re Path Ana	alysis Sumr	nary (lb _t)		
	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	
77.248.43	60.594	406.749.46	64,729.55	402.686.6	96.683.55	262,754,95	

UW-16 Weld Sizing Summary				
Weld description	Status			
Nozzle to pad fillet (Leg ₄₁)	0.25	0.2625	weld size is adequate	
Pad to shell fillet (Leg ₄₂)	0.1875	0.2188	weld size is adequate	

Calculations for internal pressure 251.59 psi @ 150 °F

Parallel Limit of reinforcement per UG-40

$$L_{R} = MAX(d, R_{n} + (t_{n} - C_{n}) + (t - C))$$

= MAX(16.124, 8.062 + (0.938 - 0) + (0.375 - 0))

= 16.124 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*(0.938 - 0) + 0.375)

= 0.9375 in

Inner Normal Limit of reinforcement per UG-40

 $L_1 = MIN(h, 2.5*(t - C), 2.5*(t_1 - C_n - C))$

= MIN(0.75, 2.5*(0.375 - 0), 2.5*(0.938 - 0 - 0))

= 0.75 in

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

 $t_{rn} = P^*R_n / (S_n^*E + 0.6^*P)$

= 251.5905*8.062 / (17,100*1 - 0.6*251.5905)

= 0.1197 in

Required thickness t, from UG-37(a)

 $t_r = P^*R_o / (S^*E + 0.4^*P)$

= 251.5905*24 / (20,000*1 + 0.4*251.5905)

= 0.3004 in

Required thickness t, per Interpretation VIII-1-07-50

 $t_r = P^*R_o / (S^*E + 0.4^*P)$

= 251.5905*24 / (20,000*0.85 + 0.4*251.5905)

= 0.3531 in

Area required per UG-37(c)

Allowable stresses: $S_n = 17,100$, $S_v = 20,000$, $S_0 = 20,000$ 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 $S_p / S_v = 1$

 $A = d^*t_r^*F + 2^*t_n^*t_r^*F^*(1 - f_{r1})$

= 16.124*0.3004*1 + 2*0.938*0.3004*1*(1 - 0.855)

= 4.9254 in²

Area available from FIG. UG-37.1

 $A_1 = \text{larger of the following} = 1.1826 \text{ in}^2$

- $= d^*(E_1^*t F^*t_r) 2^*t_n^*(E_1^*t F^*t_r)^*(1 f_{r1})$
- = 16.124*(1*0.375 1*0.3004) 2*0.938*(1*0.375 1*0.3004)*(1 0.855)
- = 1.1826 in²
- $= 2^{*}(t + t_{n})^{*}(E_{1}^{*}t F^{*}t_{r}) 2^{*}t_{n}^{*}(E_{1}^{*}t F^{*}t_{r})^{*}(1 f_{r1})$
- = 2*(0.375 + 0.938)*(1*0.375 1*0.3004) 2*0.938*(1*0.375 1*0.3004)*(1 0.855)
- = 0.1756 in²

 A_2 = smaller of the following= 1.3118 in²

- = 5*(t_n t_m)*f_{r2}*t
- = 5*(0.938 0.1197)*0.855*0.375
- = 1.3118 in²
- $= 2^{*}(t_{n} t_{m})^{*}(2.5^{*}t_{n} + t_{e})^{*}f_{r2}$
- = 2*(0.938 0.1197)*(2.5*0.938 + 0.375)*0.855
- = 3.8061 in²

 A_3 = smaller of the following= 1.203 in²

- = 5*t*t_i*f₁₂
- = 5*0.375*0.938*0.855
- $= 1.5037 \text{ in}^2$
- = 5*t_i*t_i*f_{r2}
- = 5*0.938*0.938*0.855
- = 3.7613 in²
- $= 2^{h^{t}}t_{i}^{t}$
- = 2*0.75*0.938*0.855
- = <u>1.203</u> in²

$$A_{41} = Leg^{2*}f_{r3}$$

- $= 0.375^{2}*0.855$
- $= 0.1202 \text{ in}^2$

$$A_{42} = Leg^{2*}f_{r4}$$

- 0.31252*1
- $= 0.0977 \text{ in}^2$

$$A_5 = (D_p - d - 2 t_n)^* t_e^* f_{r4}^* E_p$$

- = (22 16.124 2*0.938)*0.375*1*1
- $= 1.5 \text{ in}^2$

Area =
$$A_1 + A_2 + A_3 + A_{41} + A_{42} + A_5$$

- = 1.1826 + 1.3118 + 1.203 + 0.1202 + 0.0977 + 1.5
- = 5.4153 in²

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} = 0.375 in

$$t_{c(min)}$$
 = lesser of 0.25 or 0.7* t_{min} = 0.25 in

$$t_{c(actual)} = 0.7^*Leg = 0.7^*0.375 = 0.2625 in$$

Outer fillet:
$$t_{min}$$
 = lesser of 0.75 or t_{e} or $t = 0.375$ in

$$t_{w(min)} = 0.5^* t_{min} = 0.1875$$
 in

$$t_{w(actual)} = 0.7*Leg = 0.7*0.3125 = 0.2188 in$$

UG-45 Nozzle Neck Thickness Check (Access Opening)

$$t_{a \cup G-27} = P^*R_n / (S_n^*E - 0.6^*P) + Corrosion$$

= 0.1197 in

$$t_a = \max[t_{a \cup G-27}, t_{a \cup G-22}]$$

= max[0.1197,0]

= 0.1197 in

Available nozzle wall thickness new, $t_n = 0.875*0.938 = 0.8208$ 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 psiNozzle wall in shear: 0.7*17,100 = 11,970 psiInner fillet weld in shear: 0.49*17,100 = 8,379 psiOuter fillet weld in shear: 0.49*20,000 = 9,800 psiUpper groove weld in tension: 0.74*20,000 = 14,800 psi

Strength of welded joints:

- (1) Inner fillet weld in shear $(\pi / 2)^*$ Nozzle OD*Leg*S_i = $(\pi / 2)^*$ 18*0.375*8,379 = 88,841.49 lb_i
- (2) Outer fillet weld in shear $(\pi / 2)^*$ Pad OD*Leg*S_o = $(\pi / 2)^*$ 22*0.3125*9,800 = 105,832.4 lb_t
- (3) Nozzle wall in shear $(\pi / 2)^*$ Mean nozzle dia * t $_n^*$ S $_n = (\pi / 2)^*$ 17.062 * 0.938 * 11,970 = 300,917.05 lb $_t$
- (4) Groove weld in tension $(\pi / 2)^*$ Nozzle OD* $t_w^*S_a = (\pi / 2)^*$ 18*0.375*14,800 = 156,922.55 lb_f
- (6) Upper groove weld in tension $(\pi / 2)^*$ Nozzle OD* t_w * $S_a = (\pi / 2)^*$ 18*0.375*14,800 = 156,922.55 lb_f

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

$$W = (A - A_1 + 2^*t_n^*f_{r1}^*(E_1^*t - F^*t_r))^*S_v$$

= (4.9254 - 1.1826 + 2*0.938*0.855*(1*0.375 - 1*0.3004))*20,000
= $\frac{77,248.43}{10}$ lb_r

$$W_{1-1} = (A_2 + A_5 + A_{41} + A_{42})^* S_v$$

= (1.3118 + 1.5 + 0.1202 + 0.0977)*20,000
= 60.594 lb_f

$$W_{2\cdot 2} = (A_2 + A_3 + A_{41} + A_{43} + 2^*t_n^*t^*f_{r1})^*S_v$$

= (1.3118 + 1.203 + 0.1202 + 0 + 2*0.938*0.375*0.855)*20,000
= 64.729.55 lb,

$$W_{3\cdot3} = (A_2 + A_3 + A_5 + A_{41} + A_{42} + A_{43} + 2^*t_n^* t^* f_{r1})^* S_v$$

$$= (1.3118 + 1.203 + 1.5 + 0.1202 + 0.0977 + 0 + 2^*0.938^*0.375^*0.855)^* 20,000$$

$$= 96.683.55 \text{ lb}_t$$

Load for path 1-1 lesser of W or W₁₋₁ = 60,594 lb_f

Path 1-1 through (2) & (3) = 105,832.4 + 300,917.05 = 406,749.46 lb_f Path 1-1 is stronger than W₁₋₁ so it is acceptable per UG-41(b)(1).

Load for path 2-2 lesser of W or $W_{2.2} = 64,729.55 \, lb_f$ Path 2-2 through (1), (4), (6) = 88,841.49 + 156,922.55 + 156,922.55 = $\underline{402,686.6}$ 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 $W_{3-3}=77,248.43~lb_f$ Path 3-3 through (2), (4) = 105,832.4 + 156,922.55 = $\underline{262,754.95}~lb_f$ Path 3-3 is stronger than W so it is acceptable per UG-41(b)(2).

Liquid Level

ASME Section VIII Division 1, 2017 Edition		
Location from Datum (in)	45	
Operating Liquid Specific Gravity	1	

Lift Lug Design

<u> </u>	
Customer: MARATHON OIL	By: MLR
SHOP ORDER 18165	Date: 1/22/2018
Item: LATER	

<u>Inputs</u>				
Lug Length "A"	<u>7</u> in.			
Lug Thk. "T"	0.5 in.	Erection Wt.:	<i>5,500</i> lbs	
Width "D"	<u>6</u> in.	Impact factor:	150%	
Hole dia. "E"	<u>1.5</u> in.	Number of lugs:	2	
Projection "L"	4 in.			
Radius "R"	3 in.			
Weld size "W"	<i>0.375</i> in.	Material:	SA-516-70	
_		Sy:	38,000 psi	
		_		

Check Weld Fillet weld size P = P =	(Wt)(impct factor)/(# of lugs) 4,125 lb	
Sw =	(0.49)(20000)= <u>9800</u> psi	
Fillet Size: Fillet Size:	P/(total weld length * Sw) 0.032 inches Use	0.375 inch fillet

Check lug	in bending				
Z =	(D ² * thk)/6				
Z =	3.0000 in ³				
M=	P*L = <u>16</u>	,500 in-lb			
S1 =	M/Z	Sa =	0.66 Sy	66% yield	1.7
S1 =	5,500 psi	Sa =	25,0)80 psi	
	S < Sa, Bending Stress	OK			

Check shear tear-out at pin								
	Area = T(R - 1/2 E)							
l	Area = 1.125 in ²							
S2 = S2 =	P / Area	Sa =	0.4 Sy	40% yield				
S2 =	3,667 psi	Sa =	15,3	200 psi				
	S < Sa, Shear Stress OK							

Check b	Dearing at pin Area = (E - 0.25)T Area = 0.6250 in²	assume p	in is 1/4" smaller th	an hole
S =	P / Area	Sa =	0.9 Sy	90% yield
S =	6,600 psi S < Sa, Bearing Stress C	Sa = 0 <i>K</i>	34	,200 psi

 Check lug in bending - weak axis

 Z = (thk² * D)/6

 Z = 0.2500 in³

 M = P * L * sin 10 = 2,865 in-lb

 S4 = M / Z Sa = 0.66 Sy 66% yield

 S4 = 11,461 psi Sa = 25,080 psi

 S < Sa, Bending Stress OK</td>

 Unity Check

 S5=
 S1/SA + S4/SA

 S5=
 0.68

 S5 < 1, Bending Stress OK</td>



Katy: 1435 Katy Flewellen

Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 7 HYDROSTATIC TRAVELER W/CHART



PO BOX 677, KATY, TEXAS 77494

PHONE: 281-392-7747 FAX: 281-392-7727

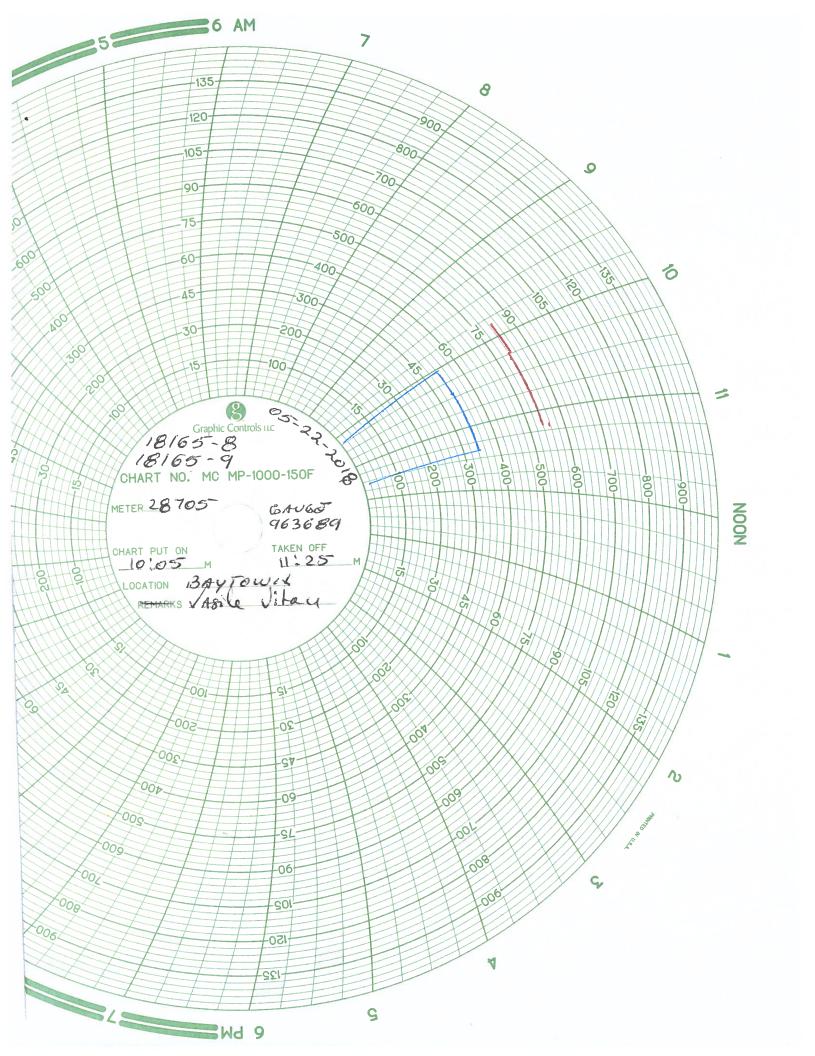
WEB: www.moore-control.com

HYDROSTATIC TEST REPORT

MCSI PROJECT No.: 1816	55	_	DATE:	5/22/2018
CUSTOMER: MAF	RATHON		-	
CUSTOMER P.O. No.: N/A		*		
UNIT DESCRIPTION: PHA	SE SEPARATOR			
DRAWING NUMBER: 1816	65-9	_		
PECIAL INSPECTION TES	TED PER ASME SEC. VII	II DIV.1 2017		
REQUIREMENTS:				
	250 PSI	_		
TEST PRESSURE:				
	60 min	TEST GAUGE USED: _	9636	89
START TIME:		_		
END TIME:	11:25			
)E
CHART REQUIRED: NOTE	YES:: UNIT PRESSURE TO BE			
NOTE	:: UNIT PRESSURE TO BE (CHECKED EVERY 15 MINU		
NOTE	OBSERVED PRESSURE TO BE O	CHECKED EVERY 15 MINU BY:	INITIALS	
NOTE	OBSERVED PRESSURE TO BE O	CHECKED EVERY 15 MINU BY:	INITIALS	
NOTE 1ST TEST PERIOD: 2ND TEST PERIOD: 3RD TEST PERIOD:	OBSERVED PRESSURE 3 40 3 42	CHECKED EVERY 15 MINU BY: BY: BY:	INITIALS VV VV	
NOTE	OBSERVED PRESSURE 3 40 3 42	CHECKED EVERY 15 MINU BY: BY: BY:	INITIALS	
NOTE 1ST TEST PERIOD: 2ND TEST PERIOD: 3RD TEST PERIOD: 4TH TEST PERIOD:	OBSERVED PRESSURE 3 40 3 42 3 42	CHECKED EVERY 15 MINU BY: BY: BY: BY: BY:	INITIALS V V V V V V	
NOTE 1ST TEST PERIOD: 2ND TEST PERIOD: 3RD TEST PERIOD: 4TH TEST PERIOD: CONDUCTED BY:	OBSERVED PRESSURE 340 342 342	CHECKED EVERY 15 MINU BY: BY: BY: BY: DATE:	INITIALS VY VY VY O5-22-24	018
NOTE 1ST TEST PERIOD: 2ND TEST PERIOD: 3RD TEST PERIOD: 4TH TEST PERIOD: CONDUCTED BY:	OBSERVED PRESSURE 3 40 3 42	CHECKED EVERY 15 MINU BY: BY: BY: BY: DATE:	INITIALS VY VY VY O5-22-24	018
NOTE 1ST TEST PERIOD: 2ND TEST PERIOD: 3RD TEST PERIOD: 4TH TEST PERIOD: CONDUCTED BY: OBSERVED BY:	OBSERVED PRESSURE 340 342 342	BY: BY: BY: BY: DATE:	INITIALS VY VY VY O5-22-24	018

NOTES:

- 1). PH Test as required
- 2). Test Requires: (1) Pressure Gauge (1) Pressure Recorder (1) Temperature Recorder
- 3). Calibration Records Required For All Equipment.



5227 DCW ROAD 77040 * P.O. BOX 55641 * HOUSTON, TX 77255 * PH. (713) 263 9740 * FAX (715) 263 9741* £ MAIL - sales@ogme.net

INSTRUMENT CERTIFICATION

DATE OF CALIBRATION: 1-29-18

CERTIFICATION DUE DATE: 7-29-18

CUSTOMER: MOORE CONTROL SYSTEMS

OGME JOB NUMBER: 22742

TYPE OF INSTRUMENT: DUAL PEN CHART RECORDER

RANGE: 0-1,000 PSI X 150° F.

ACCURACY +/-: 1%

SERIAL NUMBER: 28705

THE ABOVE INSTRUMENT HAS BEEN CERTIFIED IN ACCORDANCE WITH OGME QC MANUAL LATEST REVISION. ALL STANDARDS TRACABLE TO U.K.A.S. (UNITED RINGDOM NATIONAL STANDARDS LAB) OR N.I.S.T. (UNITED STATES NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY) IN ACCORDANCE WITH A.N.S.I. 2540.3 (2008)

TEMP.CALIBRATED TO MASTER RESSLER THERMOMETER SN# 441806 TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY TEMPERATURE: 32.00°F.REFERENCE: ICE BATE TRANSFER STANDARDS:N/A, ICE POINT FER NIST SPEC PUB 815; TEMPERATURE: 120.00°F. REFERENCE: NIST THERMOMETER STANDARDS: 229150 & 9C8073 TEMPERATURE: 212.00°F.REFERENCE: NIST THERMOMETER 40350, TRANSFER STANDARDS: 3B2847 & 2Y6528

PEN #1

INSTRUMENT
0 PSI
200 PSI
500 PSI
800 PSI
1,000 PSI
600 P91
400 PSI
O PSI

PEN #2

STANDARD	TEMPERATURE
0 °F.	0 'F.
75 F.	75 'F.
150 °F.	150 F.
75 F.	75 'F.
0 °F.	0 F.

N.I.S.T. AND UKAS TRACABLE STANDARDS

	SERIAL			CERTIFICATION
MANUFACTURER	NUMBER	RANGE	ACCURACY	DUE DATE
D.H. BUDENBURG (MOD. 3/283)	25509	1,000-60,000 PSI	0.05%	5/15/2022
* D.H. BUDENBURG (MCD. 558)	26490	10-2,000 PSI	0.03%	5/26/2021
AMETER RK (RK160WC)	85345	4" WC-1600" WC	0.05%	3/4/2020
* OMEGA TEMPERATURE READER	T43306/EB1534	0-450°F.	0.25°F.	5/18/2020
RTD'S SERIAL NUMBERS: L (C44PW-38-1) M	(30445) H (C44PH-37-1)			

* INDICATES MASTER STANDARD USED FOR THIS INSTRUMENT

CALIBRATION TECH:

QUALITY CONTROL INSPECTOR:

INSP.

0.0

The Meter Shop, Inc

6934 Signat Dr.

Houston Texas 77041

Certificate of Calibration

For Instrument:

Crystal 1KPSIXP2I Digital Test Gauge

CUSTOMER:

Moore Control Sys

Serial Number:

963689

1435 Katy Flewellen rd

Certification/Asset Number:

3693

Katy Tx 77494

Measurement Standards: NIST

RMA / Work Order: 2591-DD

P.O.:

The Meter Shop certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure unless otherwise noted). It has been calibrated using measurement standards traceable to the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques. This calibration complies with MIL-STD-45662A and ANSI/NCSL Z540.3-2013. and ISO/IEC 17025: 2005. All calibrations are done in-house unless other wise noted.

Where applicable, the expanded uncertainty of measurement at the time of test is given in the following pages. They are calculated in accordance with the method described in the ISO Guide to the Expression of Uncertainty (GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k, such that the confidence level approximates 95%.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from The Meter Shop Inc issuing this report. See attached report of Calibration for data results.

CALIBRATION INFORMATION

Cal Date
Next Cal Due:

19 Jan 2018 18 Jan 2019 Temperature 23 0°C

Humidity 45 %

Pass Y Saals OK

Tech: John

Remarks: FOUND-LEFT

Cal Procedure

Met/Cal: Torque T.O,33K6-4-2193-1

Revision

STANDARDS USED FOR CALIBRATION

Asset Number

7388

Description

Ametek GaugeCalHP 300-15 000 PSI

Cal. Date 26 Jan 2017

Due Date

25 Jan 2018

Approved by: John Brown Lab Manager

Signed JOHN BROWN

PRINTED ON 24 Jan 2018

SERIAL NUMBER:

ASSET NUMBER: 36

Certificate of Calibration or Failed Calibration Report

Page 1 of 1

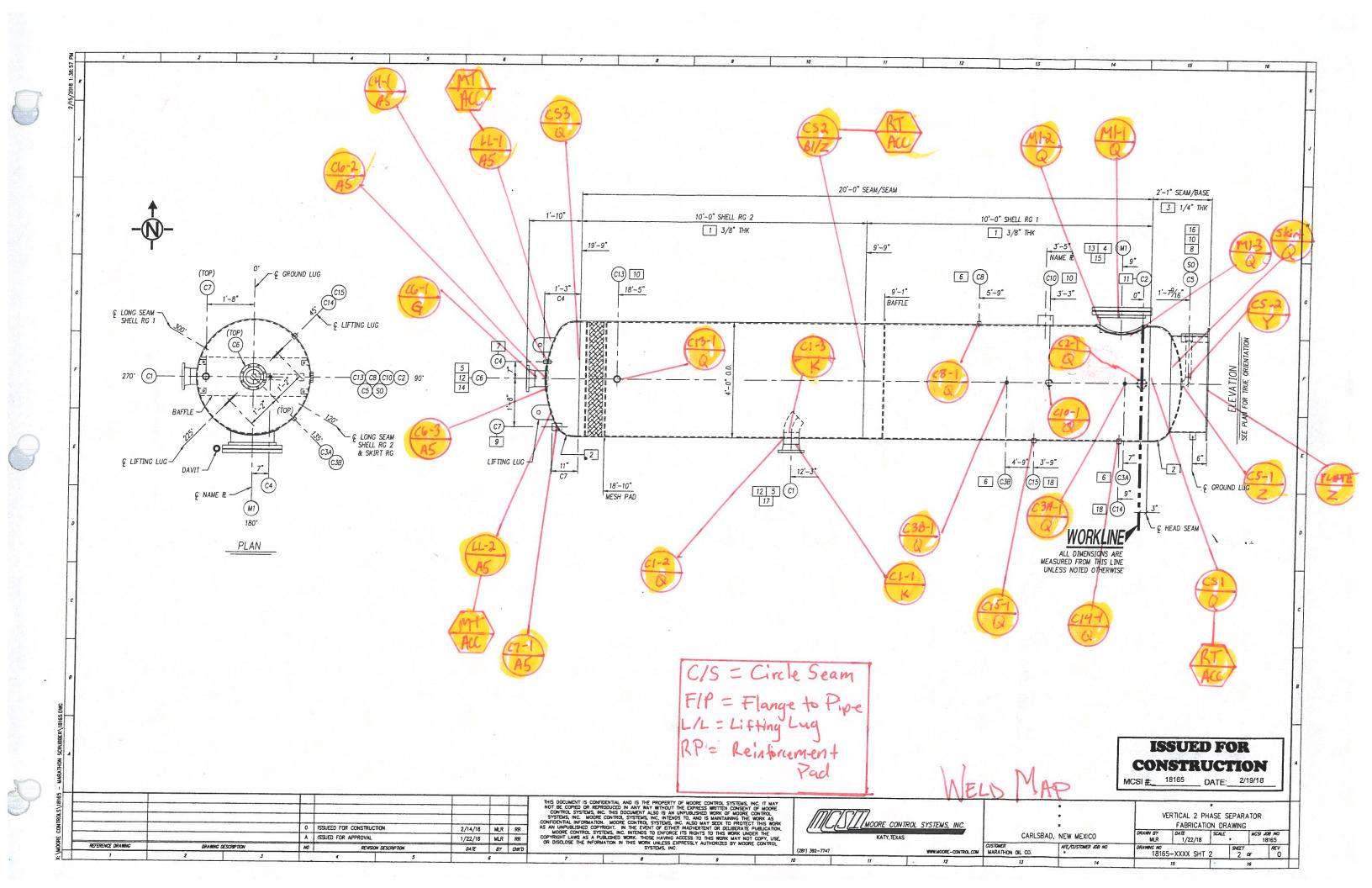


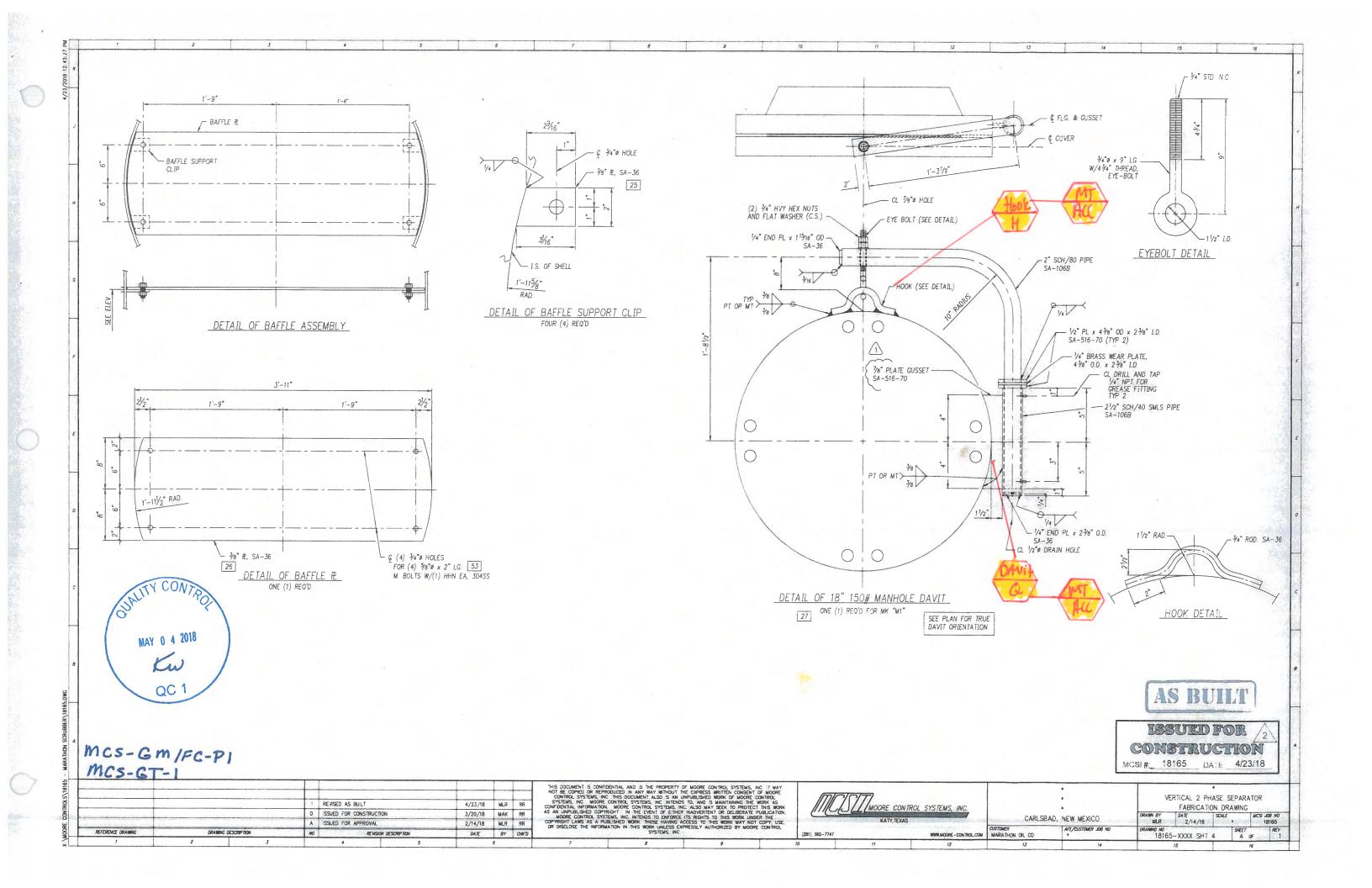
Katy: 1435 Katy Flewellen

Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 8 WELD MAP







Katy: 1435 Katy Flewellen

Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 9 WPS / PQR's

Moore Control Systems 1435 Katy Flewellen, Katy, TX 77494 ASME - Welding Procedure Specification (WPS) WeldOffice WPS

WPS record number	er	1					Qualified to		ASME Sec				
Date		10/6/20					Company name	Moore Control Systems					
Supporting PQR(s) Reference docs		Q1378	Q137841 - Rev 0										
_		1			The state of the s								
Scope		Groove	e, fillet, no	PWHT (As-welded)									
Joint				nis welding procedure spe of this WPS, Production di		neering sp	ecifications, Reference	ce documents					
BASE METALS (QW	/-403)									THICKNESS	RANGE QUA	LIFIED	
Туре		Carbon	steel (P1)	P-no. 1		Grp-no. Any			As-w	/elded	With	PWHT
Welded to		Carbon	steel (P1)	P-no. 1		Grp-no. Any			Min.	Max.	Min.	Max.
Backing:		With or	without		P-no 1		Grp-no. Any	Complete	pen.	0.188	2.00		-
Retainers		None		(10.11.11.11.11.11.11.11.11.11.11.11.11.1	5 5 5 - 5 - 5 - 5 - 5 - 5 - 5 -			Impact tes	ted	-	-	-	
Notes			3 for addi	tional base metal thicknes	s limits			Partial per		0.188	2.00	-	-
								Fillet weld	S	no min.	no max.	-	-
										DIAMETER F	RANGE QUAL	IFIED	
							•			As-w	elded	With	PWHT
								{		Min.	Max.	Min,	Max.
								Nominal pi	pe size	no min.	no max.	-	-
FILLER METALS (Q	W-404)									THICKNESS	RANGE QUA	LIFIED	
		SFA		Classification	F-no.	A-no.	Chemical and	alysis or Trade n	ame	As-w	elded	With I	PWHT
		-								Min.	Max.	Min.	Max.
GMAW		5.18	ER70S		6	=>	Chem per AWS clas	ssification		no min.	0.165		-
FCAW		5.20	E71T-1	VI	6	=>	Chem per AWS class	ssification		no min.	2.00	-	-
Sup. filler		-	ļ-		-	-	-				- No	ne -	
VELDING PROCEDI	JRE	1	.4	***************************************	!	L							
Welding process			E.		GMAV	N					CAW		
Туре					Semi-auto			1			-automatic		
Minimum preheat/int	erpass temp	erature	(°F)		70			70					
Maximum interpass t			(°F)		600			ž.			600		
Filler metal size			(in.)		.035			1			.045		
ayer number					Any						Any		
Position					All position	ons		All positions					
Weld progression					Uphill or Do	wnhill		Uphill					
Current/polarity					CEP (reverse	polarity)				DCEP (re	verse polarity)		
Amperes					70 - 15	0				150	0 - 250		
Volts					17 - 22					2:	2 - 28		
ravel speed			(in./min)		3 - 14			i I		4	- 16		
Maximum heat input			(kJ/m.)								-		
Vire feed speed			(in./min)		100 - 30			i i			0 - 500		
Arc transfer mode Shielding Ga	as type				Short-circu	-		1			pray		
	ow rate		(cfh)	•	75% Argon, 25 30 - 50			1			on, 25% CO2		
	as type		(UIII)		None	,		1			0 - 50		
-	ow rate		(cfh)		-			1		17	lone		
	is type				None			i		A	lone		
	ow rate		(cfh)		•			1		,	-		
tring or weave					Stringer or W	Veave		·		Stringer	or Weave		
rifice/gas cup size					3/8" - 5/8	3"		1			- 3/4"		
T.W.D			(in.)		1/4 - 1/2		•	1			3" - 1"		
lulti/Single pass per	side				Multiple pas	sses		1			e passes		
laximum pass thickn	ess		(in.)	No	pass greater	than 1/2"		i			ater than 1/2"		
Veld deposit chemist	ry												
			1							Flux co			

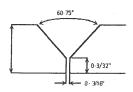
Moore Control Systems

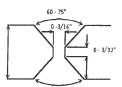
1435 Katy Flewellen, Katy, TX 77494

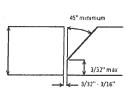
ASME - Welding Procedure Specification (WPS)

WeldOffice WPS









PREHEAT TABLE

Applicable standard	
ASME B31.1	70 (°F) minimum 200 (°F) when the nominal weld this, does not exceed 3/4 in., but any of the base metals in the joint exceeds 1 in. 250 (°F) when the nominal thickness of a weld joint exceeds 3/4 in.
ASME B31.3	70 (°F) for thickness less than 1 (in.) and specified minimum tensile strength not over 71000 (psi) 175 (°F) for 1 (in.) and greater thickness, or if specified minimum tensile strength is over 71000 (psi).
ASME Section I	70 (°F) minimum 200 (°F) when the nominal weld this, does not exceed 3/4 in., but any of the base metals in the joint exceeds 1 in. 250 (°F) when the nominal thickness of a weld joint exceeds 3/4 in
ASME Section VIII Div. 1	70 (°F) minimum 175 (°F) for thickness over 1 (in.) and specified maximum carbon content over 0 30% 200 (°F) for thickness over 1.25 (in.)

TECHNIQUE (QW-410)

1251111402 (410 410)	
Peening	None
Surface preparation	Grind to bright metal. Wire brushing as required.
Initial/interpass cleaning	Brushing and Grinding
Back gouging method	Air Carbon Arc and/or Gnnding when required.
	7

NOTES

- When used, weld backing may be base metal, weld metal, or another metal with a composition matching the base metal.
- The maximum misalignment allowed at the weld joint is 1/16" per side.
- WELD JOINT DESCRIPTIONS SHOWN ARE NOT INCLUSIVE OF ALL THOSE FOUND ON A JOB WELD JOINT DESIGN REFERENCE IN AN ENGINEERING SPECIFICATION OR A DESIGN DRAWING SHALL TAKE PRECEDENCE OVER WELD JOINTS SHOWN IN THIS WPS.

FILLET WELDS

- Fillet welds of all sizes are qualified on all base metal thicknesses and all diameters. Fillet welds will utilize base metal backing

Welder Testing, Inc.		QC Representative	
Name	Signature	Name	Signature
David Peloquin	- 0	Steven SI	are 1
Date	and the	Date	Hel
10/7/2014		7/20/15	Starling ?
			129
WeldOffice WPS 2014.01.008			(c) Copyright 2014 C-spec Software. All rights reserved worldwide
Catalog n° WPS00832			Page 2 of 3

Moore Control Systems 1435 Katy Flewellen, Katy, TX 77494

ASME - Additional information (WPS) WeldOffice WPS

			r	
WPS record number	MCS-GM/FC-P1	Revision 0	Qualified to	ASME Section IX
Date	10/6/2014		Company name	Moore Control Systems
				Mark the second

P1 Base metal with no PWHT - Thickness Limitations

- For ASME Section I applications, the maximum thickness allowed to be welded with no PWHT is 1.500"
- Note- Material over .750" may only be welded per the requirements of Section I table PW-39-1.

 For ASME Section VIII applications, the maximum thickness allowed to be welded with no PWHT is 1.500" Note- Material over 1.25" may only be welded when a 200°F or greater preheat is applied and maintained.
- For ASME B31.1 applications, the maximum thickness allowed to be welded with no PWHT is 1.500" Note- Material over .750" may only be welded per the requirements of B31.1 table 132

 For ASME B31.3 applications, the maximum thickness allowed to be welded with no PWHT is .750"

 For ASME B31.8 applications, the maximum thickness allowed to be welded with no PWHT is 1.250"

CLEANING / JOINT PREPARATION

- The surface of the parts to be welded shall be clean and free of scale, rust, oil, grease, and other deleterious foreign material for a distance of at least 1" from the welding joint preparation.
- The joint should be de-greased using a suitable organic solvent (eg- Acetone, Carbon tetrachloride, or Trichloroethylene) when required. The area shall be completely dried before welding.
- During welding, each run of a multi-pass weld shall be cleaned before depositing the next weld pass. Detrimental oxide shall be removed from the weld metal contact area when weld metal is to be deposited over a previously welded surface.
 For double welded joints, the back side of the joint shall be cleaned/gouged to sound metal prior to welding.
- Preliminary and interpass cleaning may be performed by wire brushing, and / or by grinding.
- When welding is completed, remove all slag and projections.

PREHEAT / INTERPASS TEMPERATURE

- Minimum preheat must be maintained during all thermal cutting, tacking, and welding operations.
- Preheat base metal as required to remove any moisture.
- Welding shall not be performed when the base metal surface is wet or damp.
- Preheat and interpass temperatures shall be checked by the use of thermocouples, temperature indicating crayons, pyrometers, or other suitable methods.

PROCESS NOTES

- Open root welds made from one side shall utilize GMAW welding for the root bead.

MOORE CONTROL SYSTEMS, INC.

	(See OW-201 1	Section IV A	CME Date			
Welding Procedure Spe	(See QW-201.1)	Section IX, A	SIME Boiler an	d Pressure	Vessel Code	WPS nos
		INICO-OMAA	-2-P1		Date	WPS pag
WPS Rev. No.	1 WPS Re	v. Date	12/27/17		Date	09/19/17
Supporting PQR No.(s)		807 -		By Ken	make tarry	
Welding Process(es)	GMAW-S.	FCAW, SAW		Neil	neth Withers	sennett uli
		· onti	<u>'</u>	pes Sen	i-Auto, Machin	ie
JOINT (QW-402)				(Auto	matic, Manual,	Machine or Semi-Aut
,					Detai	in a comment
Joint Design	Butt Joint			C		
Backing ry		-		ruii į	penetration wel	ided joints
, , ,	,	(No) Ro	oot - No	Long	itudinal & Ciro	umferential Seams
Backing Material (Type)	Fill - Weld I	/letal		NI	t carrier of Office	innerential Seams
Retainers No				IVOZZ	le / Pipe Circur	mferential Seams
1 11012111212	16			Sinal	e or Double Ve	Grasus
l				0	o of Double ve	e Gloove
				Groot	/e Angle: 50° I	Min. Incl'd.
1				Root	Opening: 1/4"	± 1/9"
1				Doct I	Engal A	- 1/0
				וויסטנו	Face: As need	ed
	٠					
BASE METALS (QW-4	03)					
P-No.	1	Gr. No.	1 0			
OR		GI. 140.	1 or 2	to P-No	1	Gr. No1 or
Specification type and gr	ada O		_			101
to Specification type and gr		4-516-70, SA	-106 Gr B, S	A-105		
This is a specification type and gi	rade Si	A-516-70, SA	-106 Gr B. S	A-105		
Thickness Range:		Groove X	X Fillet	VV	0.1	
Base Metal:	3/	16" - 1-1/2"	(5/8" min w/	imposite	_ Other _	
Deposited Weld Metal	GI	1AW-S 1876	" mov · FOA	Impacis)		
Pipe Diameter Range:	8"	min.	max., FUA	VV 1/4"; S	AW 1-1/2" max	Х.
Max. pass size:	1/2	F 4 141 J.				
Other:						
Odlet.	FIII	et: Any size,	any thicknes	S		
EIL SO METALS (OW &		1000		-		
FILLER METALS (QW-4	04) Ro	ot pass only				
Welding Process(es)		IAW-S		FCAW		
F-No.		6				SAW
A-No.		1		6		6
Spec. No. (SFA)		40		1		1
AWS No. (Class)		.18		5.20		5.17
		'0S-6		E71T-1M	EMIAVI	J.17
Size of filler metals	.0.	35"		0.045"	EIVITAN (Lincoln LA-71)
Electrode-Flux (Class)		VA			Note	ed WPS B
Flux Tradename		/A		N/A	F7P	6-EM14K
Consumable Insert		/A		N/A	Linc	oln 880M
_	All concumples	/A		N/A		N/A
•	All consumables	snall conforr	n to H8 or les	SS.		107
	i vo suuuleinenia	DOWIDER OF FE	In a market Bla	- 11	erial used	
	FCAW - Flux cor GMAW-S ER70S	-6 - Solid / B	argueiro Ma	.U max. (E	srand - Kobelco	o Frontiarc 711)
OSITIONS (QW-405)		pass only	are wire, win	1.6 max.,	St 1.0 max.	
osition(s) of Groove	GMA	Pass unity				
/elding Progression	GIVIA	N-S: 1G, 2G,	3G*; FC	AW, SAV	V: 1G	
osition(s) of Fillet	Up		Down	*		
oamon(a) of Filler	SAW	1F				
REHEAT (QW-406)						
eheat Temperature	1000	-i f -				
erpass Temperature	100°F	min.; for mat	erial 1-1/4" to	1-1/2" thi	ick use 200°F	
heat Maintenance						
	Fuel G	as torch and/	or weld proc	229		
ontinuous or special heating w	nere abblicable 2000	ld				
recarded)M	nimum preheat t	o he maintair	ned while wal	ding		
Pr	eheat shall exter	d a minimum	distance of	31 00 car	n of the state	
		······································	. SIGRETTUE UT	o on each	side of the we	eld.

MOORE CONTROL SYSTEMS, INC.

H .	T TREAT (QW	-407)		GAS (QW-408)			WPS	page B
Temperature Range	PWHT not	performed		4100)		Darra	-10.	
Time Range				7	Gas(es)	Perce	nt Composi	tion
Heating rate				Shielding	C25		re Flow Ra	
Cooling rate					023	75% F		SG
				Trailing	None	25% C	J2	
				Backing	None			
				Shielding gas	for GMAW-S	and FC	AW process	
ELECTRICAL CHA		S (QW-409)					iv plocess	983
Current AC or DC	DC	Polarity	Reverse	-				
		Filler I	Vietal	- Curre	nt			
Weld				Туре	Атр	-	Travel	Max
Layer(s)	Process	Class	Diameter	Polarity	Range	Volt	Speed	Hea
Root	GMAW-S	ER70S-6	.035"	DCEP	90-100	Range	Range IPM	Inpu
				502.	90-100	18-20	5-12	24,00
Hot Pass	FCAW	E71T-1M	0.045"	DCEP	240-260	24-31	10-16	48,36
Fill	SAW	EM14K	3/32"	DCEP	250-450	28-32	14-20	61,71
or Fill	SAW	EM14K	1/8"	DCEP	250-520	28-32	14-20	71,31
leverse side: Car	tion are and	/= n = -!!	!.		- 1			Joule
icverse side. Call	nou-sic sudi	or grind to so	ound metal.	if accessible	1	- 1		
1		1		. See See See See See See See See See Se	1			/(17)
1	1	1		- 1	1	- 1		/in.
everse side - Fill	1	1		- 1				/In.
1	1	1		- 1				/In.
1	1	1		- 1				/in.
1	1	1		- 1				/in.
everse side - Fill	with SAW or	FCAW proce		- 1				/in.
everse side - Fill	with SAW or	FCAW proce	ess shown	above				/In.
everse side - Fill ngsten Electrode Size de of Metal Transfer t	with SAW or And Type For GMAW	PCAW proce	ess shown	- 1	page C			/in.
everse side - Fill	with SAW or And Type For GMAW	FCAW proce	ess shown	above	page C			/in.
everse side - Fill ngsten Electrode Size de of Metal Transfer I	with SAW or And Type For GMAW Sided range	PCAW proce	ess shown	above	Dage C			/in.
everse side - Fill ngsten Electrode Size de of Metal Transfer I ctrode Wire feed spee	with SAW or And Type For GMAW Sign of Type To GMAW T	N/A hort Circuiting	ess shown	above	page C			/in.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee	with SAW or And Type For GMAW Sign of range Sti	N/A hort Circuiting	ess shown	above	page C			/in.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee	with SAW or And Type For GMAW State State GN	N/A hort Circuiting 10 - 240 IPM	ess shown g Arc - See	note on WPS p				/In.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee	with SAW or And Type For GMAW SI and range 14 Str GM Ch	N/A hort Circuiting Ing MAW-S 3/8"	ess shown Q Arc - See to 1/2* her, wire bru	note on WPS p	needed:			/in.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee	with SAW or And Type For GMAW SI And Type Stored range 14 Ch Init	N/A hort Circuiting lipping hammial cleaning t	ess shown Arc - See to 1/2" er, wire bru	note on WPS push, grinding as	needed:	preparat	ion.	/in.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee CHNIQUE (QW-410) ag or Weave Bead ce or Gas Cup Size Cleaning	with SAW or And Type For GMAW Tor	N/A hort Circuiting AAW-S 3/8" ipping hammial cleaning teaditional readitional	to 1/2* ner, wire bru	note on WPS push, grinding as mum of 1/2" ba	needed: ck from weld		ion.	/In.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee	with SAW or And Type For GMAW SI And Type For GMAW SI Ch Init See Ca	N/A hort Circuiting MAW-S 3/8" ipping hammial cleaning to additional rrbon-arc and	to 1/2* ner, wire bru	note on WPS push, grinding as	needed: ck from weld		ion.	/in.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee CHNIQUE (QW-410) ag or Weave Bead are or Gas Cup Size Cleaning od of Back Gouging Oscillation	with SAW or And Type for GMAW SI and range 14 Sti GN Ch Init See Cai Nor	N/A hort Circuiting MAW-S 3/8" ipping hammial cleaning to additional rebon-arc and	to 1/2" ner, wire bruo be a mininotes on Wigrinding to	note on WPS push, grinding as mum of 1/2" ba PS page C sound metal, n	needed: ck from weld one for skirt	to head	ion.	/in.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee CHNIQUE (QW-410) ag or Weave Bead ce or Gas Cup Size Cleaning od of Back Gouging Oscillation ct Tube to Work Distance	with SAW or And Type For GMAW Tor	N/A hort Circuiting AW-S 3/8" ipping hammial cleaning te additional rebon-arc and te AW-S: 1/2"	to 1/2" ner, wire bruo be a mininotes on Wigrinding to	note on WPS push, grinding as mum of 1/2" ba	needed: ck from weld one for skirt	to head		/in.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee CHNIQUE (QW-410) ag or Weave Bead ce or Gas Cup Size Cleaning od of Back Gouging Oscillation ct Tube to Work Distance le or Single Pass (per si	with SAW or And Type For GMAW SI GM Ch Init Sec Cas Nor GM Mul	N/A hort Circuiting MAW-S 3/8" ipping hammial cleaning to additional ribon-arc and the AW-S: 1/2"	to 1/2" for a minimotes on Wingrinding to	note on WPS push, grinding as mum of 1/2" ba PS page C sound metal, n	needed: ck from weld one for skirt	to head		/In.
everse side - Fill Ingsten Electrode Size de of Metal Transfer I ctrode Wire feed spee CHNIQUE (QW-410) ag or Weave Bead ce or Gas Cup Size Cleaning od of Back Gouging Oscillation ct Tube to Work Distance	with SAW or And Type For GMAW Solution Strict GM Ch Init Sec Can Nor Can Nor Sec GM Ide) Mul Sing	N/A hort Circuiting MAW-S 3/8" ipping hammial cleaning to additional rebon-arc and the law-S: 1/2" tiple gle electrode:	to 1/2" ner, wire bru to be a mini notes on Wi grinding to - 3/4";	note on WPS push, grinding as mum of 1/2" ba PS page C sound metal, n	needed: ck from weld one for skirt Pe /4"	to head		/In.

MOORE CONTROL SYSTEMS, INC. WELDING PROCEDURE SPECIFICATION ADDITIONAL WELD JOINT DETAILS

WPS page C

					S COUNT DETAILS
	Company Name Moore Control	Systems, Inc.	By:	Kannath	Mither & III I in
	Welding Procedure Specification No.	MCS-SAW-2-P1	Date	09/19/17	Withers fermet Withen
1	Revision No. 1	Date 12/27/17		00/19/1/	Supporting POR No.(s) 17-09-111807
	Welding Process(es)	GMAW-S, FCAW, SAW		Types	Semi-Auto, Machine
				(Auto	matic Manual Mash:
I		TYPICAL PRODUCTION	ON WE	LD JOIN	TS
- 1					

Skirt to head: If applicable

Flat faced fillet

Number of passes as required

Nozzle Circle Seams

Single Vee

Groove Angle: 52° Min. Incl'd. Root Opening: 3/32" Min. Root Face: 1/8" Max.

Feather the ends of the tacks

Cleaning: Surfaces to be welded shall be clean and free from paint, oil, dirt, scale, oxides and other foreign material detrimental to welding for at least 1/2" from joint preparation surfaces.

Reverse side of a welded joint - GMAW-S process used as a root pass will be inspected and ground if accessible.

The back side of longitudinal seams can be backgouged, ground and backwelded as needed.

Upon completion, the vessel/pipe shall be thoroughly cleaned and shall be free from grease, weld spatter, scale, slag, and any other foreign matter.



Moore Control Systems 1435 Katy Fiewellen, Katy, TX 77494

Minimate stated See pg 3 for additional base metal thickness fimits Partial pen Disal 200 Partial Per Disal 200 Partial Per Disal 200 Partial Per Disal 200 Partial Pen Disal 20	tron Cardinan	1 1 3m-y • C-41	प्रतिश्च ^क जिल्ला				Α	SME - Welding	y Flewellen, Ka Procedure S WeldOffice Wi	Specificatio	n (WPS)		
Suppose Gray	1			f		Revis	ion 1	1					
List		01	37841 - Rev	0 FQ163365 - Ra	ev Ç			, conjugate	· · · · · ·	oors Control Syste	rms		
Joint Seat of this is early proposed to strict and its VPS Production of this VPS Production drawings. Engineering specifications. Reference documents	Scope												
SEAS METALS (QW.423) THICKNESS RANGE QWALFIELD	Jaint												
Type		JOIN	Conars iong CCS section o	is A somplanded Linis WPS Produ	iura soss uction dra	=flagilan in Ewings, Engir	eerina :	Specifications Defende	- dos				
Vericing Carbon steel (P1)								Promodelis, Releiens	a occuments	THICKIE	77 84::		
Backing With or without	1			3		Pac 1		Gro-no Any				UAUFIED	
Rationers None See pg 3 for additional base metal thickness Smits Complete pen 0.188 2.00	1					Pac 1				1		i	ich PVV
Rationer None See pg 3 for additional base matal thickness Smits Impact lested Parish pen 0.188 2.00 -	DOCKITY .	With	er without			P-no 1			C		Max	Min.	
Partial pen 0 128 2 00	Ratainers	None							} .	0 188	2 00	-	
Filet welds Filet	Notes	See p	g 3 for additio	rial base metal th	irlmas s	Genite		1	1	-		-	-
CAMSTER RANGE CUAUFED A-record A-recor				2.0	E33 i	n:4:7		1		1	2 00	-	
As-welded With PWI Mar.								· · · · · · · · · · · · · · · · · · ·	FARGE WEICS		,	-	
As-welded With PWI Mar.										DIAMETER	RANGE QUAL	UFED	
Min. Max													PWH
SFA Classification F-nc A-nc Chemical analysis or Trade name A-weided Writh PVH										Min.	Mex.	J.	
A-ric Chemical analysis or Trade name A-swelded Writh PVM	LLER VETALS (QV/404)								Nominal pipe siz	a na mir.	no max	1 -	1
A-ric Chemical analysis or Trade name A-swelded Writh PVM			I			1				THICKNES	RANGERUS	I FEE	
MAW 518 ER73S-6 6 1 Mn = 1.6% max / Si = 1.0% max no min 0.165 p		SFA		Classification		F-nc	A-ric	Chemical analys	is or Toda espea				BULL
Second S	MAW	5 18	FR77S.6			-				Ma.	Hez		_ 11/II.
Differ D	CAW		1			_ 1		Mn = 1.6% max / Si = 1	0% max	na min	0.125		
LDING PROCEDURE LORG PROCEDURE LORG PROCEDURE LORG PROCEDURE GMAW Semi-automatic FCAW Semi-automatic TO TO Semi-automatic TO TO TO TO TO TO TO TO TO T	m Bilar	-				6 1		Mn = 1.5% Max		1		-	ĺ
Iding process a GMAW a Semi-automatic Semi-automatic imum preheat/interpass temperature imum interpass temper		<u>l</u> .	•		ĺ	. .							
GMAW FCAW											- Nan	8 -	
Semi-automatic FCAW						GUAW			1				
### prefractiviterpass temperature (F)			İ		5		_		† ;	F	CAW		
######################################	mum preheat/interpass temp	e:ature	17				-		; ,	Sensi-	utomatic		
India 328 601 .035 .600 .645 .64			15					į			70		
Any			F= 1					ļ		e	3 0		
All positions All positions Any progression Uphili or Downhill Uphili or Downhill progression Uphili or Downhill progression Uphili or Downhill progression Uphili or Downhill		İ) 1		.0	45			
Progression			1		4					A	Πy		
DCEP (reverse polanty) Uphil			1					:			-		
DCEP (reverse polarity) DCEP (reverse polarity)	nt/polarity		1					1					
17 - 22 150 - 250	eres						ny)	1					
Speed (e.mm) 3-14 22-29			1					į					
### heat input (Life) 4-15 and speed (Life) 190-300	Speed	(4	man i					;					
and speed (n.mm) 190 - 300	tum heat input		1			J - 14		# 1			-		
nsfer mode	eed speed					•		1		-	-		
	nsfer mode		-					i		355	trur		

Short-circuiting

75% Argon, 25% CO2

30 - 50

None

None

Stringer or Weave

3/5" - 5/8"

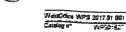
1/4 - 1/2

Multiple passes

No pass greater than 1/2"

Bare solid wire





Shielding

Trailing

Backing

CTWD

Notes

String or weave

Onlicaigas cup siza

Multi/Single pass per side

Maximum pass thickness

Weld deposit chemistry

Gas type

Ficw rate

Gas type

Ficw rate

Gas type

Ficw rates

(\$₹)

(str)

tin i

Spray

75% Argon, 25% CO2

30 - 50

None

None

Stringer or Weave

35-34

5/5" - 1"

Multiple passes

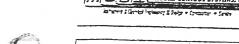
No pass greater than 1/2"

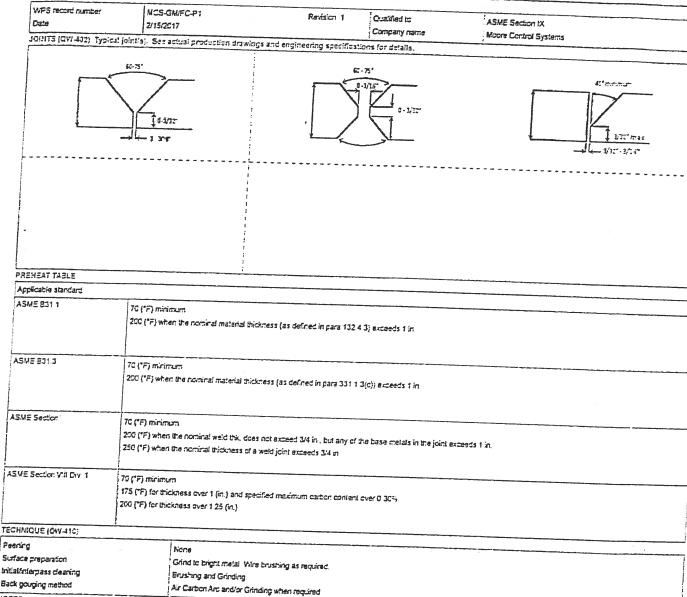
Flux cored wire



Moore Control Systems 1435 Katy Flewellen, Katy, TX 77494 ASME - Welding Procedure Specification (WPS) WeldOffice WPS







	Pearing	None
	Surface preparation	Grind to bright metal. Wire brushing as required.
		Erushing and Grinding
		Air Carbon Arc and/or Grinding when required
1	1077	and a committee at the contract

JOINT NOTES

- When used, weld backing may be base metal, weld metal, or another metal with a composition matching the base metal.
- The maximum misalignment allowed at the weld joint is 1/167 per side
- WELD JOINT DESCRIPTIONS SHOWN ARE NOT INCLUSIVE OF ALL THOSE FOUND ON A JOS. WELD JOINT DESIGN REFERENCE IN AN ENGINEERING SPECIFICATION OR A DESIGN DRAWING SHALL TAKE PRECEDENCE OVER WELD JOINTS SHOWN IN THIS WPS

FILLET WELDS

-Fillet welds of all sizes are qualified on all base metal thicknesses and all diameters. Fillet welds will utilize base metal backing

Cocumentation by Weider Testing	j. inc		Commun. The	
Name	Signature		Company Representative	
David Peloquin	fil		Name	Signature
Date 2/15/2017		Carlely.	Kenneth With	Fermetholether
WeldCiffice WPS 2017 01 301			15 Feb. 2017	- Hemerille
Catalog n° VIPTO 1507				(c) Complete 1017 0
				(c) Copyright 3017 C-spec Software. All rights reserved worldwish



Moore Control Systems 1435 Katy Flowellen, Katy, TX 77494 ASME - Additional Information (WPS)

WeldOffice WPS

WPS record number MCS-GM:FC-P1 Revision 1 Cualified to Cate ASME Section IX 2/15/2017 Сотрапу пате Moore Control Systems

P1 Base metal with no PWHT - Thickness Limitations
- For ASME Section I applications, the maximum thickness allowed to be welded with no PWHT is 1.500° Note-Material over ,750" thick may only be welded if the CE does not exceed 0.45, and no single weld pass exceeds 250".

For ASME Section VIII applications, the maximum thickness allowed to be welded with no PWHT is 1,500° - For ASME B31.8 applications, the maximum thickness allowed to be welded with no PWHT is 1.250°

CLEANING / JOINT PREPARATION

- The surface of the parts to be welded shall be clean and free of scale, rust, oil, grease, and other deleterious foreign material for a distance of at least 1" from the welding joint preparation..

- The joint should be de-greased using a suitable organic solvent (eg-Acetone, Carbon tetrachloride, or Trichloroethylene) when solvent the secondard distance welding.

required. The area shall be completely dried before welding.

During welding, each run of a multi-pass weld shall be cleaned before depositing the next weld pass. Detrimental oxide shall be removed from the weld metal contact area when weld metal is to be deposited over a previously welded surface.

- For double welded joints, the back side of the joint shall be cleaned/gouged to sound metal prior to welding.

Preliminary and interpass cleaning may be performed by wire brushing, and / or by grinding.
 When welding is completed, remove all slag and projections.

PREHEAT / INTERPASS TEMPERATURE

Minimum preheat must be maintained during all thermal cutting, tacking, and welding operations.

Preheat base metal as required to remove any moisture.

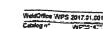
Welding shall not be performed when the base metal surface is wet or damp.

Preheat and interpass temperatures shall be checked by the use of thermocouples, temperature indicating crayons.

PROCESS NOTES

Open root welds made from one side shall utilize GMAW welding for the root bead.







Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East

Baytown, Tx 77523

SECTION 10 WELDER QUALIFICATON RECORDS



Welder's Name:	ELISEO P	EREYRA	The second secon	Identification ==	4	735
Identification of WPS followed			Test De	escription		
Base Material Type Grade:			Grade 70	C-11	Test Coupon S	
Welding Variables (QW-350)		l Test Values		nge Qualified	Base Material Thicknet Actual Test Values	
Welding process(es)		FCAW			Actual rest values	Range Qualified
Type (Manual, Semi-auto, etc.)		mi-Auto		FCAW Semi-Auto		and a finite point where the two transfer $p \neq 0$ decomposition is interestingless.
Backing (With (Without)		(backweld)		The second secon		material adoption of the resident of the state of the sta
Base metal (P no to P no)					Di bier pai più più	Makes - modes that with of a relatively model of law profit flags and a sub-role resource areas.
Pipe XI Piate	and the second s	_1			P1-P15F.P34.P41-P49	
Filler metal or Electrode SFA no	Park and an arrangement and a state of the s	5.20			e & Pipe 2.875" od & Larg	
filler metal or Electrode Classifier		717-1M				
iller metal F no		6		6	The second secon	
iller metal product form	The street of the first of the street of the	N/A		N.A		
Consumable insert		N A		N/A	enterente della indicata compresa di diffi algorigi antornati matta della anticci in collectivi controlico	Skinds - ever many print are a see -majority sets - even to great represent the direct set who are great a great
Veld deposit thickness (3 layers m				Unlimited	Annual of Statement and Annual Statements and Company of the Statement of Statement	
Velding position (2G, 5G, 3F, etc.				A Mantinella III	e transace sua criser no deput e principalisticano in cambrida y a transacente deput deservo entre distributivamente.	
ertical progression (Up or down)		Ur			the factor than the state of th	An a material contraction for market the second of
nert gas backing				Vithout gas backing	ik saith Alberhager allen. Hi phinyonher somr a respublished sintester delited shi or ya ketikye da	
MAW transfer mode				oular & Spray	e effective and an extractive field of supply hand graph, and an extractive region to the contractive decision, and	THE STREET GROUP WE SE SHOW SE AND THE SERVICE STREET AND SERVICES AND
TAW Current Type Polarity		NºA_			and all and the state of the st	REPORT OF THE CHAPTER ASSESSMENT OF THE CONTRACTOR
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga	knesses, fillet si considered wel s does not requi	zes, and diamete ding with backing re requalification	ers qualified ng (QW-40 n for weldi	d (QW-452-6) 2.4)	Is are qualified in Horizont welded butt joints, and sin	
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408-8) This QW-462.2 Side bends QW-462.5(c) Pipe bend sp	knesses, fillet si considered wel s does not requi exception does becimen, Corros	zes, and diameteding with backing requalification not apply to P5 QW-462.3(a) ion resistant over	ers qualifieding (QW-40) in for weldi. Iturouzh 52 (RESU) Transvers	d (QW-452 6) 2 4) ng fillet welds, double 3. P61, P62, or P101 n LTS e Root & Face Bends QW-462.5	e welded butt joints, and sin naterials) QW-462. (d) Pipe bend specimen. C	ngle welded butt joints 3(b) Longitudinal Bend orrosion resistant overla
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408 8) This QW-462.2 Side bends QW-462.5(c) Pipe bend spour QW-462.5(b) Pipe specim	knesses, fillet si considered wel s does not requi expension does becimen, Corros en - Macro test	zes, and diameteding with backing with backing requalification to party to P5 QW-462.3(a) ion resistant over for fusion	ers qualifiering (QW-40) in for weldi. Harevelt 5. RESUI Transvers	d (QW-452 6) 2 4) ng fillet welds, double 3, P61, P62, or P101 n LTS e Root & Face Bends QW-462.5	e welded butt joints, and sin naterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim	ngle welded butt joints 3(b) Longitudinal Bend orrosion resistant overla
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408.8) This QW-462.2 Side bends QW-462.5(c) Pipe bend sp QW-462.5(b) Pipe specim Specimen No.	knesses, fillet si considered wel s does not requi expension does becimen, Corros en - Macro test Results	zes, and diameteding with backing requalification not apply to P5 QW-462.3(a) ion resistant over	ers qualifiering (QW-40) in for weldi. Harevelt 5. RESUI Transvers	d (QW-452 6) 2 4) ng fillet welds, double 3. P61, P62, or P101 n LTS e Root & Face Bends QW-462.5	e welded butt joints, and sin naterials) QW-462. (d) Pipe bend specimen. C	ngle welded butt joints 3(b) Longitudinal Bend orrosion resistant overla
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408-8). This QW-462.2 Side bends QW-462.5(c) Pipe bend sp. QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI	knesses, fillet si considered wel s does not requi expension does ecimen, Corros en - Macro test Results	zes, and diameteding with backing requalification not analy to P5 QW-462.3(a) ion resistant over fusion Speciment	ers qualifiering (QW-40) in for weldi. Harevelt 5. RESUI Transvers	d (QW-452 6) 2 4) ng fillet welds, double 3, P61, P62, or P101 n LTS e Root & Face Bends QW-462.5	e welded butt joints, and sin naterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim	ngle welded butt joints 3(b) Longitudinal Bene orrosion resistant overlu en - Macro test for fusio
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408 8) This QW-462.2 Side bends QW-462.5(c) Pipe bend sp QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI	knesses, fillet si considered wel s does not requi exception does becimen, Corros en - Macro test Results SFACTORY	zes, and diameteding with backing requalification not analy to P5 QW-462.3(a) ion resistant over fusion Speciment	ers qualifiering (QW-40) in for weldi. Harevelt 5. RESUI Transvers	d (QW-452 6) 2 4) ng fillet welds, double 3, P61, P62, or P101 n LTS e Root & Face Bends QW-462.5	e welded butt joints, and sin naterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim	ngle welded butt joints 3(b) Longitudinal Bene orrosion resistant overlu en - Macro test for fusio
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-40\$ 8) This QW-462.2 Side bends QW-462.5(c) Pipe bend sp QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (knesses, fillet si considered wel s does not requi examplion does becimen, Corros en - Macro test Results SFACTORY QW-302.4)	zes, and diameteding with backing with backing regualification not apply to P5 QW-462.3(a) ion resistant over for fusion Speciment	ers qualifier ng (QW-40 n for weldi <u>Hurouch 5</u> <u>RESU</u>) Transvers erlay	d (QW-452 6) 2 4) ng fillet welds, double 3, P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results	e welded butt joints, and sin naterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim	ngle welded butt joints 3(b) Longitudinal Bene orrosion resistant overlu en - Macro test for fusic
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408-8). This QW-462.2 Side bends QW-462.2 Side bends QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam	knesses, fillet si considered wel s does not requi experion does becimen, Corros en - Macro test Results SFACTORY QW-302.4) ination (QW-	zes, and diameteding with backing with backing re-requalification not apply to P5 QW-462.3(a) for resistant over for fusion Speciments	ers qualifier ng (QW-40 n for weldi Haravach 5 RESU) Transvers erlay n No.	d (QW-452 6) 2 4) ng fillet welds, double 3 P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results	welded butt joints, and sinaterials] QW-462 (d) Pipe bend specimen, C QW-462.5(e) Plate specim Specimen No.	ngle welded butt joints 3(b) Longitudinal Bent orrosion resistant overla en - Macro test for fusio
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408 8) IThis QW-462.2 Side bends QW-462.5(c) Pipe bend spour QW-462.5(b) Pipe specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test (Q	knesses, fillet si considered wel s does not requi examplion does becimen, Corros en - Macro test Results SFACTORY QW-302.4) ination (QW-W-181.2)	zes, and diamets ding with backing re requalification not apply to P5 QW-462.3(a) ion resistant over for fusion Speciment	ers qualifier ng (QW-40 n for weldi Haravach 5 RESU) Transvers erlay n No.	d (QW-452 6) 2 4) ng fillet welds, double 3, P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects	welded butt joints, and sinaterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. X Satisfactory Satisfactory	agle welded butt joints 3(b) Longitudinal Bene orrosion resistant overla en - Macro test for fusio Results Unsatisfactory Unsatisfactory
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408 8) [This QW-462.2 Side bends QW-462.5(b) Pipe bend spour QW-462.5(b) Pipe specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test (Q Fillet welds in pla	knesses, fillet si considered wel s does not requi examplion does becimen, Corros en - Macro test Results SFACTORY QW-302.4) ination (QW-W-181.2) te [QW-462.4(zes, and diameteding with backing with backing re-requalification not patch to P5 QW-462.3(a) ion resistant over for fusion Speciment 191)	ers qualifiering (QW-40 n for welding (QW-40 n for welding librarath 5: RESUIT Transverserlay NO.	d (QW-452 6) 2 4) ng fillet welds, double 3, P61, P62, or P101 m LTS e Root & Face Bends QW-462.5 Results UT & percent defects	QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. Satisfactory Satisfactory Ids in pipe [OW-462, 462, 465]	agle welded butt joints 3(b) Longitudinal Benomosion resistant overlacen - Macro test for fusion Results Unsatisfactory Unsatisfactory
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing gawith backing. (QW-408-8) This QW-462.2 Side bends QW-462.5(c) Pipe bend spour QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test. (Q Fillet welds in pla Macro examination (QW-184)	knesses, fillet si considered wel si does not requi experion does becimen, Corros en - Macro test Results SFACTORY QW-302.4) ination (QW-W-181.2)	zes, and diameteding with backing with backing regualification not apply to P5 QW-462.3(a) ion resistant over for fusion Speciment [ers qualifier ng (QW-40 n for weldi Harersh 5: RESU) Transvers erlay n No.	d (QW-452 6) 2 4) ng fillet welds, double 3. P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects Fillet we XCo	welded butt joints, and sinaterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. Satisfactory Ids in pipe [QW-462.4(c) neavity/Convexity(in).	agle welded butt joints 3(b) Longitudinal Benomosion resistant overlacen - Macro test for fusion Results Unsatisfactory Unsatisfactory
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408 8) IThis QW-462.2 Side bends QW-462.5(c) Pipe bend spour QW-462.5(b) Pipe specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test (Q	knesses, fillet si considered wel si does not requi experion does becimen, Corros en - Macro test Results SFACTORY QW-302.4) ination (QW-W-181.2)	zes, and diameteding with backing with backing regualification not apply to P5 QW-462.3(a) ion resistant over for fusion Speciment [ers qualifier ng (QW-40 n for weldi Harersh 5: RESU) Transvers erlay n No.	d (QW-452 6) 2 4) ng fillet welds, double 3. P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects Fillet we XCo	welded butt joints, and sinaterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. Satisfactory Ids in pipe [QW-462.4(c) neavity/Convexity(in).	agle welded butt joints 3(b) Longitudinal Benomosion resistant overlacen - Macro test for fusion Results Unsatisfactory Unsatisfactory
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing. (QW-408-8) This QW-462.2 Side bends QW-462.5(b) Pipe specim QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test. (Q Fillet welds in pla Macro examination (QW-184) Other tests performed	knesses, fillet si considered wel si does not requi experion does becimen, Corros en - Macro test Results SFACTORY QW-302.4) ination (QW-W-181.2)	zes, and diameteding with backing with backing with backing representation and apply to P5 QW-462.3(a) ion resistant over for fusion Speciment [ers qualifier ng (QW-40 n for weldi http://discourts.com/ RESU) Transvers erlay n No.	d (QW-452 6) 2 4) ng fillet welds, double 3, P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects Fillet we XCo	welded butt joints, and sinaterials] QW-462 (d) Pipe bend specimen, C QW-462.5(e) Plate specim Specimen No. Satisfactory Satisfactory Ids in pipe [QW-462.4(c) neavity/Convexity(in)	agle welded butt joints 3(b) Longitudinal Bene orrosion resistant overla en - Macro test for fusion Results Unsatisfactory Unsatisfactory
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing. (QW-408-8) This QW-462.2 Side bends QW-462.2 Side bends QW-462.5(c) Pipe bend sp QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test. (Q Fillet welds in pla Macro examination (QW-184) Other tests performed Welding Test conducted B:	knesses, fillet si considered wel s does not requi experion does becimen, Corros en - Macro test Results SFACTORY SFACTORY QW-302.4) ination (QW- W-181.2) te [QW-462.4(zes, and diameteding with backing with backing with backing representation and apply to P5 QW-462.3(a) ion resistant over for fusion Speciment [ers qualifier ng (QW-40 n for weldi http://discourses.com/ Transvers erlay n No.	d (QW-452 6) 2 4) ng fillet welds, double 3 P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects Fillet we XCo	welded butt joints, and sinaterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. Satisfactory Satisfactory Ids in pipe [QW-462.4(ancavity/Convexity(in)]	ogle welded butt joints 5(b) Longitudinal Beneorrosion resistant overlacen - Macro test for fusion Results Unsatisfactory Unsatisfactory
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408 8) This QW-462.2 Side bends QW-462.5(c) Pipe bend sp QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test (Q Fillet welds in pla Macro examination (QW-184 Other tests performed Welding Test conducted By Mechanical tests conducted We certify that the statements in	knesses, fillet si considered wel si does not requi experion does becimen, Corros en - Macro test Results SFACTORY QW-302.4) ination (QW-W-181.2)	zes, and diameteding with backing with backing regualification not apply to P5 QW-462.3(a) ion resistant over for fusion Speciment [ers qualifiering (QW-40 in for welding (QW-40 in for welding the rest of the r	d (QW-452 6) 2 4) ng fillet welds, double 3. P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects Fillet we X Co Moore Control S Labor	welded butt joints, and sinaterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. Satisfactory Ids in pipe [QW-462.4(e) neavity/Convexity(in) Systems ratory Test No.: 171620	ogle welded butt joints 5(b) Longitudinal Beneficial resistant overlapses - Macro test for fusion Results Unsatisfactory Unsatisfactory (WELDED OFF-SITE
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408 8) This QW-462.2 Side bends QW-462.5(c) Pipe bend sp QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test (Q Fillet welds in pla Macro examination (QW-184 Other tests performed Welding Test conducted By Mechanical tests conducted We certify that the statements in of Section IX of the ASME Boile	knesses, fillet si considered wel si does not requi examplion does becimen, Corros en - Macro test Results SFACTORY SFACTORY QW-302.4) ination (QW-W-181.2)	zes, and diameteding with backing with backing re requalification not apply to P5 QW-462.3(a) ion resistant over for fusion Speciment Speciment	ers qualifier ing (QW-40 in for weld) Itarouch 5: RESU Transvers erlay In No. RT Length size (in) inc. the coupons	d (QW-452 6) 2 4) ng fillet welds, double 3 P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects Fillet we XCo Moore Control SLabor were prepared, welde	welded butt joints, and sinaterials] QW-462 (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. Satisfactory Ids in pipe [QW-462.4(s) neavity/Convexity(in)	ogle welded butt joints 5(b) Longitudinal Bene orrosion resistant overla en - Macro test for fusio Results Unsatisfactory Unsatisfactory O(WELDED OFF-SITE
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing (QW-408 8) This QW-462.2 Side bends QW-462.5(c) Pipe bend sp QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test (Q Fillet welds in pla Macro examination (QW-184 Other tests performed Welding Test conducted By Mechanical tests conducted We certify that the statements in of Section IX of the ASME Boile Prepared By:	knesses, fillet si considered wel si does not requirence men. Corros en - Macro test Results SFACTORY W-302.4) ination (QW-W-181.2)	zes, and diameteding with backing with backing regualification not apply to P5 QW-462.3(a) ion resistant over for fusion Speciment b) Fillet der Testing, I orrect and that the asset Code	ers qualifier ing (QW-40 in for weldi Harensh 5: RESU) Transvers erlay In No. RT Length size (in) inc. he coupons	d (QW-452 6) 2 4) ng fillet welds, double 3. P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects Fillet we X Co Moore Control S Labor were prepared, welde	welded butt joints, and sinaterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. X Satisfactory Satisfactory Ids in pipe [QW-462.4(c) neavity/Convexity(in)_ Systems ratory Test No.: 171620 ed. and tested in accordance	agle welded butt joints 3(b) Longitudinal Bene orrosion resistant overlagen - Macro test for fusion Results Unsatisfactory Unsatisfactory (WELDED OFF-SITE) with the requirements
Fillet welds - All base metal thic Double welded groove welds are The omission of inert backing ga with backing. (QW-408-8) This QW-462.2 Side bends QW-462.5(c) Pipe bend sp QW-462.5(b) Pipe specim Specimen No. Side Bend 1 SATI Side Bend 2 SATI Visual Examination Results (Alternative Volumetric Exam Fillet weld - Fracture test. (Q Fillet welds in pla Macro examination (QW-184) Other tests performed Welding Test conducted B:	knesses, fillet si considered wel si does not require varion does becimen, Corros en - Macro test Results SFACTORY SFACTORY QW-302.4) ination (QW-W-181.2)	zes, and diameteding with backing with backing regualification not apply to P5 QW-462.3(a) ion resistant over for fusion Speciment b) Fillet der Testing, I orrect and that the asset Code	ers qualifier ng (QW-40 n for weldi Harensh 5: RESU) Transvers erlay n No.	d (QW-452 6) 2 4) ng fillet welds, double 3. P61, P62, or P101 n LTS e Root & Face Bends QW-462.5 Results UT & percent defects Fillet we X Co Moore Control S Labor were prepared, welde ified By:	welded butt joints, and sinaterials] QW-462. (d) Pipe bend specimen. C QW-462.5(e) Plate specim Specimen No. X Satisfactory Satisfactory Ids in pipe [QW-462.4(c) neavity/Convexity(in)_ Systems ratory Test No.: 171620 ed. and tested in accordance	agle welded butt joints 3(b) Longitudinal Beneforrosion resistant overlagen - Macro test for fusion Results Unsatisfactory Unsatisfactory (WELDED OFF-SITE with the requirements

WELDER TESTING, INC.

	(See C	(W-301, Section 1	IX, ASME	ler Performance Qual Boiler and Pressure Vess	el Code)	
Welder's Name:	OSIEL HER	NANDEZ		Identification no	:	Milessey have take that they have state to be a place of the second of the state of the second of the state of the second of the state of the second of the
Identification of WPS follow			ICS-GMa		Test Coupon	Production Weld
Base Material Type/Grade:			Grade B		Base Material Thickn	ess: .864"
Welding Variables (QW-350)	Actual	Test Values	rocess 1 F	Range Qualified	Actual Test Values	rocess 2 Range Qualified
Welding process(es)		BMAW		GMAW	FCAW	FCAW •
Type (Manual, Semi-auto, etc.)	Se	mi-Auto		Semi-Auto	Semi-Auto	Semi-Auto
Backing (With / Without)		Vithout	With	or Without backing	With(weld metal)	With backing
Base metal (P no. to P no.)	state of the bidd for all anyone in the annual anapopular	1			P1-P15F,P34,P41-P49	
X Pipe Plate	6.	625"od		2,8	375"od & larger pipe & pla	te
Filler metal or Electrode SFA n		5.18			5.20	
Filler metal or Electrode Classi	ficationE	R70S-6			E71T-IM	
Filler metal F no.		_6		6		6
Filler metal product form		N/A		N/A	N/A	N/A
Consumable insert		N/A		N/A	N/A	N/A
Weld deposit thickness (3 layer:		25"[n/a]		.1375"max	.739"[n/a]	Unlimited
Welding position (2G, 5G, 3F, c		6 G		All Positions	6G	All Positions
Vertical progression (Up or dow	1 (nv	Down		Down	Un	Up
Inert gas backing		ithout	With or	Without gas backing	Without	With or Without gas backin
GMAW transfer mode		Circuiting	S	ort Circuiting	Spray	Globular & Spray
GTAW Current Type Polarity	-	N-A		N/A	N/A	N/A
Other:						
QW-462.2 Side bends QW-462.5(c) Pipe bend	l specimen, Corrosi	ion resistant ove	Transve	ULTS rse Root & Face Bends QW-462.		2.3(b) Longitudinal Bends Corrosion resistant overlay
QW-462.5(b) Pipe spec	timen - Macro test i	for fusion			QW-462.5(e) Plate specin	nen - Macro test for fusion
Specimen No.	Results	Specime	n No.	Results	Specimen No.	Results
Side Bend I SA	TISFACTORY	Side Ber	nd 3	SATISFACTORY		
Side Bend 2 SA	TISFACTORY	Side Ber	nd 4	SATISFACTORY		
Visual Examination Result	ts (QW-302.4)	1			X Satisfactory	Unsatisfactory
Alternative Volumetric Ex	amination (QW-	191)	RT	UT	Satisfactory	Unsatisfactory
Fillet weld - Fracture test	(QW-181.2)		Lengt			Olisatistactory
Fillet welds in	plate [QW-462.4(b)]			elds in pipe [QW-462.4(c)]
Macro examination (QW-I	84)	Fillet	size (in)	X co	oncavity/Convexity(in)	٥٫٫٫
Other tests performed	· · · · · · · · · · · · · · · · · · ·					
Welding Test conducted	Ву:			Moore Control Sys	stems, Inc.	
Mechanical tests conduc	ted by: Wel-	der Testing. I	nc.	Labo	ratory Test No.: 16990	6(WELDED OFF-SITE)
We certify that the statements of Section IX of the ASME Bo	in this record are e	orrect and that t	he coupo	ns were prepared, weld	ed, and tested in accordance	e with the requirements
Prepared By:					nett wither	
Organization:	Welder Testing	.Inc.	Ог	ganization:	Moore Control Syst	ems, Inc.
Date:				-	7	
OM-1814		Result of te	st: 🗶	Pass Fail		

WELDER TESTING,

Welder's Name:	EDGAR G	UTTERREZ		Identification no: .	XXXX-X	XXX-XX-3352	
Identification of WPS follow	a di	14/		Description			
Base Material Type/Grade:			IS-GM/ Irade B		Test Coupon X Base Material Thicknes		
Welding Variables (QW-350)		il Test Values		lange Qualified	Actual Test Values	Range Qualified	
Welding process(es)		GMAW		GMAW	FCAW	-	
Type (Manual, Semi-auto, etc.)		emi-Auto		Semi-Auto -	Semi-Auto	FCAW	
Backing (With / Without)		None	w	/ith or Without	Weld Metal	Semi-Auto	
Base metal (P no. to P no.)		1			P1-P15F,P34,P41-P49	With backing	
X Pipe Plate		2.375°od			od & larger pipe & plate		
Filler metal or Electrode SFA no).	5.18			5.20		
Filler metal or Electrode Classifi	cation	R70S-6			E7IT-IM		
Filler metal F no.		6		6	6	6_	
Filler metal product form		N/A		N/A	N/A	N/A	
Consumable insert		N/A		N/A	N/A	N/A	
Weld deposit thickness (3 layers	min?)1	50"[n/a]		.165"max	.194"[n/a]	.388*max	
Welding position (2G, 5G, 3F, et	c.)	6G	A	All Positions	6G	All Positions	
Vertical progression (Up or down	1)	Up		Up	Up	Up	
Inert gas backing		None	Wi	th or Without	None	With or Without	
GMAW transfer mode	Short	Circuiting	Sh	ort Circuiting	Spray	Globular, Sprey, Pulsed	
GTAW Current Type /Polarity		N/A .		N/A	N/A	N/A	
Notes Fillet welds - All base metal thi Double welded groove welds as The omission of inert backing g with backing. (QW-408.8) [Th	re considered wel tas does not requi	ding with backing re-requalification ((QW-4) for weld wough 5	02.4) ling fillet welds, double 1 33, P61, P62, or P101 ma	welded butt joints, and sing terials]	le welded butt joints	
Fillet welds - All base metal thi Double welded groove welds as The omission of inert backing g with backing (OW-408.8) Th OW-462.2 Side bends	re considered welf as does not require to exception does	ding with backing the requalification to not apply to P51th	(QW-4) for weld wough 5 RESU ransver	02.4) ling fillet welds, double 5 53, P61, P62, or P101 ma ILTS se Root & Face Bends	[QW-462.3	(b) Longitudinal Bends	
Fillet welds - All base metal thi Double welded groove welds at The omission of inert backing g with backing. (QW-408.8) Th QW-462.2 Side bends QW-462.5(c) Pipe bend	re considered welges does not requisive exception does Second Second exception does	ding with backing for requalification (not apply to P51th Q W-462.3(a) T ion resistant overla	(QW-4) for weld wough 5 RESU ransver	02.4) ling fillet welds, double 163, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(0	(D) Pipe bend specimen, Cor	(b) Longitudinal Bends	
Fillet welds - All base metal thi Double welded groove welds as The omission of inert backing g with backing. (OW-408.8) Th QW-462.2 Side bends QW-462.5(c) Pipe bend s QW-462.5(b) Pipe specin	re considered well as does not requise exception does specimen, Corros nen - Macro test	ding with backing fre requalification (not apply to P51th) QW-462.3(a) Tien resistant overlator fusion	(QW-4) for weld wough 5 RESU ransvers	02.4) ing fillet welds, double 13, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(c	QW-462.3 D Pipe bend specimen, Cor W-462.5(e) Plate specimer	(b) Longitudinal Bends	
Fillet welds - All base metal this Double welded groove welds as The omission of inert backing gwith backing. (QW-408.8) The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe special Specimen No.	re considered welges does not requise exception does specimen, Corros nen - Macro test Results	ding with backing fre requalification (not apply to P51th) QW-462.3(a) Tion resistant overlator fusion Specimen I	(QW-40 for weld wough 5 RESU ransvers	02.4) ing fillet welds, double 163, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(0	(D) Pipe bend specimen, Cor	(b) Longitudinal Bends	
Fillet welds - All base metal thi Double welded groove welds at The omission of inert backing g with backing. (QW-408.8) Th QW-462.2 Side bends QW-462.5(c) Pipe bend side of the specimen No. Root Bend I SAT	re considered well as does not requise exception does specimen, Corros men - Macro test Results TSFACTORY	ding with backing fre requalification (not apply to PS1th) QW-462.3(a) Tion resistant overlator fusion Specimen I Face Bend	(QW-40 for weld for weld wough 5 RESU ransversity	02.4) ing fillet welds, double 163, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(c) Results SATISFACTORY	QW-462.3 D Pipe bend specimen, Cor W-462.5(e) Plate specimer	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion	
Fillet welds - All base metal thi Double welded groove welds as The omission of inert backing g with backing. (QW-408.8) Th QW-462.2 Side bends QW-462.5(c) Pipe bend s QW-462.5(b) Pipe specir Specimen No. Root Bend 1 SAT Root Bend 2 SAT	re considered well as does not requise exception does specimen, Corrospien - Macro test Results TSFACTORY TSFACTORY	ding with backing fre requalification (not apply to P51th) QW-462.3(a) Tion resistant overlator fusion Specimen I	(QW-40 for weld for weld wough 5 RESU ransversity	02.4) ing fillet welds, double visit for property or P101 ma ILTS se Root & Face Bends QW-462.5(c) Results SATISFACTORY	QW-462.3 D) Pipe bend specimen, Corw-462.5(e) Plate specimer Spacimen No.	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing a with backing. (OW-408.8) The OW-462.2 Side bends OW-462.5(c) Pipe bends OW-462.5(b) Pipe special Specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results	specimen, Corros nen - Macro test Results TSFACTORY (QW-302.4)	ding with backing fre requalification (not apply to P51th) QW-462.3(a) To dien resistant overlation fusion Specimen 1 Face Bend Face Bend	(QW-40 for weld wough 5 RESU ransvers	02.4) ing fillet welds, double 163, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(c) Results SATISFACTORY	QW-462.3 D) Pipe bend specimen, Cor W-462.5(e) Plate specimer Spacimen No.	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing a with backing. (QW-408.8) The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Examples.	specimen, Corrosmen - Macro test Results TSFACTORY (QW-302.4) mination (QW-	ding with backing fre requalification (not apply to P51th) QW-462.3(a) Tion resistant overlation fusion Specimen I Face Bend Face Bend	(QW-40 for weld wough 5 RESU ransvers	02.4) ing fillet welds, double is 53, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(c) Results SATISFACTORY SATISFACTORY	QW-462.3 Di Pipe bend specimen, Cor W-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing a with backing. (QW-408.8) The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Example 10 September 1	re considered well as does not requise exception does for exception does for exception does for exception does for exception does for exception does for exception for exc	ding with backing fre requalification (not apply to P51th) QW-462.3(a) Tion resistant overlator fusion Specimen 1 Face Bend Face Bend	(QW-40 for weld wough 5 RESU ransvers	02.4) ing fillet welds, double to 63, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(c) Results SATISFACTORY DT UT & percent defects	QW-462.3 D) Pipe bend specimen, Corw-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory	(b) Longitudinal Bends rosion resistant overlay Macro test for fusion Results Unsatisfactory Unsatisfactory	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing with backing. (QW-408.8) [The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Example Fillet welds in place.	re considered well as does not requise exception does specimen, Corros men - Macro test Results TSFACTORY (QW-302.4) mination (QW-QW-181.2) ate [QW-462.4]	ding with backing fre requalification (not apply to P51th) QW-462.3(a) Tion resistant overlator fusion Specimen 1 Face Bend Face Bend 191) RT	(QW-40 for weld wough 5 RESU ransversity No. 1 2	02.4) ing fillet welds, double of the fillet welds, double of the fillet welds, double of the fillet welds, double of the fillet welds, double of the fillet welds. OUT OUT OUT OUT OUT OUT OUT OU	QW-462.3 D) Pipe bend specimen, Cor W-462.5(e) Plate specimer Specimen No. Satisfactory Satisfactory Sin pipe [OW-462.4(c)]	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing gwith backing. (QW-408.8) The QW-462.2 Side bends QW-462.2 Side bends QW-462.5(c) Pipe bend sides QW-462.5(b) Pipe specine Specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Examinative Volumetric Examination Results Fillet welds in pl. Macro examination (QW-18)	re considered well as does not requise exception does for exception does for exception does for exception does for exception does for exception does for exception does for exception for exception for exception (QW-302.4) for exception for e	ding with backing fre requalification (not apply to P51th) QW-462.3(a) Tion resistant overlator fusion Specimen I Face Bend Face Bend 191) RT	(QW-40 for weld wough 5 RESU ransversay No. 1 2 Length	02.4) ling fillet welds, double to 63, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(c) Results SATISFACTORY SATISFACTORY UT & percent defects Fillet welc XCon	QW-462.3 D) Pipe bend specimen, Corw-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory Is in pipe [QW-462.4(c)] Cavity/Convexity(in)	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing with backing. (QW-408.8) [The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Example Fillet welds in place.	re considered well as does not requise exception does for exception does for exception does for exception does for exception does for exception does for exception does for exception for exception for exception (QW-302.4) for exception for e	ding with backing fre requalification (not apply to P51th) QW-462.3(a) Tion resistant overlator fusion Specimen I Face Bend Face Bend 191) RT	(QW-40 for weld wough 5 RESU ransversay No. 1 2 Length	02.4) ling fillet welds, double to 63, P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(c) Results SATISFACTORY SATISFACTORY UT & percent defects Fillet welc XCon	QW-462.3 D) Pipe bend specimen, Corw-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory Is in pipe [QW-462.4(c)] Cavity/Convexity(in)	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing a with backing. (QW-408.8) The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Example Fillet welds in pl. Macro examination (QW-18 Other tests performed	specimen, Corros nen - Macro test Results TSFACTORY (QW-302.4) mination (QW- QW-181.2) ate [QW-462.4(4)	ding with backing fre requalification (not apply to P51th) QW-462.3(a) To describe the resistant overlation resistant overlation for fusion Specimen 1 Face Bend Face Bend 191) RT	(QW-40 for weld wough 5 RESU ransversity No. 1 2 Length	02.4) ing fillet welds, double in ing fillet welds, double in its fillet welds, double in its fillet welds, double in its fillet welds. Go P101 ma	QW-462.3 D) Pipe bend specimen, Cor W-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory Is in pipe [QW-462.4(c)] cavity/Convexity(in)	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing gwith backing. (OW-408.8) The OW-462.2 Side bends QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specin Specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Examinative Volumetric Examination (QW-18) Macro examination (QW-18) Other tests performed Welding Test conducted E	specimen, Corros nen - Macro test Results TSFACTORY (QW-302.4) mination (QW- QW-181.2) ate [QW-462.4(4)	ding with backing free requalification of apply to P51th QW-462.3(a) To ion resistant overlation for fusion Specimen I Face Bend Face Bend 191) RT	(QW-40 for weld wough 5 RESU ransversity No. 1 2 Length	02.4) ing fillet welds, double in ing fillet welds, double in its fillet welds, double in its fillet welds, double in its fillet welds. The instance of the image	QW-462.3 D) Pipe bend specimen, Cor W-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory Is in pipe [QW-462.4(c)] cavity/Convexity(in) Stems	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing a with backing. (QW-408.8) The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Example Fillet welds in pl. Macro examination (QW-18 Other tests performed	re considered welfas does not requise exception does specimen, Corros men - Macro test Results TSFACTORY TSFACTORY (QW-302.4) mination (QW-QW-181.2) ate [QW-462.4(4) By: welfast in this record are contained and contained are	ding with backing free requalification of not apply to P51th QW-462.3(a) Tion resistant overlator fusion Specimen I Face Bend Face Bend Face Bend Face Bend Face Bend Face Bend Face Bend The properties of the size o	(QW-40 for weld wough 5 RESU ransversity No. 1 2 Length	02.4) ling fillet welds, double of the fillet welds, double of the fillet welds, double of the fillet welds, double of the fillet welds. Fillet welds Moore Control Sy Labora	QW-462.3 D) Pipe bend specimen, Corw-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory Sin pipe [QW-462.4(c)] cavity/Convexity(in) stems tory Test No.: 170280(1)	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory WELDED OFF-SITE)	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing with backing. (QW-408.8) The QW-462.2 Side bends QW-462.5(c) Pipe bend side QW-462.5(b) Pipe specification No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Example Fillet weld - Fracture test (QU-18) Macro examination (QW-18) Other tests performed Welding Test conducted Emechanical tests conducted We certify that the statements in	specimen, Corros nen - Macro test Results TSFACTORY TSFACTORY (QW-302.4) mination (QW- QW-181.2) ate [QW-462.4(4) By: this record are cler and Pressure)	ding with backing the requalification of apply to P51th QW-462.3(a) To ion resistant overlation fusion Specimen I Face Bend Face Bend Face Bend Face Bend Face Bend Face Bend Face Code der Testing, Incomect and that the Vessel Code	(QW-40 for weld wough 5 RESU ransversity No. 1 2 Length ze (in) coupons	O2.4) ing fillet welds, double to fig. P61, P62, or P101 ma ILTS se Root & Face Bends QW-462.5(c) Results SATISFACTORY SATISFACTORY UT & percent defects Fillet welc X Con Moore Control Sy Labora s were prepared, welded.	QW-462.36 D) Pipe bend specimen, Corw-462.5(e) Plate specimen Spacimen No. Satisfactory Satisfactory Sis in pipe [QW-462.4(c)] cavity/Convexity(in) stems tory Test No.: 170280() and tested in accordance v	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory WELDED OFF-SITE) with the requirements	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing gwith backing. (QW-408.8) The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Examinative Volumetric Examination (QW-18) Macro examination (QW-18) Other tests performed Welding Test conducted Emechanical tests conducted We certify that the statements in of Section IX of the ASME Boilt Prepared By:	specimen, Corros nen - Macro test Results TSFACTORY TSFACTORY TSFACTORY (QW-302.4) mination (QW- 181.2) ate [QW-462.4(4) By: this record are celer and Pressure) David Pelogum Velder Testing	ding with backing fre requalification of apply to P51th QW-462.3(a) To ion resistant overlation for fusion Specimen I Face Bend Face Bend Face Bend Face Bend Face Bend Face Bend Face Bend The f	(QW-40 for weld wough 5 RESU ransvers y Length coupons — Cert — Orgg	D2.4) ing fillet welds, double in ing fillet welds, double in its face fillet welds, double in its face fillet welds. The percent defects fillet weld in its fillet weld fille	QW-462.3 Pipe bend specimen, Cor W-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory Substitution Substitution Substitution Stems Story Test No.: 170280(1) and tested in accordance we with the control Systems Moore Control Systems	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory WELDED OFF-SITE) with the requirements	
Fillet welds - All base metal this Double welded groove welds at The omission of inert backing with backing. (QW-408.8) The QW-462.2 Side bends QW-462.5(c) Pipe bends QW-462.5(b) Pipe specimen No. Root Bend 1 SAT Root Bend 2 SAT Visual Examination Results Alternative Volumetric Example Fillet welds in pl. Macro examination (QW-18 Other tests performed Welding Test conducted E Mechanical tests conducted We certify that the statements in of Section IX of the ASME Boild	specimen, Corros nen - Macro test Results TSFACTORY TSFACTORY TSFACTORY (QW-302.4) mination (QW- 181.2) ate [QW-462.4(4) By: this record are celer and Pressure) David Pelogum Velder Testing	ding with backing fre requalification of apply to P51th QW-462.3(a) To ion resistant overlation for fusion Specimen I Face Bend Face Bend Face Bend Face Bend Face Bend Face Bend Face Bend The f	(QW-40 for weld wough 5 RESU ransvers y Length coupons — Cert — Orgg	D2.4) ing fillet welds, double in ing fillet welds, double in its face fillet welds, double in its face fillet welds. The percent defects fillet weld in its fillet weld fille	QW-462.3 Pipe bend specimen, Cor W-462.5(e) Plate specimer Spacimen No. Satisfactory Satisfactory Substitution Substitution Substitution Stems Story Test No.: 170280(1) and tested in accordance we with the control Systems Moore Control Systems	(b) Longitudinal Bends rosion resistant overlay - Macro test for fusion Results Unsatisfactory Unsatisfactory WELDED OFF-SITE) with the requirements	

WELDER TESTING,

QW-484A;

502 West 13th Street, Deer Park, TX 77536 Phone (281) 930-9966 Fax (281) 478-0010

QW-484A Suggested Format For Welder Performance Qualifications (WPQ) (See QW-301, Section IX, ASME Boiler and Pressure Vessel Code) Welder's Name: **EDGAR GUTIERREZ** _ Identification no: _ XXX-XX-3352 Test Description Identification of WPS followed: MCS-GM&FC-PI Test Coupon X Production Weld Base Material Type/Grade: SA-106 Grade B Base Material Thickness: Process 1 Process 2 Actual Test Values Welding Variables (QW-350) Range Qualified Actual Test Values Range Qualified Welding process(es) **GMAW** GMAW FCAW Type (Manual, Semi-auto, etc.) Semi-Auto Semi-Auto Semi-Auto Semi-Auto Backing (With / Without) Without With or Without backing With(weld metal) With becking Base metal (P no. to P no.) PI-PI5F, P34, P41-P49 X Pipe Plate 6.625"od 2.875"od & larger pipe & plate Filler metal or Electrode SFA no. 5.18 5.20 Filler metal or Electrode Classification ER70S-6 E7IT-IM Filler metal F no. 6 6 Filler metal product form N/A N/A N/A N/A Consumable insert N/A N/A NIA N/A Weld deposit thickness (3 layers min?) 125"[n/a] 1375"max 739"[n/a] Unlimited Welding position (2G, 5G, 3F, etc.) 6G All Positions 6G All Positions Vertical progression (Up or down) Down DOWN Un Up Without Inert gas backing With or Without gas backing Without With or Without gas backing GMAW transfer mode Short Circuiting Short Circuiting Some Globular & Spray GTAW Current Type /Polarity N/A N/A Other; Notes Fillet welds - All base metal thicknesses, fillet sizes, and diameters qualified. (QW-452.6) * Double welded groove welds are considered welding with backing (QW-402.4) * The omission of inert backing gas does not require requalification for welding fillet welds, double welded butt joints, and single welded butt joints with backing. (OW-108.8) [This exception does not apply to P51through 53, P61, P62, or P101 materials] RESULTS X QW-462.2 Side bends X QW-462.3(a) Transverse Root & Face Bends QW-462.3(b) Longitudinal Bends QW-462.5(c) Pipe bend specimen, Corrosion resistant overlay QW-462.5(d) Plate bend specimen, Corrosion resistant overlay QW-462.5(b) Pipe specimen - Macro test for fusion QW-462.5(e) Plate specimen - Macro test for fusion Specimen No. Results Specimen No. Results Specimen No. Results Side Bend 1 SATISFACTORY Side Bend 3 SATISFACTORY Side Bend 2 SATISFACTORY Side Bend 4 SATISFACTORY Visual Examination Results (QW-302.4) X Satisfactory Unsatisfactory Alternative Volumetric Examination (QW-191) Пит RT Satisfactory Unsatisfactory Fillet weld - Fracture test (QW-181.2)_ Length & percent defects. Fillet welds in plate [QW-462.4(b)] Fillet welds in pipe [QW-462.4(c)] Macro examination (QW-184)_____ Fillet size (in) Concavity/Convexity(in)_ Other tests performed __ Moore Control Systems, Inc. Welding Test conducted By:_ Mechanical tests conducted by: Welder Testing, Inc. Laboratory Test No.: 170279(WELDED OFF-SITE) We certify that the statements in this record are correct and that the coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code Certified By: Termettel The Prepared By: __ Welder Testing, Inc. Organization:____ Organization:____ Moore Control Systems, Inc. 1/19/2018 1-19-2018 Date: Date:_

Result of test: | Pass | Fail

QW-484 WELDER, WELDING OPERATOR QUALIFICATION TEST RECORD (See QW-301, ASME Section IX)

Welder's name JUA!	N CARLOS ROSTRO		Stencil	<u> </u>
Welding process(as) used	FCAW	Туре	Semi-Auto	
WPS followed by walder during w	velding of test coupon	MCS-GN/FC-P1		
Base material(s) welded	SA-36			Thickness 3/4"
Manual or Semiautomatic Varia	blas for Each Process (QW-350)	Actual Values		Range Qualified
Bac	king Material (QW-402)	Weld metal		With backing
(meta	I, weld metal, flux, etc.)			
	ASME P-No. (QW-403)	3/4*		P1 thru P15F, P34, and P4X
Plate or Pipe	(enter diameter, if pipe)	Plate		Plate and pipe 2-7/8" O.D. and over
				Groove: Flat only for pipe less than 24
Filler meta	specification(QW-404)			
	SFA No.	5.20		All with SFA 5.20, 5.22, 5.29
	Classification	E71T-1 / T-9		All with SFA 5.20, 5.22, 5.29
	Filler metal F-No.	6		All with SFA 5.20, 5.22, 5.29
Cansu	mable insert for GTAW	N/A		N/A
W	ald deposit thickness	3/4°		Max. to be welded
Weld	ing position (QW-405)	3G		Groove: F, V
				Fillet: F, H, V
	Welding progression	Vertical Up		Flat, Vertical Up
Backing gas for GTA	W or GMAW: (QW-408)	N/A		N/A
GMAW / FCAW to	ransfer mode (QW-409)	Spray		Globular, Spray or Pulsating arc
GTAW weldir	ig current type/polarity	N/A		N/A
achine Welding Variables (Q)	4/ 75 O			
	emote visual control	B1/A		****
	oftage control (GTAW)	N/A N/A		N/A
	omatic joint tracking	N/A		N/A
	Position (1G, 5G, etc.)	N/A		N/A
araiding	Consumable insert	N/A		N/A
	Backing Material	N/A		N/A
(metal,	weld metal, flux, etc.)	100		N/A
	Gui	ded Bend Test Results		
	TYPE AND FIG. NO.	82.2, QW-462.3 (a) & (b))	550	
Γ			RESI	JLI
	2 Side bends per QW-462.2		Satisfa	ctory
-				
L				
sual examination results (QW-30)	2.4) Satisfactory			
diographic test results No	one			
W-304 and QW-305)	110			
Iding test conducted byM	core Control Systems, Inc.			
chanical tests conducted by M	oore Control Systems, Inc.			
cartify that the statements in thi led in accordance with the requi	s record are correct and that the trements of Section IX of the ASME	est coupons were prepare Code.	ed, welded, and	
		MOCRE CO	NTROL SYST	EMC INC
		MOONE CO		EMO, INC.
Date 19/26/15				EM3, INC.
Date 10/26/15	8			- 10

WELDER TESTING, INC.

Welder's Name: Carlos Rostro		ostro	Idanic.	rure Vessel C	7/7/72 4	XXX-XX-6131	
in ender 3 statiste.	C4103 K	0300	Test Description	ition no: _	XXX-X	X-6131	
Identification of WPS followed:		MC	S-GM/FC-PI		Test Coupon	Production Weld	
Base Material Type/Grade :		SA-3			Base Material Thickne		
Welding Variables (QW-350)	Actual	Test Values	Range Qualifie	d b	Actual Test Values	Range Qualified	
Welding process(es)	G	MAW	GMAW		FCAW	FCAW	
Type (Manual, Semi-auto, etc.)	Ser	ni-Auto	Semi-Auto		Scmi-Auto	Semi-Auto	
Backing (With / Without)		Vone	With or Withou		Weld Metal	With backing	
Base metal (P no. to P no.)		1		P	1-P15F, P34, P41-P49	With Obeking	
Pipe 🔀 Plate		du			& Pipe 2.875"od & Laras	·-	
Filler metal or Electrode SFA no.		5.18			5.20		
Filler metal or Electrode Classification	ER	70S-6		-	E7LT-1M		
Filler metal F no.		6	6	-	6	,	
Filler metal product form		N/A	N/A	6	N/A	6 N/A	
Consumable insert		N/A	N/A	_	N/A	N/A	
Weld deposit thickness (3 layers min?)	.12	5"[n/a]	.1375" max		.250"[n/a]		
		IĢ	Flat	_ _	1G	.500" max	
/ertical progression (Up or down)	1	V/A	N/A	_ _	N/A	<u>Flat</u>	
nert gas backing	N	one	With or Without		None	N/A	
GMAW transfer mode	Short (Circuiting	Short Circuiting		Spray	With or Without	
TAW Current Type /Polarity		₹/A	N/A	_ -	N/A	Globular & Spray	
					10/16	N/A	
Other							
with backing (OW-408.8) This excess QW-462.2 Side bends QW-462.5(c) Pipe bend specime	en, Corrosi	QW-462.3(a) 1 on resistant overla	RESULTS ransverse Root & Fa	ce Bends	QW-462.	3(b) Longitudinal Bends	
QW-462.5(b) Pipe specimen - N	lacro t es t f	or fusion				en - Macro test for fusion	
Specimen No. Resu	lls	Specimen					
Side Bond 1 CATTORIA			No. Rest		Specimen No.		
Side Bend I SATISFA	CTORY		Vo. Resi		Specimen No.	Results	
Side Bend 2 SATISFAC			No. Resi		Specimen No.		
Side Bend 2 SATISFA	CTORY		No. Resi			Results	
Side Bend 2 SATISFAC Visual Examination Results (QW-	302.4)				Satisfactory	Results Unsatisfactory	
Side Bend 2 SATISFAC Visual Examination Results (QW- Alternative Volumetric Examination	CTORY 302.4) on (QW-1	91)	г Пит		Satisfactory Satisfactory	Results	
Side Bend 2 SATISFACE Visual Examination Results (QW-Alternative Volumetric Examination Fillet weld - Fracture test (QW-18)	202.4) 201. (QW-1	91)	UT UT Length & percent	defects	Satisfactory Satisfactory	Results Unsatisfactory Unsatisfactory	
Side Bend 2 SATISFAC Visual Examination Results (QW- Alternative Volumetric Examinatio Fillet weld - Fracture test (QW-18 Fillet welds in plate [QM-184) Macro examination (QW-184)	OTORY 302.4) on (QW-1 11.2) W-462.4(I	91)	UT Length & percent of the percent o	defects Fillet weld	Satisfactory Satisfactory Is in pipe [QW-462.4(convexity(in))	Results Unsatisfactory Unsatisfactory	
Side Bend 2 SATISFACE Visual Examination Results (QW-Alternative Volumetric Examination Fillet weld - Fracture test (QW-18)	OTORY 302.4) on (QW-1 11.2) W-462.4(I	91)	UT Length & percent of the percent o	defects Fillet weld	Satisfactory Satisfactory Is in pipe [QW-462.4(convexity(in))	Results Unsatisfactory Unsatisfactory	
Side Bend 2 SATISFAC Visual Examination Results (QW- Alternative Volumetric Examinatio Fillet weld - Fracture test (QW-18 Fillet welds in plate [Q' Macro examination (QW-184) Other tests performed	270RY 302.4) on (QW-1 11.2) W-452.4(I	91)	UT Length & percent of the percent o	defects Fillet weld	Satisfactory Satisfactory Substitute (Satisfactory) Substitute (Satisfact	Results Unsatisfactory Unsatisfactory	
Side Bend 2 SATISFACE Visual Examination Results (QW-Alternative Volumetric Examination Fillet weld - Fracture test (QW-18 Fillet welds in plate [QMacro examination (QW-184) Other tests performed Welding Test conducted By:	OTORY 302.4) on (QW-1 11.2) W-452.4(I	91)	Length & percent of the control of t	defects Fillet weld	Satisfactory Satisfactory s in pipe [QW-462.4(cavity/Convexity(in)_	Results Unsatisfactory Unsatisfactory	
Side Bend 2 SATISFACE Visual Examination Results (QW-Alternative Volumetric Examination Fillet weld - Fracture test (QW-18 Fillet weld - Fracture test (QW-18 Fillet welds in plate [QMacro examination (QW-184) Other tests performed Welding Test conducted By: Mechanical tests conducted by; We certify that the statements in this re	270RY 302.4) on (QW-1 11.2)	91) R Fillet si	Length & percent of the control of t	defects Fillet weld Con- control Sy Labora	Satisfactory Satisfactory Is in pipe [QW-462.4(cavity/Convexity(in) stems tory Test No.:	Results Unsatisfactory Unsatisfactory	
Side Bend 2 SATISFAC Visual Examination Results (QW- Alternative Volumetric Examination Fillet weld - Fracture test (QW-18 Fillet welds in plate [Q Macro examination (QW-184) Other tests performed Welding Test conducted By: Mechanical tests conducted by; We certify that the statements in this re of Section IX of the ASME Boiler and Prepared By:	Welcord are co	91) R Fillet si ler Testing, Increet and that the	Length & percent of the percent of t	defects Fillet welden Constrol Sy Labora ed, welded	Satisfactory Sa	Results Unsatisfactory Unsatisfactory	
Side Bend 2 SATISFAC Visual Examination Results (QW- Alternative Volumetric Examination Fillet weld - Fracture test (QW-18 Fillet welds in plate [Q Macro examination (QW-184) Other tests performed Welding Test conducted By: Mechanical tests conducted by; We certify that the statements in this re of Section IX of the ASME Boiler and Prepared By:	Welcord are co	91) R Fillet si ler Testing, Increet and that the	Length & percent of the percent of t	defects Fillet welden Constrol Sy Labora ed, welded	Satisfactory Satisfactory Satisfactory Sati	Results Unsatisfactory Unsatisfactory 138406 with the requirements	
Side Bend 2 SATISFACE Visual Examination Results (QW-Alternative Volumetric Examination Fillet weld - Fracture test (QW-18 Fillet weld - Fracture test (QW-18 Macro examination (QW-184) Other tests performed Welding Test conducted By: Mechanical tests conducted by: We certify that the statements in this re of Section IX of the ASME Boiler and	Welcher Cord are cord	91) R Pillet si Fillet si Fillet si Fillet si Fillet si	Moore Co. Coupons were prepar Certified By: Organization:	defects Fillet welded Constrol Sy Laborated, welded	Satisfactory Satisfactory Satisfactory Sati	Results Unsatisfactory Unsatisfactory 138406 with the requirements Results	



QW-484 WELDER, WELDING OPERATOR QUALIFICATION TEST RECORD (Sae QW-301, ASME Section IX)

Welder's name Juan Carlos Rostro	Stancil	<u> </u>
Walding process(es) used SAW	Typs	Vachinë
WPS followed by welder during welding of test coupon	MCS-SAW-P1	
Base material(s) welded SA-516-70		Thickness 12°
Manual or Semisulomatic Variables for Each Process (QW-350)	Actual Values	Range Qualified
Backing Material (QW-402)	Weld Metal	With backing
(metal, waid metal, flux, etc.)		
ASME P-No. (QW-403)	1	P1 thru P15 and P4X
Plate or Pipe (enter diameter, if pipe)	Plate	Plate and pipe over 24" O D
Fillar metal specification(QW-404)		
SFA No.	5.17	All with SFA 5 9 5 17. 5 23
Classification	EM13K	Any with F6
Filler metal F-No	6	Any with F6
Consumable insert for GTAW	N/A	NA
Wald deposit thickness	1/2*	Max. to be welded
Walding position (QW-405)	1G	1G Flat
NUMBER OF LAYERSIGW-452.1(b)	minimum of three	
Welding progression	<u>N/A</u>	NA
Backing gas for GTAW or GMAW: (QW-40a)	N/A	N A
GMAW / FCAW transfer mode (QW-409)	N/A	NA
GTAW walding current type/polarity	N/A	IVA
Aschine Welding Variables (QW-360)		
Direct / remote visual control	Direct	Direct
(WATC) lorinos egatios citamotus.	N/A	N/A
Automatic joint tracking	None	None
Welding Position (1G, 5G, etc.)	1G	16
Consumable insert	None	None
Backing Material	Weld Mela	With backing
(metal, wald metal, flux, etc.)		
Gui	ded Band Test Results	
	62.2, QW-482.3 (a) & (b))	
TYPE AND FIG. NO.		RESULT
iual examination results (QW-302.4) Satisfactory		
, , , ,		
diagraphic test results Circumferential Seam C2, Job # 14- W-304 and QW-305)	-777. Tag # V-5510, 43° O	D - Satisfactory No Defects
st conducted by Radiography performed by IRIS ND	T	
chanical tests conducted by N-A		
certify that the statements in this record are correct and that the ta ditested in accordance with the requirements of Section IX of the Al	est coupons were prepared ME Code	. welded
	, o MOC	DRE CONTROL SYSTEMS_INC.
Date 02:72:16 8v	. Lamas	4.1.70
8)	KEN	NETH WITHERS

WELDER TESTING, INC.

502 West 13th Street, Deer Park, TX 77536 Thone (281) 930-9966 Fax (281) 478-0010



QW-434A Suggested Format For Welder Performance Qualifications (WPQ) (See QW-391, Section IX, ASME Boiler and Pressure Vessel Code)

Welder's Name:	RAMON	LOFEZ		Identification no	XXX-	XX-1723
			Test	Description		
Identification of ViPS followed		MCS-GNUFC-Pİ			Test Coupon [
Base Material Type Grade:		SA-106 C	irada <u>B</u>		Base Material Thicks	055: 344*
Welding Variables (QW-350)	Actua	Test Values	F	lange Qualified	Actual Test Values	Range Qualified
Welding process(as)	(SMAW		GMAW	FCAW	FCAW
Type (Manual, Semi-auto, etc.)	S:	mi-Auto		Semi-Aute	Semi-Auto	Semi-Auto
Backing (With/Without)		None	V	lith or Without	Weld Metal	With backing
Base metal (Pine, te. Pine.)	***	1			P1-P15F.P34.P41-P49	
🗙 Pipe 🔲 Platy	2	375°04			05"ed & larger pipe & pla:	5
Filler metal or Electrode SFA no.		5.18			5.20	
Filler metal or Electrode Classifica	tion <u>E</u>	2,705-5			E71T-1M	
Filler metal F no		6		6	6	6
Filler metal product form		N/A		N/A	N/A	N/A
Consumable insert		N/A		N/A	N/A	N/A
Weld deposit thickness (3 layers m	n^)(^n	01[n/a]		.155°max	.194"[n/a]	,333°max
Wolding position (2G, 5G, 3F, etc.)		6G		All Pasitions	60	All Positions
Vertical progression (Up or down)		Un		<u>Uc</u>	Uş	Ųг
lnert gas bocking		<u> Yors</u>	ħ.	th or Without	Nore	With or Without
GMAW (master mede	Shor	Circuiting	St	ort Circuiting	<u>Saray</u>	Globyly, Spray, Pulsed
GTAW Current Type (Pelarity		N/A		_ N/A	N/A	N/A
Diha:						
Notes		· · · · · · · · · · · · · · · · · · ·				
* The emission of mon backing gas with backing (OW-103 \$) [This	exacetian dess	nat apple to P51ti	RESI	53, P61, P62, c: P101 (I LTS	materials]	
QWI462 2 Side bends				se Rool & Face Bend.		.3(b) Longitudinal Bends
QW-452.5(c) Pipe bond spo			y.	QW-462	5(d) Pipe band specimen, C	cmosion resistant overlay
QW-462.5(b) Pipe specime	n - Maero test I	or fusion			QW-462.5(e) Plate specim	en - Macro test for fusion
	esults	Specimen I	No.	Results	Specimen No.	Results
Root Bend 1 SATIS	FACTORY	Face Bend	1	SATISFACTORY		
Root Bend 2 SATIS	FACTORY	Face Bend	2	SATISFACTORY		
Visual Examination Results (C Alternative Volumetric Exami Fillet weld - Fracture test (QV	nation (QW-			UT	Satisfactory Satisfactory	Unsatisfactory Unsatisfactory
Fillet welds in plats	[QW-4634[5)]		Fille: W	elds in pige IOW-462.40	•)}
Fillet welds in plate Macro examination (QW-184)		Fillet si	ze (in)	X Co	oncavity/Convexity(in)_	
Other tests performed						
Welding Test conducted By				Moore Control :	Systems	
Mechanical tests conducted	by Wele	der Testing, Inc		Labo	ratory Test No.: 170478	(WELDED OFF-SITE)
We certify that the statements in the of Section IX of the ASME Bailer	is record are or	orrest and that the				
Prepared By:	Cario resolery			tified By: Le		Then
Organization: We						
Date:	/25/2018		Dai	e: 1-26-2	018	
GM 4817				Pass Fail		

WELDER TESTING, INC.

QW-484A

502 West 13th Street, Deer Park, TX 77536 Phone (281) 930-9966 Pax (281) 478-0010

QW-484A Suggested Format For Welder Performance Qualifications (WPO) (See QW-301, Section IX, ASME Boiler and Pressure Vessel Code) RAMON LOPEZ Welder's Name: ___ Identification non____ XXX-XX-1728 Test Description Identification of WPS followed: MCS-GM&FC-PT __ Test Coupon X Production Weld SA-106 Grade B Base Material Type/Grade: __ __ Base Moterial Thickness :___ Process 1 Process 2 Welding Variables (QW-350) Actual Test Values Range Qualified Actual Test Values Range Qualified GNIAW Wolding process(es) GMAW. FCAW FCAW Type (Manual, Semi-auto, etc.) Scmi-Auto Semi-Auto Semi-Auto Semi-Auto Backing (With / Without) Without With or Without backing With(weld metal) With backing Base metal (Pino. to Pino.) P1-P15F,P34,P41-P49 X Pipe Plate 6 625 'nd 2.875" od & larger pipe & plate Filler metal or Electrode SFA no 5.13 5 20 Filler metal or Electrode Classification ER705-6 E71T-1M Filler metal Fino 6 N/A Filler metal product form N/A N/A N/A N/A Consumable insert N/A N/A N/A .125"[n/a] Weld deposit thickness (3 layers min?) _ 1375° max .739"[n/a] Unlimited Walding position (2G, 5G, 3F, etc.) _ 6Q All Positions 6G All Positions Vertical progression (Up or down) Down Down Up Inertigas backing Without Without With or Without gas booking With or Without pay backing GMAW transfer mode Short Circuiting Short Circuiting Globular & Some Saray GTAW Current Type /Polarity MA Other Notes * Fillet welds - All base metal thicknesses, fillet sizes, and diameters qualified. (QW-452-6) * Double welded groove welds are considered welding with backing (OW 402.4) * The emission of inert backing gas does not require requalification for welding fillet welds, double welded but joints, and single welded but joints. with backing. (OW-403.8). [This exception does not apply to P51through 53, P61, P62, or P101 materials] RESULTS X OW-462.2 Side bends QW-462 3(a) Transverse Root & Face Bands QW-462 3(b) Langitudinal Bends QW-462.5(c) Pipe band specimen. Corresion resistant everlay QW-462.5(d) Plate bend specimen, Corrosion resistant overlay QW-462.5(b) Pipe specimen - Macro test for fusion QW-462.5(e) Plate specimen - Macro test for fusion Specimen No. Results Specimen No. Results Specimen No. Results Side Bend 1 SATISFACTORY Side Bend 3 SATISFACTORY Side Bend 2 SATISFACTORY Side Bend 4 SATISFACTORY Visual Examination Results (QW-302.4) X Satisfactory Unsatisfactory Alternative Volumetric Examination (QW-191) TI RT UT Satisfactory Unsatisfactory Fillet weld - Fracture test (QW-181.2)___ Length & percent defects . Fillet welds in pipe [QW-462.4(e)] Fillet welds in plate [QW-462.4(5)] Macro examination (QW-184) Fillet size (in) _ X _____ Concavity/Convexity(in)___ Other tests performed _____ Moore Control Systems, Inc. Welding Test conducted By:___ Mechanical tests conducted by: Welder Testing, Inc. Laboratory Test No.: 170479(WELDED OFF-SITE) We certify that the statements in this record are correct and that the coupons were prepared, walded, and tested in accordance with the requirements of Section IX of the ASME Boiler and Pressure Yassel Code _ Certified By: Xennett Wither Prepared By: ___ Welder Testing, Inc. Organization: Moore Control Systems, Inc. Organization: ___ 1-26-2018 1/26/2018 Date:___ Date:_

Result of test: X Pass Fail

WELDER TESTING,

673.1	QW-434A Sug (See	gested Forma: QW-DH, Section	For Well	der Performance Qua Boder and Prossure Vez	difications (WPQ) est Code)	
Welder's Name.	RODOLFO	AGUILAR		Identification no	XXX	-XX-4339
				Description		
dentification of WPS folk			ICS-GM			🔀 - Production Weld [
Base Material Type/Grade			6 Grade 8		Base Material Thick	
Welding Variables (QW-35))) Actus	Test Values	rocess I I	Range Qualified	F Actual Test Values	rocess 2 Range Qüalifiled
Wolding process(as)		GMAW		GMAW	FCAW	FCAW
Type (Manual, Semi-outo, etc	(.) So	mi-Auto	-	Semi-Auto	Semi-Auto	Semi-Auto
Backing (With / Without)		i ithout	With	or Without backing	With(weld metal)	With backing
Base metal (Pine. to Pine.)		1			P1-P15F.P34 P41-P49	19 (In: Gashing
X Pipe Plate	6	625°cd		2.5	875"cd & larger pipe & pl	-1-
Filler maial or Electrode SEA	no	5 13			5.20	K.E.
Filler meial er Electrode Class	ificationE	R705-6			E71T-1M	-
Filler metal Fina		6		6	6	6
Filler motal product form		N/A		N/A	N/A	N/A
Consumable insert		N/A		N/A	N/A	N/A
Weld deposit thickness (3 laye	rs min?)(:	25*(n/a)		.1375"max	.739*(n'a]	Unlimited
Walding position (2G, 5G, 3F,	e(c)	¢G		All Pasitions	6G	All Positions
Venteal progression (Up or do	15n)	Down		Down	Up	Up
Ineri gas backing		/ithou	V. lih or	Without mis backing	Without	With or Without on back.
OMAW transfer minde	Short	Circling	S:	en Circuitina	Sept.	Globular & Spray
STAW Current Type Relation		N/A		N/A	N/A	N/A
* The omission of inert bookin with backing (QW-108.8) I \times QW-462.2 Side bends \times QW-462.5,c) Pipe ben	Lais exception does Al specimen, Comosi	not apoly to P3 QW-462.3(a) Ion resistant ove	RESI Transve	53, P61, P62, or P101 n JLTS rsc Root & Face Bends	QW-461	ingle welded ben Jeints 2.3(b) Longitudinal Bends Comesion resistant over ay
QW-462 5(b) Pipe spe		or lusion			QW-462.5(e) Plate specin	nen - Maero test for fusion
Specimen No.	Resu'ts	Spesimer	1 No.	Results	Specimen No.	Results
Side Bend 1 Si	ATISFACTORY	Side Ben	id 3	SATISFACTORY		
Side Rend 2 S/	ATISFACTORY	Side Ben	d 4	SATISFACTORY		
Visual Examination Result Alternative Volumetric Ex Fillet weld - Fracture test	(QW-131.2) (QW-131.2) place [QW-462.4 184)	b)] Fil'er	_ Lengti size (in).	Fillet we	lds in pipe (OW-462.4)	Unsatisfactory Unsatisfactory
Welding Test conducted Mechanical tests conduc						7(WELDED OFF-S(TE)
We certify that the statements of Section IX of the ASME B	in this record are ea	orrect and that the lessel Code	ne soupen	s were prepared, welde	ed, and tested in accordance	e with the requirements
Prepared By	David Peloculo	-	Cer	tified By: X-e	mett Wet	her
Organization:	Welder Testing					
Date:	1/26/2018		Dat	e: 1-2	6-2018	
Q11'-484.C				Pass Fall		



502 West 13th Street, Deer Park, TX 77535 Thone (281) 930-9966 Fax (281) 478-0010

QW-434 \ Suggested Format For Welder Performance Qualifications (WPQ) (See QW-331, Section IX, ASME Boller and Pressure Vessel Code)

Welder's Name	RODOLFO A	AGUILAR		(dentification no	xxx-x	X-4339
ti in a company	1			Description FO DI		
Identification of WPS felicit					Test Coupon ix	
Base Material Type Grade :					Base Material Thickne	53 :
Welding Variables (QW-350)	Actual	Test Values	P	ange Qualified	Actual Test Values	Range Qualified
Welding process(es)		MAW		GMAW	FCAW	FCAW
Type (Manual, Sumi-auto, etc.)	Se	mi-Auto		Semi-Auto	Semi-Auto	Semi-Auto
Backing (With / Without)		None	<u>V.</u>	ith or Without	Weld Metal	With backing
Base metal (Pino. to Pino.)		1			P1-P15F,P34,P41-P49	
X Pipe Plate		375 'od			00"ed & larger pipe & plate	
Filler metal or Electrode SFA no	0	5.13			5.20	
Filler metal or Electrode Classif	ication <u>Ef</u>	R705-6			E7IT-IM	
Filler metal Fino.		_6		6	66_	6
Filler metal product form		N/A		N/A	N/A	N/A
Consumable insert		N/A		N/A	N/A	N/A
Weld deposit thickness (3 layers	min?)	0"[r/a]		.165"max	.194"[n/a]	.3381max
Welding position (2G, 5G, 3F, c	(2.)	6Ç		VII Positions	6G	All Positions
Vertical progression (Up or dow	n)	Up.		Up	<u>Up</u>	Up
Inem gas backing		4000	W	ith or Without	None	With or Without
GMAW transfer mede	Short	Ciraviting	Sh	en Circuiting	Spres	Globelar, Some Pelised
GTAW Current Type /Polarity	and the same of th	WA		N/A	N/A	N/A
Other:				•		
Votes						
With backing, (QW-103.8) [11] QW-162.2 Side bends QW-462.5(c) Pipe bend	×	QW-462 3(4)	RESI Transver	<u>ULTS</u> se Root & Face Bend	s QW-452.	3(b) Longitudical Bends
			ie)	☐ 6 # ~ 405	5(d) Pipe bend specimen, Co	
QW-462.5(b) Pipe speci					QW-462.5(e) Plate specim	en - Maero test for fusion
Specimen No.	Results	Specimen	No	Results	Specimen No.	Results
	TISFACTORY	Face Bend	11	SATISFACTOR	r	
Root Bend 2 SA	TISFACTORY	Face Bend	12	SATISFACTOR	í L	
Visual Examination Result Alternative Volumetric Exa Fillet weld - Fracture test (mination (QW-			UT	Satisfactory Satisfactory	Unsatisfactory Unsatisfactory
Fillet welds in p			_ = = = = = = = = = = = = = = = = = = =		elds in pipe [QW-462.4(c	
Macro examination (QW-1			ize (in)			
Other tests performed						
O.1161 1635 perior						
Welding Test conducted	By:			Moore Control	Systems	
Mechanical tests conduct					pratory Test No.: 170476	(WELDED OFF-SITE)
We certify that the statements of Section IX of the ASME Ba	n this record are co	orrect and that the				
Prepared By:	& astill	<u>.</u>	Ce	nified By:	emett We	the -
Organization:	David Peloquen Welder Testing			ganization:	Moore Control Sv	
Date:	1/26/2018		Da	le: /- Z	6-2018	
ुप-1814		Result of tes	ti 🔀			
		,	· (A)	. 555 🔲 ' 811		



Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 11 INSPECTION AND TEST PLAN



Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

NON-APPLICABLE



Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 12 COATING REPORT



BB SWO# MOOCO-S21039-W29721-P3

N/A

Customer MOORE CONTROL SYSTEMS, INC.

CERTIFICATE OF COMPLIANCE

Certificate Date: 6/28/2018

This is to certify that the equipment described below was processed in compliance to the guidelines and/or specification requirements.

Specification

Cor-Pro Systems, Rev. 0, SB: 2 Coat

System Description

SPC-SP10, Near White Metal,, Nickel Slag (Green Diamond)/SHWN: Macropoxy 646 Fast Cure, Contrast/SHWN: Hi-Solids Polyurethane,

PO

Item# Qty Part Number

Equipment Description

Trace Number

INTERNAL EXTERNAL PAINTING (SITE JOB)

EV1, Job # 18165, SN: 4-10

MOOCO120617R

QUOTE#

Jonathan McBride
NACE CERTIFIED
COATING INSPECTOR
Level - 3 #269735

CPSO QC Sign:	Stamp:	Date: 6-28-18
3rd Party QC Sign:	Stamp:	Date:



Router

Equipment List MOOCO-EL19451

Purchase Order: 181655071J

Print

Customer:

MOORE CONTROL SYSTEMS, INC.

Production Order:

MOOCO-S21039-W29721-P3

	Due Date:	
<u></u>		
Project Manager: Brandi M.	Order Creator: Brand	li Madeley (KISC)
	Specification	
Cor-Pro Systems, Rev. 0, SB: 2 Coat	200 00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
The second contract contracts		13.30 or 100 specific
	System Description	
SSPC-SP10, Near White Metal,, Nickel Slag (Gree Polyurethane, BLM. Shale Green	n Diamond)/SHWN: Macropoxy 646	Fast Cure, Contrast/SHWN: Hi-Solids
	TO THE STATE OF TH	XX X 244

Additional Instructions

N/A

3

Third Party Inspector Information

PO		Equipment List	Equipment List		
ltem	Qty	Equipment Name	PartNumber	TraceNumber	
1	7	INTERNAL/EXTERNAL PAINTING (SITE JOB)	N/A	QUOTE # MOOCO120617REV 1, Job # 18165, SN: 4-10	

Stage	Contract Review
300' Activity	Job Traveler Creation
Processing Info:	Job Traveler Creation Info
	e drawings, special instructions, specifications, quotes and purchase order. The and create the router, including all relevant information.
Router Results	
Completed By:	Date:
Stage	Contract Review
11100 Activity	Job Traveler Manager Review
Processing Info:	Job Traveler Manager Review
Step Instructions and SOP Review and confirm that the router reflectionity, and that all necessary documents Router Results	cts all specification and customer requirements. Review the order for accuracy, are attached.
Completed By:	Date: 6 / 5 / 18 Time: 8:00 (AM)/PM (Circle One)
Stage	Таре
13100 Activity	Solvent Cleaning
Processing Info:	Solvent Clean - Hand Clean
Specification Requirements Solvent Clean to the following Standa	ard:SSPC-SP1. Use:Simple Green Original
contaminants from steel surfaces.	g all visible oil, grease, soil, drawing and cutting compounds, and other soluble ng the surface with rags or brushes wetted with solvent. Use clean solvent and clean
Router Results	
Galorio I Edwards	• • • • • • • • • • • • • • • • • • •
Gabriel Edwards Completed By: Tin Smith	Date: 10 / 5 / 18 Time: 8:30 (AN)/PM (Circle One)
Stage	Таре

13102 Activity Masking Processing Info: Masking **Special Project Instructions** There are No Special Instructions for the Masking Stage. Step Instructions and SOP Please mask the Equipment according to the Taping Instruction Document (TID). If there is no masking required, please "N/A" this step. **Router Results** Date: <u>6 / 5 /18</u> Time: 2:30 AM/PM (Circle One) Completed By: and Blast Stage 14000 Activity Blasting Processing Info: **Abrasive Blast Specification Requirements** SSPC-SP10, Near White Metal, - Nickel Slag (Green Diamond) -2.0-3.0 mils

Special Project Instructions

Enter any Special Instructions that apply to the Abrasive Blast

-
e.

Step Instructions and SOP

Special Project Instructions No Special Instructions
Step Instructions and SOP
Apply coating according to Manufacturer Product Data Sheet.
Router Results Paint Batch Numbers: Part A: XMO468UR Part B: XMO868JB
Part C: NA Part D: NA
Air Temp: 94 Surface Temp: 93 %Humidity: 55% Dew Point: 74.3
Actual Min. WFT: 8 Actual Max WFT: 10
Completed By: Tim Swith Date: 6 / 6/18 Time: 12:00 AM/PM (Gircle One)
Stage Topcoat
18000 Activity Inspection Test Processing Info: Pre Coat Inspection
Inspect the previous coat visually for runs, dry spray, sags, blushes, pinholes, holidays, inclusions, mudcracking and any other defects where applicable. Verify the Dry Film Thickness (DFT) is in accordance with the customer's requirements and/or per ISO 19840 and SSPC-PA 2. Verify the coating extent, masking, and color of the previous coat are in adherence to instructions. Verify the cure of the coating by testing in accordance with customer requirements and/or manufacturer recommendations.
Router Results
Accept: Reject:
Actual Min DFT: 5.0 Actual Max DFT: 8.5 Average DFT: 6.4
Cure Test: PassFail
Completed By: Tim Swith Date: 6 /7 13 Time: 6:00 (AM/PM (Circle One)
Stage Topcoat
18001 Activity Coating Application
Processing Info: Coating Information
Specification Requirements SHWN: Hi-Solids Polyurethane, BUM SHALE GREE, 3.0-4.0 mils
Special Project Instructions No Special Instructions

Step Instructions and SOP
Apply coating according to Manufacturer Product Data Sheet.
Router Results Paint Batch Numbers: Part A: XM1898 VL Part B: MQ D548 HF
Part C: NA Part D: NA
Air Temp: 85.4 Surface Temp: 84.0 %Humidity: 73-1% Dew Point: 75.8
Actual Min. WFT: Actual Max WFT:
Completed By: TIM Smith Date: 10 / 8 / 18 Time: 3:00 AM PM (Circle One)
Quality Control - Final Inspection
20002 Activity Inspection Test
Processing Info: Final Inspection
Special Project Instructions There are No Special Instructions for this Inspection Stage
Step Instructions and SOP
Quality Control Inspector will inspect the coating visually for runs, dry spray, sags, blushes, pinholes, holidays, inclusions, mud-cracking, color and any other defects that could occur. Verify the Dry Film Thickness (DFT) is in accordance with the customer's requirements and/or per ISO 19840 and SSPC-PA 2 Review the documentation and parts to ensure completeness. After verifying that all is completed in accordance with the router, the inspector will sign off on all releases, certificates, eports, and inspection documents.
Router Results
Results: Accept: Reject:
Actual Min DFT: 7.8 Actual Max DFT: 15 Average DFT: 12
Completed By: Jonnie Lugua Date: Le 117 18 Time: (-30 (AM)/PM (Circle One)



CERTIFICATE OF COMPLIANCE

Certificate Date: 6/28/2018

This is to certify that the equipment described below was processed in compliance to the guidelines and/or specification requirements.

BB SWO# MOOCO-S21039-W29721-P1

Customer MOORE CONTROL SYSTEMS, INC.

PO Number 181655071J

			Specification	
Cor-Pro	Systems	s, Rev. 0, SB: 1 Coat		
	-			
SSPC-SP:	10, Near	White Metal,, Nickel Slag (G	System Description reen Diamond)/SHWN: Nova-Plate UHS,White	
РО				
Item#	Qty	Part Number	Equipment Description	Trace Number
1	7	N/A INTERN	VAL EXTERNAL PAINTING (SITE JOB)	QUOTE #

MOOCO120617R

EV1, Job# 18165, SN: 4-10

Jonathan McBride **NACE CERTIFIED COATING INSPECTOR** Level - 3 #269735

CPSO QC Sign:	Stamp:	Date: 6-28-18
3rd Party QC Sign:	Stamp:	Date:



Router

Equipment List MOOCO-EL19451

Purchase Order: 181655071J

Customer: MOORE CONTROL SYSTEMS, INC.

Print

Production Order:

MOOCO-S21039-W29721-P1

	THE CONTRACT COME.	Due Date:	* (· · · · · · · · · · · · · · · · · ·		
Project Manager: Brandi M.		Order Creat	or: Brandi Madel	ey (KISC)	
Cor-Pro Systems, Rev. 0, SB: 1 Co	pat	Specification		100 100 100 100	Company (Acc)
	2 1/21 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	System Description			
SSPC-SP10, Near White Metal,, N	lickel Slag (Green I	Diamond)/SHWN: Nova-P	late UHS,White		Alternative V
₹ N/A		Additional Instructions		1.770.1700 2.1	
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Third	Party Inspector Informat	ion		

PO		Equipment L	ist		
tem	Qty	Equipment Name	PartNumber	TraceNumber	
1	7	INTERNAL/EXTERNAL PAINTING (SITE JOB)	N/A	QUOTE # MOOCO120617REV 1, Job # 18165, SN: 4-10	

Stage **Contract Review** Activity Job Traveler Creation Processing info. Job Traveler Creation Info Step Instructions and SOP Review the receiving documents with the drawings, special instructions, specifications, quotes and purchase order. The Project Coordinator will enter the order and create the router, including all relevant information. **Router Results** Date: (0 / 5 / 18 Time: 8:00 (AM/PM (Circle One) Completed By: Stage **Contract Review** 11100 Activity Job Traveler Manager Review Processing Info: Job Traveler Manager Review Step Instructions and SOP Review and confirm that the router reflects all specification and customer requirements. Review the order for accuracy, clarity, and that all necessary documents are attached. **Router Results** 6 / 5 / 18 Time: 8:00 (AM/) M (Circle One) Completed By: Stage Tape 13100 Activity **Solvent Cleaning** Processing Info: Solvent Clean - Hand Clean **Specification Requirements** Solvent Clean to the following Standard:SSPC-SP1. Use:Simple Green Original Step Instructions and SOP Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces. Remove oil or grease by wiping or scrubing the surface with rags or brushes wetted with solvent. Use clean solvent and clean rags or brushes for the final wiping. **Router Results** Samuel Date: 6 / 5 / 18 Time: 8:30 (AM/PM (Circle One) Stage Tape

.13102 Activity	Masking
Processing Info:	Masking
Special Project Instructions	
There are No Special Instructions	for the Masking Stage.
Step Instructions and SOP	
	g to the Taping Instruction Document (TID). If there is no masking required, please
Router Results	
Completed By: Gabriel Edu	wardsDate: 16 /5 /18 Time \$130 (AM/PM (Circle One)
tage	Blast
14000 Activity	Blasting
Processing Info:	Abrasive Blast
Specification Requirements	
SSPC-SP10 Near White Metal - N	Nickel Slag (Green Diamond) -2.0-3.0 mils
331 C-31 10, Wear Write Wetar, - 1	
Special Project Instructions	

Blast according to the SSPC standard. Aft One reading is required unless otherwise	er completion of the Blast, verify specified by the Customer or a T	the surface profile hird Party Inspecto	of the blast cleaned surf	ace.
Router Results				* 110 444
Scotch Tape Test: Pass: Fail:	Testex Tape	<u>}</u> ;	the state of the s	
Actual Average Anchor Profile: 2.7	mils			
Air Temp: 90.3 Surface Temp: 4	89%Humidity: 53%	Dew Point: 7	2.6	
Completed By: Tim Smith	Date: <u>le / le / 18</u>	3_ Time: 10 : 0	M) (Circle One)
RESTORATION BLAST (if not applicable, N		o specified surface	cleanliness, due to time	lapse.
Scotch Tape Test: Pass: Fail:	NA Testex Tape:	:		
Actual Average Anchor Profile:	mils			
Air Temp: Surface Temp:	%Humidity:	Dew Point:		
Completed By:	Date://	Time:	AM/PM (Circle One)	
Stage	Paint Coat 1			
15000 Activity	Inspection Test			
Processing Info: Existing	Coating DFT or Base Meta	al Reading (BN	1R)	
Step Instructions and SOP Using a Dry Film Thickness gauge, record the router. The mils from this reading should be thickness applied is in exact accordance with Router Results	e subtracted from the final Dry Fil	coating or the bard Im Thickness, to er	e metal. Record this on the name of the coating	ne
(Circle one) DFT or BMR:	_			1
Completed By: Tim Smith	Date: <u>U / U</u> / 18	Time: _(0) (AM)PM (Circle One)	
tage 15001 Activity	Paint Coat 1 Coating Application	n		
Processing Info:	Coating Information	n		
Specification Requirements SHWN: Nova-Plate UHS, White, 20.0-25.	0 mils	en come de la comp		

Step Instructions and SOP

No Special Instructions
Step Instructions and SOP
Apply coating according to Manufacturer Product Data Sheet.
Paint Batch Numbers: Part A: XMO178NV Part B: XMO098CV
Part C: N(K Part D: N/K
Air Temp: 95 Surface Temp: 94.5 %Humidity: 5690 Dew Point: 75.1
Actual Min. WFT: 30 Actual Max WFT: 25
Completed By: Tim Smith Date: 10/6/8 Time: 1:00 AM PM (Circle One)
Quality Control - Final Inspection
20002 Activity Inspection Test
Processing Info: Final Inspection
Step Instructions and SOP
Quality Control Inspector will inspect the coating visually for runs, dry spray, sags, blushes, pinholes, holidays, inclusions, mud-cracking, color and any other defects that could occur. Verify the Dry Film Thickness (DFT) is in accordance with the customer's requirements and/or per ISO 19840 and SSPC-PA 2 Review the documentation and parts to ensure completeness. After verifying that all is completed in accordance with the router, the inspector will sign off on all releases, certificates, reports, and inspection documents.
Router Results
Results: Accept: Reject:
Actual Min DFT: 19.3 Actual Max DFT: 28 Average DFT: 24.4
Completed By: Lonni Fugua Date: 6 /12 /18 Time: [1:30 (AM)/PM (Circle One)



Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 13 POST WELD HEAT TREATING REPORT W/CHART



Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

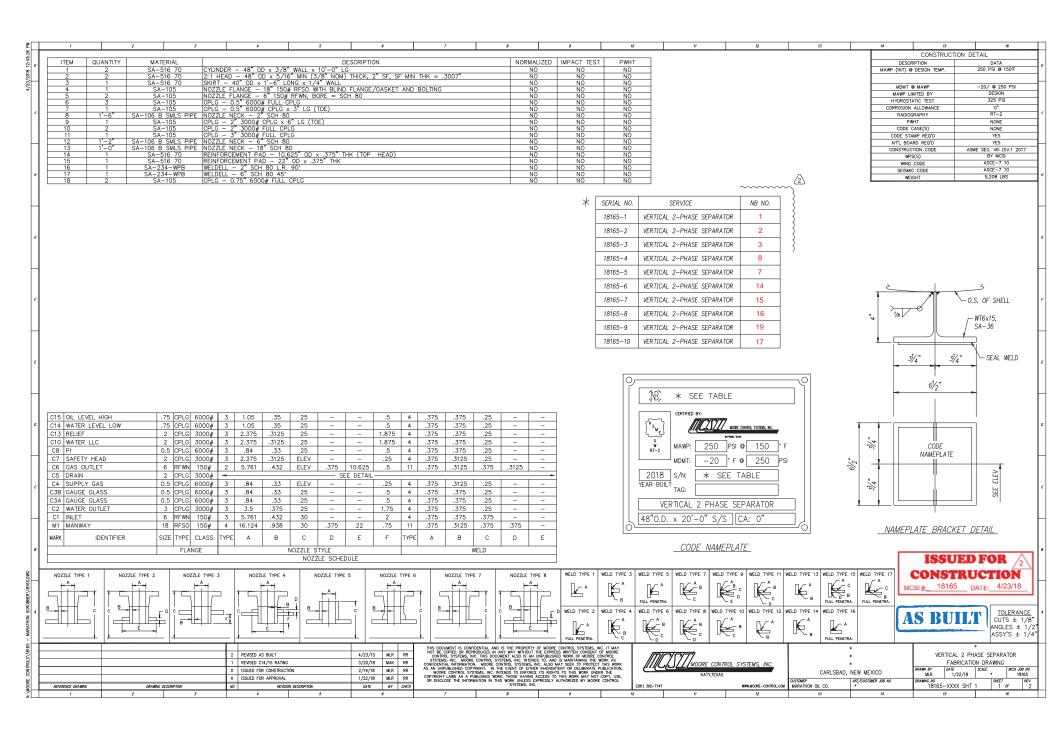
NON-APPLICABLE

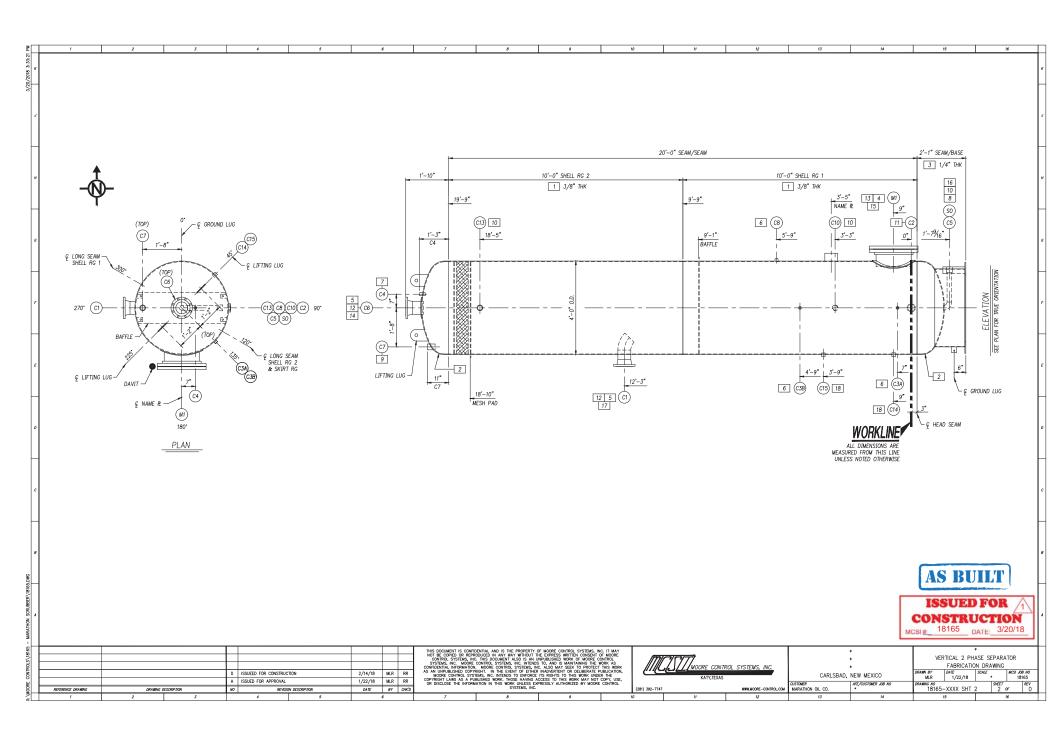


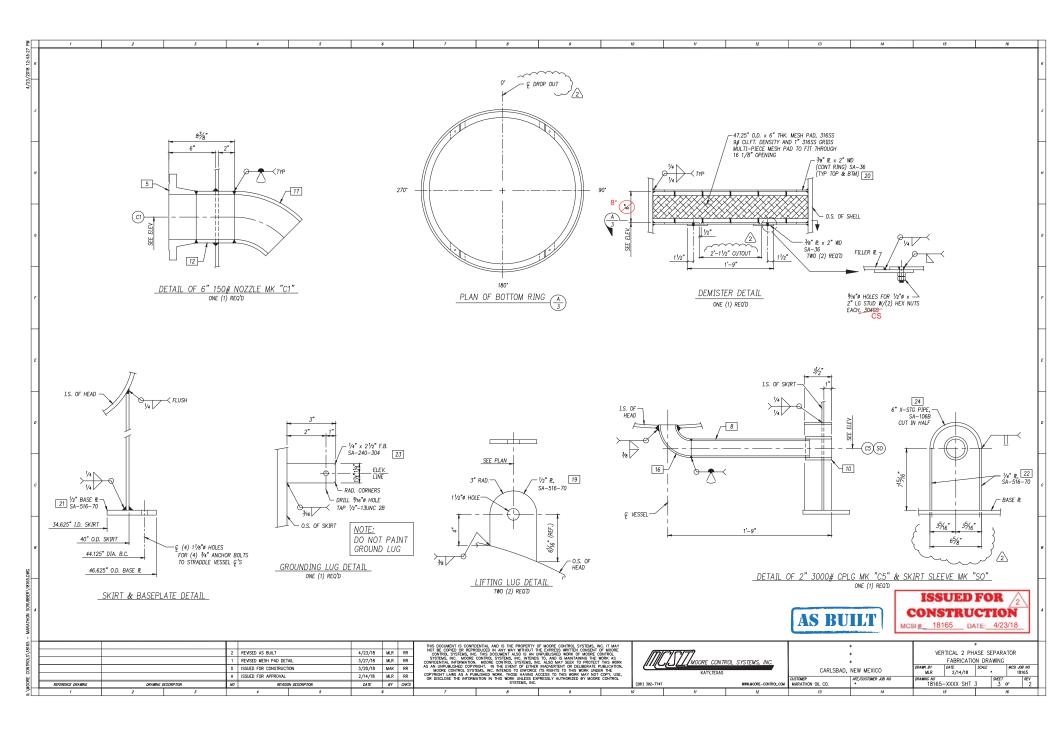
Katy, Tx 77494

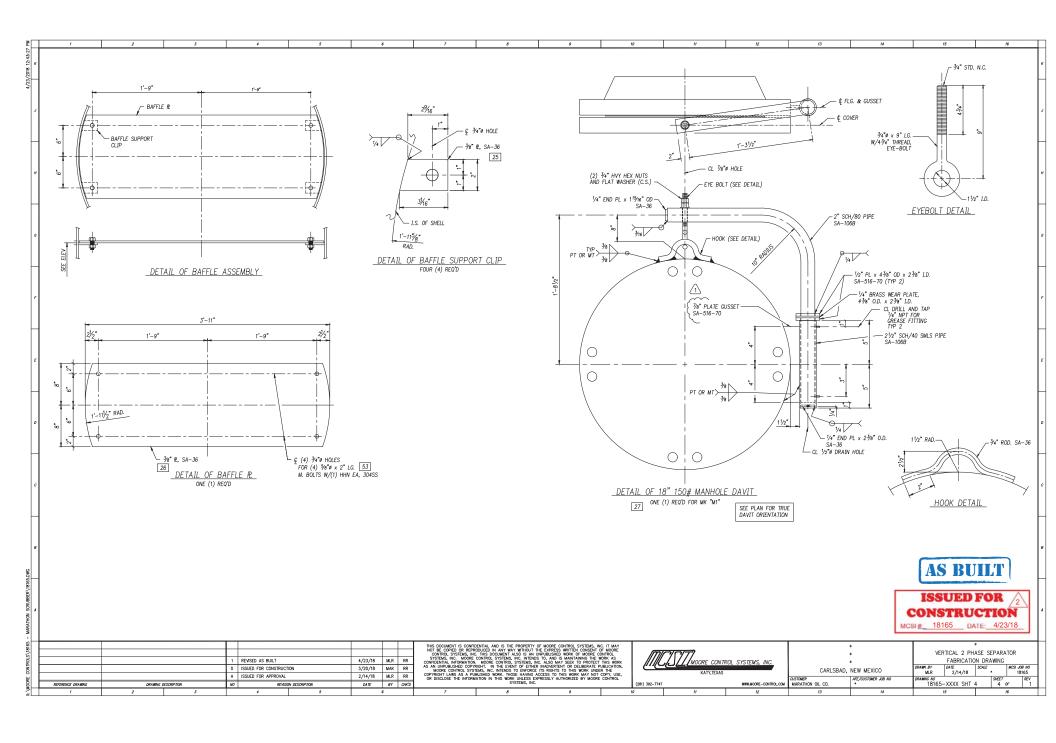
Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 14 AS-BUILTS











Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

SECTION 15 NON-CONFORMATION REPORTS



Katy, Tx 77494

Mailing: P.O. Box 677 Katy, Tx 77494 Baytown: 14827 I-10 East Baytown, Tx 77523

NON-APPLICABLE