



W0-030789

QC DATA BOOK

For

Suncor Energy Resources Partnership
Slug Finger

Tag: V-120

Kobes North Liquids Handling Upgrades/
Kobes C-97-G/94-B-9



VENDOR DATA
BOOK



CUSTOMER: Suncor Energy Resources Partnership

FOREMOST UNIVERSAL LP. W-030789

VESSEL LOCATION: Kobes North Liquids Handling Upgrades / Kobes C-97-G/94-B-9

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SLUG FINGER

Tag: V-120

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VENDOR DATA
BOOK



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MANUFACTURERS DATA REPORT

636910

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS

(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)

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

1. Manufactured and certified by FOREMOST UNIVERSAL L.P., 8825 SHEPARD ROAD SE, CALGARY, AB T2C 4N9 CANADA

2. Manufactured for SUNCOR ENERGY BOX 2844, 150 - 6TH AVENUE SW CALGARY AB, T2P 3E3 CANADA

3. Location of installation KOBES C-97-G/94-B-9 WATER HANDLING

4. Type HORIZONTAL 13-030789-101 W3375.21 030625-D101 SHTS 1 & 2 REV. 5 & 0 N/A 2014

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2010

6. Shell SA-516-70N 38.10MM 3.2MM 1829MM 9144MM S/S

7. Seams TYPE 1 FULL 100% 621°C 1.75HRS TYPE 1 FULL 100% 3

8. Heads: (a) Material SA-516-70N (b) Material SA-516-70N

Table with 10 columns: Location (Top, Bottom, Ends), Minimum Thickness, Corrosion Allowance, Crown Radius, Knuckle Radius, Elliptical Ratio, Conical Apex Angle, Hemispherical Radius, Flat Diameter, Side to Pressure (Convex or Concave). Rows (a) LEFT, (b) RIGHT.

If removable, bolts used (describe other fastenings) N/A

9. MAWP 5068KPAG 104 KPA at max. temp. 38°C 66°C/-40°C

Min. design metal temp. -40°C at 5070KPAG Hydro, pneu., or comb. test pressure 6591KPAG

Proof Test N/A

Nozzles, inspection, and safety valve openings:

Table with 12 columns: Purpose (Inlet, Outlet, Drain etc.), No., Diameter or Size, Type, Material (Nozzle, Flange), Nozzle Thickness (Nom., Corr.), Reinforcement Material, Attachment Details (Nozzle, Flange), Location (Insp. Open). Rows include M1 MANWAY, N1 INLET, N2 VAPOUR OUTLET, N3 LIQUID OUTLET, N4 SPARE, N5a-c EQUALIZATION, B6 a,b HOT WATER.

11. Supports: Skirt NO Lugs 2 Legs 0 Other 2 SADDLES Attached WELDED TO HEADS AND SHELL

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: N/A

PSV TO BE INSTALLED BY OWNER PER UG-125 - CONSTRUCTION DWG 030789-D101 SH.1 REV.5 & SH.2 REV.4 - SLUG FINGER TAG V-120 - L.C.V.N. TEST HEAD / SHELL PLATES AND PRODUCTION WELDS TO 15/10 FT-LB @ -40°F PER UG-84 - VOL: 25.889m³ M1 BLIND DN600 SA-350-LF2 CL.1 CL.300 24 STUDS X 38.1MM X 228.6MM L SA-193-B7M UNC W/ 48 NUTS 38.1MM SA-194-2HM N4 BLIND DN100 SA-350-FL2 CL.1 CL.300 8 STUDS X 19.05MM X 114.3MM L SA-193-B7M UNC W/ 16 NUTS 19.05MM SA-194-2HM

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 15,742 expires May 05, 2016

Date JAN 10 2014 Co. Name FOREMOST UNIVERSAL LP Signed [Signature] (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by FOREMOST UNIVERSAL LP at 8825 Shepard Road S.E. Calgary, AB, T2C 4N9 Canada I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of Alberta and employed by ABSA

I have inspected the component described in this Manufacturer's Data Report on JAN 10 2014, and state that,

the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date JAN 10 2014 Signed [Signature] Commissions AB 11 NB 10270 A, B

NAMEPLATE FACSIMILE



U
W
RT1
HT

CERTIFIED BY

FOREMOST UNIVERSAL LP

MAWP: 5068 kPa @ 38 °C

735 psi @ 100 °F

MAWP EXT: 104 kPa @ 66/-40 °C

15 psi @ 150/-40 °F

MDMT: -40 °C @ 5070 kPa

-40 °F @ 735 psi

SERIAL# 13-030789-101

YEAR BUILT 2013 CRN: W3375.21

Ⓐ 636910

CRN LETTER OF REGISTRATION

January 09, 2014

Attention: An Vo
FOREMOST UNIVERSAL LP
8825 SHEPARD ROAD SE
CALGARY, AB

The design submission, tracking number 2014-00090, originally received on January 09, 2014 was surveyed and accepted for registration as follows:

CRN : W3375.2

Accepted on: January 09, 2014

Reg Type: Revision To accepted Design

Drawing No. : 030625-D101 SHT 1 Rev 5

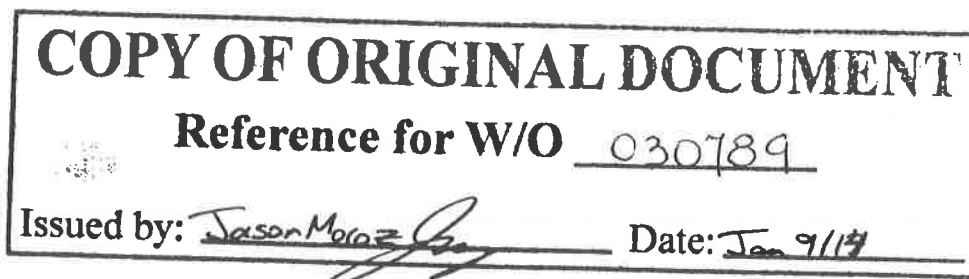
Description	MAWP	Design Temperature	MDMT
Internal Pressure	5068kPa	38 °C	-40 °C
External Pressure	104kPa	66 °C	-40 °C

An invoice covering survey and registration fees will be forwarded from our Revenue Accounts.

If you have any question don't hesitate to contact me by phone at (780) 433-0281 ext 3347 or fax (780) 437-7787 or e-mail Preda@absa.ca.

Sincerely,

PREDA, DRAGOS, P. Eng.





the pressure equipment safety authority

9410 - 20 Ave N.W.
Edmonton, Alberta, Canada T6N 0A4
Tel: (780) 437-9100 / Fax: (780) 437-7787

November 18, 2013

Attention: An Vo
FOREMOST UNIVERSAL LP
8825 SHEPARD ROAD SE
CALGARY, AB

The design submission, tracking number 2013-07270, originally received on September 27, 2013 was surveyed and accepted for registration as follows:

CRN : W3375.2 **Accepted on:** November 18, 2013
Reg Type: New Design
Drawing No. : 030625-D101 SHTS 1 & 2 Rev 0 & 0

Description	MAWP	Design Temperature	MDMT
Internal Pressure	5068kPa	38 °C	-40 °C

An invoice covering survey and registration fees will be forwarded from our Revenue Accounts.

If you have any question don't hesitate to contact me by phone at (780) 433-0281 ext 3347 or fax (780) 437-7787 or e-mail Preda@absa.ca.

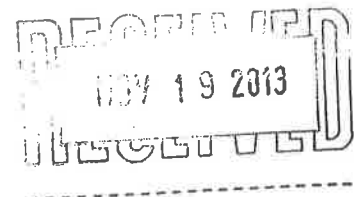
Sincerely,

PREDA, DRAGOS, P. Eng.

COPY OF ORIGINAL DOCUMENT

Reference for W/O 030789

Issued by: Jason Montgomery Date: Nov 20/13





505 - 6th Street, Suite 200
New Westminster, BC V3L 0E1

Toll Free: 1-866-566-SAFE

Fax: (778) 396 - 2064

www.safetyauthority.ca

FOREMOST UNIVERSAL LP
6614 50TH AVENUE
LLOYDMINSTER AB T9V 2W8

Date: January 8, 2014
Account #: 48537
Journal #: 58487
Our File #: 5476509

Attn: AN VO

Re: Application for Design Registration

The design, as detailed in your, WO-030625, for a Pressure Vessel is accepted for registration as follows:

Registered To: FOREMOST UNIVERSAL LP CRN: W3375.21

MDMT: -40 deg C

MAWT: 38 deg C

MAWP: 5068 kPa

Drawing #: 030625-D101 Shts 1 & 2

Drawing Revision: 0 & 0

Conditions Of Registration:

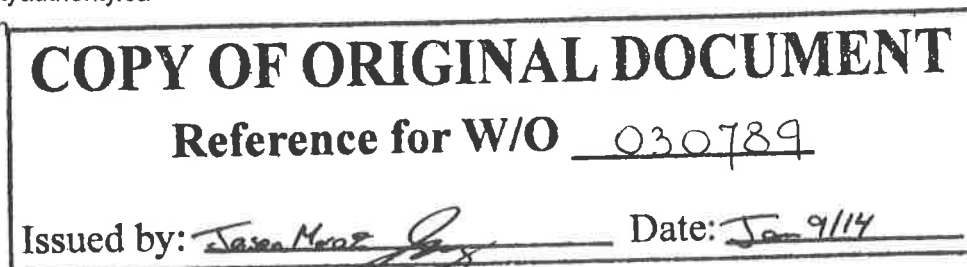
Registration of a 72" Slug Catcher. External pressure: 104 kPa.

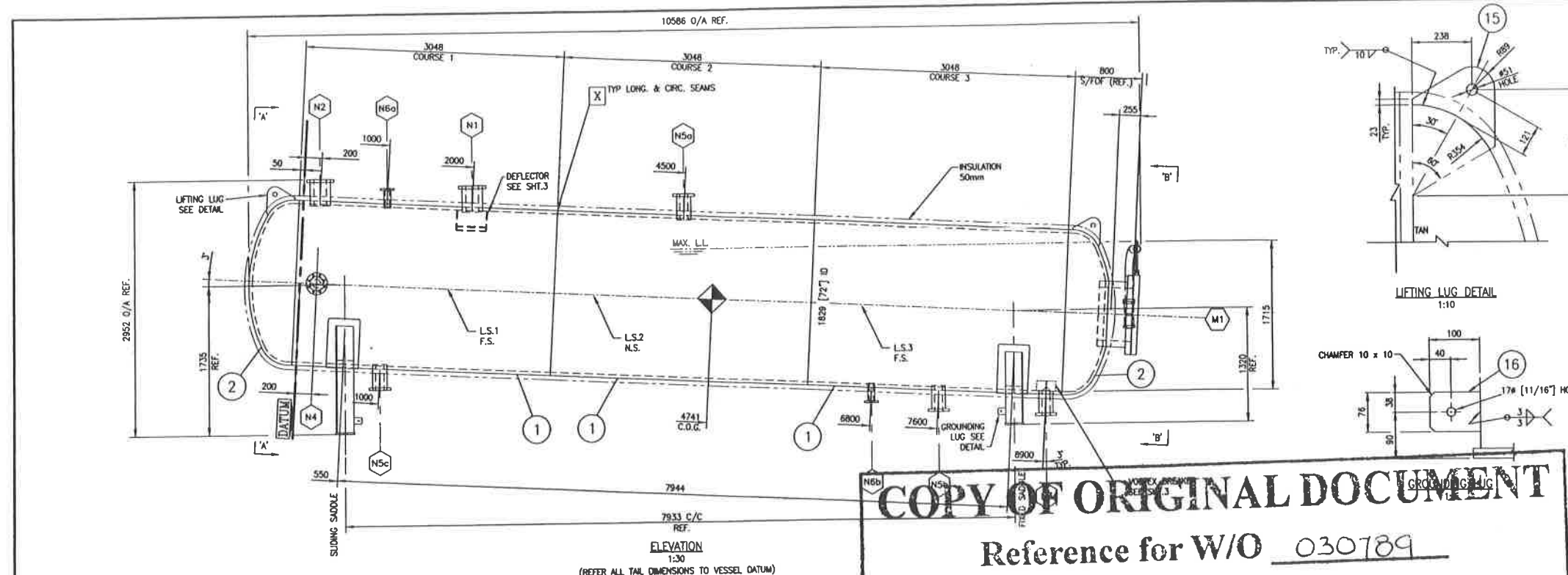
This design was registered based on a technical review performed by the province of initial registration in accordance with the Association of Chief Inspectors policy on reciprocal recognition of design review.

Contact me if you have any questions. The invoice for registration will be forwarded under separate cover.

SHARON PETERS
(778) 396-2027
Sharon.Peters@safetyauthority.ca
Design Administration

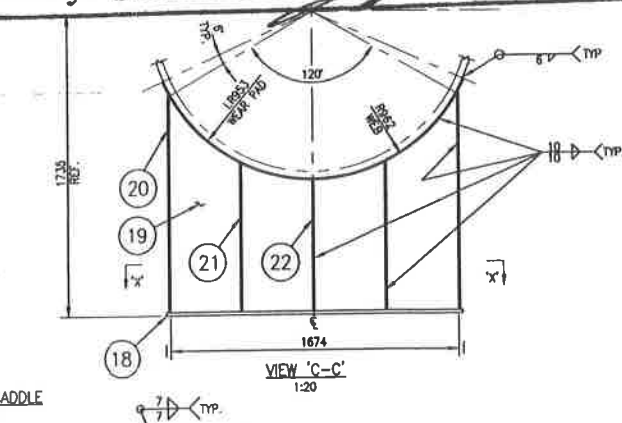
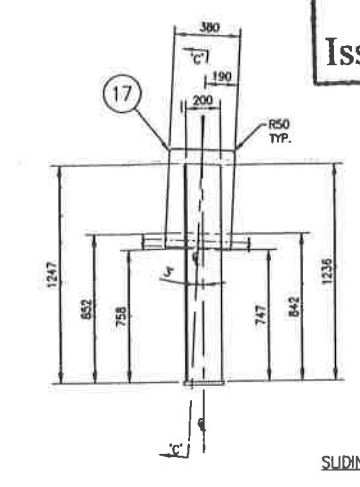
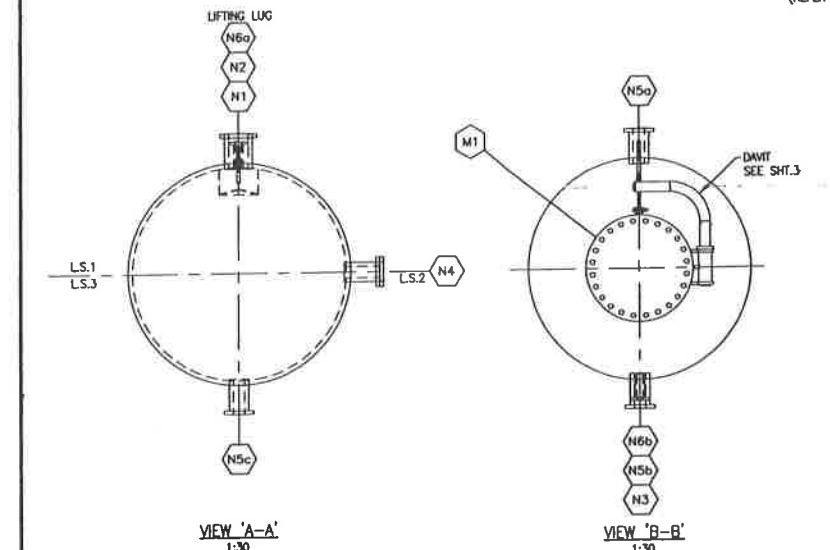
cc:





MATERIAL LIST										
MATERIAL REQUIREMENTS										
NOTE: REQUIRED AND MATERIAL EQUIPPED AS PER I.C. NUMBER. SEE SHEET 3.										
MK	QTY	PART NO.	DESCRIPTION	LENGTH	MATERIAL	WT (kg)	MAT REQ			
1	3	10498	SHELL, CYLINDRICAL, 38 10 [1.500"] THK x 1829 [72"] ID	3048	SA-516-70N	5348	M,N			
2	2	10498	SLIDING HEAD, 21 SE, 429 [17"] O.D. x 50 [2"] S.F. AND MIN. THK OF 37.50 [1.480"] MIN. CROWN & KNOCKLE THK		SA-516-70N	1250	M,N			
3	1		FLANGE, DN600 [24"] CLASS 300 ASME B16.5 RF7B	406	SA-350-LF2 CL1	947	M,N			
4	1	9710	FLANGE BLIND, DN600 [24"] CLASS 300 ASME B16.5 RF		SA-350-LF2 CL1	342	M,N			
5	2		FLANGE, DN150 [6"] CLASS 300 ASME B16.5 RF7B	305	SA-350-LF2 CL1	141	M,N			
6	5		FLANGE, DN100 [4"] CLASS 300 ASME B16.5 RF7B	305	SA-350-LF2 CL1	77	M,N			
7	1	9700	FLANGE BLIND, DN100 [4"] CLASS 300 ASME B16.5 RF		SA-350-LF2 CL1	12.3	M,N			
8	2		FLANGE, DN50 [2"] CLASS 300 ASME B16.5 RFL7B	229	SA-350-LF2 CL1	15.5	M,N			
9	1	10819	GASKET, BRASS [N] CLASS 300 ASME B16.5 RF SPRING COMPARE FILLER		316SS					
10	24		STUD, 1 1/2" x UNS	9 1/4"	SA-193-B7M					
11	48	10901	HEAVY HEX HEAD NUT, 1 1/2" x UNS		SA-193-B7M					
12	1	10821	GASKET, DN100 [4"] CLASS 300 ASME B16.5 RF SPRING COMPARE FILLER		316SS					
13	8	5384	STUD, 3/4" x UNS	4 1/2"	SA-193-B7M					
14	16	5400	HEAVY HEX HEAD NUT, 3/4" x UNS		SA-193-B7M					
15	2	8565	PLATE, 25.4 [1"] THK x 323 WD	327	SA-516-70N	10	M			
16	2	10821	FLAT BAR, 6.35 [1/4"] THK x 76 WD	100	304L SS	0.55				
17	2	8566	SADDLE WEAR PLATE, 9.53 [3/8"] THK x 350 WD (ROLL TO 953 WD)	2218	SA-516-70N	63	M			
18	2	8566	SADDLE BASE PLATE, 19 [3/4"] THK x 230 WD	1720	SA-516-70N	59				
19	1	8566	SADDLE WEB PLATE, 9.53 [3/8"] THK x 1247 WD	1674	SA-516-70N	11.3				
20	2	8566	SADDLE END PLATE, 9.53 [3/8"] THK x 200 WD (CUT TO SUIT)	1247	SA-516-70N	18.6				
21	2	8566	SADDLE RIB PLATE, 9.53 [3/8"] THK x 200 WD (CUT TO SUIT)	852	SA-516-70N	12.8				
22	1	8566	SADDLE RIB PLATE, 9.53 [3/8"] THK x 200 WD (CUT TO SUIT)	758	SA-516-70N	11				
23	1	8566	SADDLE WEB PLATE, 9.53 [3/8"] THK x 820 WD	1674	SA-516-70N	59.5				
24	2	8566	SADDLE END PLATE, 9.53 [3/8"] THK x 200 WD (CUT TO SUIT)	831	SA-516-70N	12.4				
25	2	8566	SADDLE RIB PLATE, 9.53 [3/8"] THK x 200 WD (CUT TO SUIT)	437	SA-516-70N	8.5				
26	1	8566	SADDLE RIB PLATE, 9.53 [3/8"] THK x 200 WD (CUT TO SUIT)	343	SA-516-70N	5.1				

COPY OF ORIGINAL DOCUMENT
 Reference for W/O 030789
 Issued by: Jason Moore Date: Nov 22/13



MK	NO.	SERVICE	SIZE	SCH	CLASS	TYPE	WELD DETAIL	EXT. PROJ.	MIN. HT. PROJ.	HOLE SIZE	REPAD	leg1	leg2	leg3	COMMENTS	ITEM NO.	CUT LENGTH
N6	2	HOT WATER	DN100 [4"]	2	300	RFLWN x 229 LG	W	180	MIN.	-	-	10	-	5	-	-	8
N5c	1	EQUALIZATION	DN100 [4"]	-	300	RFBH x 305 LG	W	250	MIN.	-	-	10	-	5	-	-	6
N5b	1	EQUALIZATION	DN100 [4"]	-	300	RFBH x 305 LG	W	250	MIN.	-	-	10	-	5	-	-	6
N5a	1	EQUALIZATION	DN100 [4"]	-	300	RFBH x 305 LG	W	250	MIN.	-	-	10	-	5	c/w BLIND	6,7,12,13,14	6
N4	1	SPARE	DN100 [4"]	-	300	RFBH x 305 LG	W	250	MIN.	-	-	10	-	5	-	-	6
N3	1	LIQUID OUTLET	DN100 [4"]	-	300	RFBH x 305 LG	Y	250	FLUSH	-	-	10	-	-	-	-	6
N2	1	VAPOUR OUTLET	DN150 [6"]	-	300	RFBH x 305 LG	W	250	MIN.	-	-	10	-	5	-	-	5
N1	1	INLET	DN150 [6"]	-	300	RFBH x 305 LG	W	250	MIN.	-	-	10	-	5	-	-	5
M1	1	MANWAY	DN600 [24"]	-	300	RFBH x 406 LG	W	SPEC.	60	-	-	10	-	5	c/w BLIND & DAVIT	3,4,9,10,11	60

ASME B16.5 FLANGES		NOZZLE SCHEDULE	
WPS	MI-OSS-4	WPS	MI-OSS-4
BEVEL	BEVEL 80° ± 10°	BEVEL	30° ± 2°
GAP	5 ± 1	GAP	5 ± 1
LAND	NONE	LAND	NONE

2-25 [1"] EA. x 38 [1 1/2"] LG. SLITS (SLIDING SADDLE ONLY)
 2-25 [1"] DIA HOLES (FIXED SADDLE ONLY)
 FOR 7/8" x ANCHOR BOLTS

DESIGN NOTES

DESIGN CODE - ASME SECTION VIII, DIVISION 1, 2010 ADDENDA 2011a

DESIGN PRESSURE OR MAMP (HOT & CORRODED) 5070 kPa [735 Psi] DESIGN TEMPERATURE 38 °C [100 °F]

MAMP (HOT & CORRODED) LIMITED BY HEAD MIN. SPEC. THK.

RADIOGRAPHY RT I, UN-11a) 100% ON BUTT-WELDED JOINTS JOINT EFFICIENCY SHELL 1.00, HEAD 1.00

POST WELD HEAT TREATMENT YES, SEE SH2 ADDITIONAL CODES CSA B51/09

CORROSION ALLOWANCE 3.2mm [1/8"]

HYDRO-TEST PRESSURE 8591 kPa (956 Psi) (1.3 x MAMP)

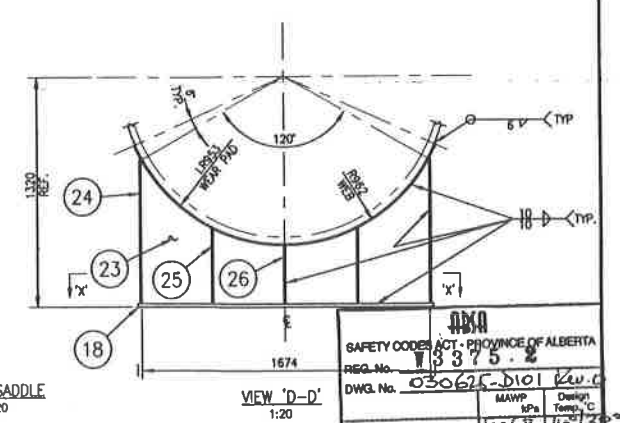
SERVICE 50HR CAPACITY 25,889 cu.m [915 cu.ft)

WEIGHT dry 22,500 kg [49,804 lbs] hydro 47,800 kg [105,381 lbs] design

OVERALL LENGTH 10,588 [34' ± 3/4"] OAL (REF) OVERALL HEIGHT 2,952 [9' ± 1/4"] OAL (REF)

MINIMUM DESIGN METAL TEMPERATURE -40 °C [-40 °F] @ MAMP

SEE SH2 FOR IMPACT TEST



FIXED SADDLE 1:20

SAFETY CODES ACT - PROVINCE OF ALBERTA
 REG. No. 13375-2
 DWG No. 030625-D101 Rev. 0
 MAMP kPa Design Temp. °C
 5068 146/30
 NOV 18 2013
 ACCEPTED
 DRAGOS PRIEDA, P.Eng.
 DESIGN SURVEY ENGINEER

FOREMOST

CLIENT: SUNCOR ENERGY c/o EQUINOX ENGINEERING LTD.
 BOX 2844, 150 - 6th Ave. SW CALGARY AB T2P 3E3
 KOBES C-97-G/94-B-9 WATER HANDLING

DWG TITLE: SLUG CATCHER (V-) 1829mm [72"] ID x 9144mm [30'-0"] S/S GENERAL ARRANGEMENT

NO. REV. 1
 SCALE 1:30 UNO
 DATE (d/m/y) 18/09/13
 DWG NO. 030625
 SHEET NO. (REV. NO.) 1 of 3

SURFACE PREPARATION AND PAINTING REQUIREMENTS					
ITEM	BLAST	PRIMER	D.F.T.	FINISH	D.F.T.
INSULATED VESSEL EXTERIOR	SSPC-SP8	LIGHT GREY	4.0-6.0	4.0-6.0	4.0-6.0
UNINSULATED VESSEL EXTERIOR	SSPC-SP8	LIGHT GREY	4.0-6.0	4.0-6.0	4.0-6.0
VESSEL INTERIOR	N/A	N/A	N/A	N/A	N/A
APPURTENANCES	-	-	-	-	-
PROTUSIONS	-	-	-	-	-
SADDLE	SSPC-SP8	LIGHT GREY	4.0-6.0	4.0-6.0	4.0-6.0
LADDERS	N/A	N/A	N/A	N/A	N/A
PLATFORMS	N/A	N/A	N/A	N/A	N/A
INTERNAL PIPING	-	-	-	-	-
EXTERNAL PIPING	N/A	N/A	N/A	N/A	N/A
UNINSULATED PIPING	N/A	N/A	N/A	N/A	N/A
SKID	N/A	N/A	N/A	N/A	N/A

NOTES:
 1. PRIME GREY OVER CLEAN MILL SCALE (NO BLAST).
 2. REFER TO PAINTING SCHEDULE

HEAT TREATMENT

GOVERNING COMPONENT: HEAD
 GOVERNING WELD THICKNESS: 4.45 [1 3/4"]
 TYPE OF HEAT TREATMENT REQUIRED: POST WELD

INSTRUCTIONS

- TEMPERATURE TO BE RAISED FROM 800F TO 1150±50F AT A MAXIMUM RATE OF 225F PER HOUR.
- TEMPERATURE TO BE HELD AT 1150±50F FOR 1 HOUR 45 MINUTES.
- TEMPERATURE TO BE LOWERED FROM 1150±50F TO 800F AT A MAXIMUM RATE OF 285F PER HOUR.
- PLACEMENTS AND LOCATIONS OF THERMOCOUPLES: AS PER ASME VIII, DIV 1, UW-40(c).
- ADDITIONAL REQUIREMENTS: N/A

FABRICATION NOTES

- ALL FLANGE RATINGS TO BE ASME B16.5 - 2009.
- FLANGE AND BOLT HOLES TO STRADDLE PRINCIPAL CENTRELINES OF VESSEL.
- ALL DIMENSIONS ARE IN S.I. (mm). UNITS OF MEASUREMENT IN [BRACKETS] ARE IMPERIAL HARD CONVERSIONS FOR SHOP REFERENCE ONLY AND PURCHASING REFERENCE ONLY.
- NO WELDING OR HEATING TO CORRECT MISALIGNMENT SHALL BE PERMITTED AFTER PWHT.
- TACK WELDS TO BE REMOVED DURING ROOT PASS.
- L.S. = LONGITUDINAL SEAM
F.S. = FAR SIDE
- HEAD TO SHELL JOINT TO BE TRANSITIONED AS PER UW-9(c).
- RADIUS EXPOSED INSIDE EDGES AS PER UG-76(c).
- ALL MATERIAL AND WELDER IDENTIFICATION SHALL BE WITH LOW STRESS STAMPS.
- FABRICATION TOLERANCES SHALL BE IN ACCORDANCE WITH TOLERANCE DRAWINGS (EDS-6070 LATEST REV., EDS-6071 LATEST REV. & MI-PVTOL-01 REV. 3).
- PERMANENT BACKING RINGS ARE NOT PERMITTED.
- ITEMS FORMED BY OTHERS MUST COMPLY WITH UG-79 & REFERENCED PARAGRAPHS, I.E. HEADS & SHELLS.
- WELD GAPS TO BE 0 TO 5 [0 TO 3/16"] MAXIMUM
- MI-GSS-2 REV.1, MI-GSS-4 REV.1, CA-TIG-6 REV.3
CA-PIPB1-1 REV.5, CSA-W47.1, CSA-W59 WELD PROCEDURES INCLUDE PREHEAT TO 200F
- NO DIFFERENT 'P' NUMBER WELDED TO PRESSURE ENVELOPE PER SOUR SPEC, 4.1.6

NAMEPLATE DETAIL

CERTIFIED BY
FOREMOST LP

MAWP: 5070 kPa @ 38°C
 735 psi @ 100°F

MAWP EXT: 104 kPa @ 66/-40°C
 15 psi @ 150/-40°F

MDMT: -40°C @ 5070 kPa
 -40°F @ 735 psi

SERIAL#: 13-030625-101
 YEAR BUILT: 2013 CRN: _____

REGISTRATION

REGISTERED IN THE PROVINCE(S) AB AND BC
 CRN NUMBER _____
 MFR SERIAL NUMBER 13-030625-101

INSULATION REQUIREMENTS

ITEM	INSULATION TYPE	THK.	CLAD TYP.	THK.
VESSEL	FIBREGLASS	51 [2"]	SUNCO CROSSSED CORRUGATED ALUMINUM CLADDING	0.020

NOTES:

HYDROTEST REQUIREMENTS

- VESSEL SHOULD BE HYDROTESTED IN THE HORIZONTAL POSITION AND SHALL BE ADEQUATELY SUPPORTED TO PREVENT WEIGHT DEFORMATION.
- HYDROTEST PRESSURE SHALL BE MAINTAINED FOR A MINIMUM OF ONE(1) HOUR.
- UPON COMPLETION OF HYDROTEST, VESSEL SHALL BE COMPLETELY DRAINED OF ALL WATER.
- HYDROTESTING SHALL BE CARRIED OUT ON THE VESSEL BEFORE IT IS EXTERNALLY PAINTED.

MATERIAL REQUIREMENTS

SHELL
 MATERIAL SA-516-70H

HEADS

- MATERIAL SA-516-70H TYPE 2.1 SE
- MATERIAL SA-516-70H TYPE 2.1 SE
- MATERIAL _____ TYPE _____

FLANGE SA-350-LF2 CL1 PIPE SA-333-GR6

WELD FITTINGS SA-420-WPL6 FRETUBE N/A

NONPRESSURE 640.21/300W/SA-516-70H FRETUBE N/A

WELDOLET N/A THREDOLET N/A

STUD BOLTS SA-193-B7M HEX NUTS SA-114-2HM

GASKETS 316SS SPIND GRAPHITE FILLER

NOTES:

- ITEMS IDENTIFIED WITH AN 'M' ARE ATTACHED TO PRESSURE ENVELOPE AND REQUIRE IDENTIFICATION IN ACCORDANCE WITH Q.C. MANUAL
- ITEMS IDENTIFIED WITH AN 'I' ARE IMPACT TESTED, SEE INSPECTION AND TESTING NOTE E
- ITEMS IDENTIFIED WITH 'C' WILL MEET NACE MR0175/ISO 15156 OR CSA Z245 COMPLIANT FOR SOUR SERVICE
- PLATE: FINE GRAIN PRACTICE, FULL KILLED, NORMALIZED, SA-516-70 S = 0.003 % MAX.

PROCESS DATA

COPY OF ORIGINAL DOCUMENT
 Reference for W/O 030789
 Issued by: *Jason Mores* Date: *Nov 22/13*

FIREPROOFING REQUIREMENTS

ITEM	INSULATION TYPE	THK.

OTHER NOTES

MARKING AND PREPARATION FOR SHIPMENT

- ALL FLANGED OPENINGS SHALL BE PROTECTED WITH WOODEN OR STEEL BLINDS TO PREVENT THE ACCUMULATION OF DIRT AND OTHER DEBRIS DURING SHIPPING.
- VESSEL SHALL HAVE THE WORDS "DO NOT WELD ON VESSEL - PWHT" STENCIL PAINTED ON IT IN LARGE (6") WHITE LETTERS IN 2 PLACES PRIOR TO SHIPPING.
- ALL REMOVABLE PIECES TO BE MARKED WITH EQUIPMENT TAG NUMBER.
- VESSEL MUST BE COMPLETELY CLEAN AND DRY BEFORE BEING SEALED FOR SHIPMENT. (NO HYDROCARBON FILM, MILL SCALE, HEAVY RUST, DIRT & SPLATTER.)

INSPECTION AND TESTING

A. QUALIFICATIONS

- ALL NON-DESTRUCTIVE EXAMINATIONS SHALL BE CONDUCTED AND/OR INTERPRETED BY PERSONNEL CERTIFIED IN ACCORDANCE WITH CGSB AND SNT-TC-1A LEVEL II.

B. VISUAL EXAMINATION

- EXAMINATION AND ACCEPTANCE CRITERIA SHALL BE IN ACCORDANCE WITH ASME SECTION V (ARTICLE 9) AND ASME VIII DIV.1 RESPECTIVELY.
- 100% VISUAL EXAMINATION IS REQUIRED FOR ALL WELDING.

C. RT INSPECTION

- RADIOGRAPHIC EXAMINATION AND ACCEPTANCE CRITERIA SHALL BE IN ACCORDANCE WITH ASME SECTION V (ARTICLE 2) AND ASME SECTION VIII, DIV.1 PARA UW-11(a) 100%, INCLUDING ALL CAT. B & C BUTTWELDS.
- 100% RADIOGRAPHY - BEFORE AND AFTER PWHT
 - ALL CATEGORY A AND B WELDS

D. MPI:

- HEAD KNUCKLE CONVEX SIDE AFTER FORMING
- BEFORE AND AFTER PWHT
- ALL FILLET WELDING, LIFTING LUGS, INTERNAL AND EXTERNAL ATTACHMENTS
- ALL TEMPORARY ATTACHMENT REMOVAL

E. IMPACT TESTING:

L.C.V.A. TEST HEAD/SHELL PLATES & PRODUCTION WELDS TO 15/10 ft-lb @ -40 °F PER UG-84.

F. UT:

- HEAD/SHELL PLATE ON 100mm GRID TO SA-518 LEVEL 'B' ACCEPTANCE
- PRIOR TO ALL NOZZLE CUT OUTS
- BEFORE AND AFTER PWHT
- CATEGORY D WELDS

G. HYDROTEST x 1.3 MAWP

W 3375.2
 NOV 18 2013

25.7.13 ISSUED FOR CONSTRUCTION

NO. DATE (d/m/y) REVISIONS BY APPD

THIS DRAWING IS THE PROPERTY OF FOREMOST UNIVERSAL LP AND IS TO BE USED ONLY IN CONJUNCTION WITH PERFORMANCE OF WORK BY FOREMOST UNIVERSAL LP. REPRODUCTION OR USE OF IN WHOLE OR IN PART FOR ANY OTHER PURPOSE IS EXPRESSLY FORBIDDEN.

FOREMOST

CLIENT
 SUNCOR ENERGY c/o EQUINOX ENGINEERING LTD.
 BOX 2844, 150 - 6th Ave. SW CALGARY AB T2P 3E3
 KOBES C-97-B WATER HANDLING

DWG TITLE
 SLUG CATCHER (V-)
 1829mm [72"] I.D. X 9144mm [30'-0"] S/S
 DATA SHEET

NO. REV'D	DWG NO.	NO. NO.	LUC NO.
		030625	
SCALE	DWG BY	DWG NO.	SHEET NO. REV. NO.
	P.CHANG		
DATE (d/m/y)	CHKD	APPD	
18/09/13			030625-0101 2 of 3

TRAVEL SHEETS

**FOREMOST UNIVERSAL L.P.
VESSEL TRAVEL SHEET**

ASME Code Stamped (U, U2, S) <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	National Board Stamped <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Non Code Vessel <input type="checkbox"/>	Page 1 of 1
Authorized Inspector Review and Review Date: <u>8</u> OCT 11 2013	Tag Number: <u>V-120</u>
Drawing Number: <u>030789-D101</u>	Vessel Description: <u>Slug Catcher FINGER</u>
Drawing Revision Number: <u>012345</u>	Vessel Serial Number: <u>13-030789-101</u>

CODE OF FABRICATION: 2010 ASME Sec. VIII DIV.1 2011a		FULP QC	Date	A.I. Hold Points	A.I.	Date	Owner	Date				
1.	Approved Drawing for Review	PC	10/11/13	X	8	OCT 11 2013	JAN 10 2014					
2.	Materials Examined	JH	11/16/13									
3.	Heat Numbers Recorded	PC	12/13/13	X	AA	JAN - 6 2014	JAN 10 2014					
4.	MTR's Checked incl. Partial Data Reports	NB	11/29/13	X	8	JAN 10 2014	JAN 10 2014					
5.	W.P.S Checked	PC	10/11/13	X	8	OCT 11 2013	JAN 10 2014					
6.	Welder's Qualified	PC	12/13/13									
7.	Head and Shell Thickness' Recorded	PC	11/28/13	X	AA	JAN - 6 2014						
8.	Layout Checks Performed	Head (s)	RS	10/31/13								
		Shell (s)	RS	11/7/13								
		Saddle	RS	12/12/13								
9.	Head and Shell Seam Fit Up and Orientation	RS	11/25/13					SR Dec 12/13				
10.	Nozzles & Fittings Fitted	RS	11/25/13					SR Dec 14/13				
11.	Nozzle & Flange Rating Checked 300#	PC	11/25/13					SR Dec 14/13				
Impact Test Requirements		List Details: Heads, Shells & Prod. Welds Per UG-84										
12.	Material	15/10	Ft/Lbs. @ -40 °F	mm	11/29/13	X	AA	JAN 10 2014	JAN 10 2014			
	Production Welds	15/10	Ft/Lbs. @ -40 °F	PC	12/15/13	X	AA	"				
13.	Internals Checked			PC	12/18/13							
14.	Progressive Internal Inspection(s)	Progressive 1										
		Progressive 2										
		Progressive 3										
15.	Final Internal Inspection			PC	12/13/13	X X	8	DEC 0 3 2013	DEC 3/13			
16.	Weld Size Checked			SA	12/13/13				SR Dec 12/13			
17.	Welder Identification Checked			PC	12/13/13							
18.	Repad Air Test			N/A								
19.	Final External Inspection			PC	12/19/13	X	AA	JAN - 6	SR Dec 12/13			
20.	Radiography	Before PWHT	RT-1, UW-11(a) 100%									
		After PWHT	RT-1, UW-11(a) 100%	PC	11/28/13	X	AA	JAN 10 2014	JAN 10/13			
21.	Other NDE	BHN -		N/A								
		MPI -	Head Knuckle, int. all welds, int/ext - fw, attach, temp attach, lift, lugs bef. & aft PWHT	PC	12/19/13							
		UT -	SA-578-B 4", UT Cat D Before & Aft. PWHT	PC	12/19/13							
		Other -	Plate - S≤0.003	mm	11/29/13							
22.	Final External Prior to Heat Treatment			SR	12/13/13							
23.	Heat Treatment Chart Reviewed 1.75H @ 1150±50F			PC	11/16/13	X	AA	JAN 10 2014	JAN 10/13			
Hydrostatic Test		Pressure Required		Gauges		1 hour hold						
24.	Shell Side	Psi	956	Kpa	6591	0329, 0359	PC	11/6/14	X X	AA	JAN - 6 2014	JAN 10/13
		Psi		Kpa								
24.	Tube Side	Psi		Kpa								
		Psi		Kpa								
	Preheat Coil											
25.	C.R.N Letter	Drawing	X									
26.	Calculations Reviewed			mm	12/23/13	X X	AA	JAN 10 2014	JAN 10 2014			
27.	Nameplate Stamped			mm	12/23/13	X X	AA	"	JAN 23 2014			
28.	Manufacturer's Data Report Completed			mm	12/23/13	X X	AA	"	JAN 23 2014			
29.	Nameplate Installed			mm	12/23/13	X X	AA	"	JAN 23 2014			
30.	Non Conformance Report (s)											

Form Number: FRM-VTS-01-04	Date Issued: September 10, 1999	Revision: 7	Date Revised: April 03, 2007
Authorized Inspector Shall be presented with the travel sheet prior to construction so that he can designate inspection and or Hold points. * Denotes an A.I. Inspection Point ** Denotes an A.I. Hold Point			

Vessel Travel Sheet – Heat Record Sheet

Drawing Number:	030789-D101	Drawing Revision Number:	02345	Page	2 of
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Special Material Requirements					
Brinell Hardness	Max Value	Set Definition:			N/A

Chemistry Requirements					
CE= C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15≤	N/A	Cr+Mo+V+Ni+Cu≤	N/A	Nace MR0175	YES
CE= C+Mn/6+.05	N/A	C+Mn/4≤	N/A	Mn/C =>	N/A
		C≤	N/A	S≤	0.003
		Mn≤	N/A	P≤	N/A

Head and Shell Heat Numbers

	Dia.	Specified Thickness	UT Measured Thickness	Material Specification SA or SB	Material Heat Number/PID#	WPS/Weld ID/Welders Symbol/Fitup						Ver Typ Jot
						Weld ID	Symbol	Fit up	Weld ID	Symbol	Fit up	
Shell #1D	72"ID, 1829mm	1.500" 38.10mm	SA-516-70N	1.494 130 83	3503128-04	L-1	XMSA	RS	C-1	XM	RS	
Shell #2	72"ID, 1829mm	1.500" 38.10mm	SA-516-70N	1.497 130 81	3503129-05	L-2	XMS	RS	C-2	MX	RS	
Shell #3 m	72"ID, 1829mm	1.500" 38.10mm	SA-516-70N	1.502 130 89	3503129-02	L-3	MSX	RS	C-3	MX	RS	
Shell #4						L-			C-			
Shell #5						L-			C-			
Shell #6						L-			C-			
Shell #7						L-			C-			
Shell #8						L-			C-			
Shell #9						L-			C-			
Shell #10						L-			C-			
Head #1D	72"ID, 1829mm	1.480"min 37.50mm min	SA-516-70N	1.646	M24219PA1330089-1		XM	RS	C-			
Head #2m	72"ID, 1829mm	1.480"min 37.50mm min	SA-516-70N	1.620	M24219PA1330090	C-4	OX	RS	C-			

Firetube Heat Numbers – Must Include a Map

	Dia.	Specified Thickness	UT Measured Thickness	Material Specification SA or SB	Material Heat Number/MID#	WPS/Weld ID/Welders Symbol/Fitup					
						Weld ID	Symbol	Fit up	Weld ID	Symbol	Fit up
Shell #1						L-			C-		
Shell #2						L-			C-		
Shell #3						L-			C-		
Shell #4						L-			C-		
Shell #5						L-			C-		
Shell #6						L-			C-		
Shell #7						L-			C-		
Shell #8						L-			C-		
Shell #9						L-			C-		
Shell #10						L-			C-		
Shell #11						L-			C-		
Shell #12						L-			C-		
Shell #13						L-			C-		

	Specified Thickness	UT Measured Thickness	Material Specification SA or SB	Material Heat Number/MID#	Welders Symbol	
					C	D
Oval Firetube Flange						
Oval Vessel Neck						
Oval Vessel Flange						

Vessel Travel Sheet – Heat Record Sheet

Drawing Number: 030789-D101 Drawing Revision Number: 02895 Page 2 of 2

Vessel Nozzle Heat Numbers

Location or Mark	Description	Dia.	Specified Thickness	UT Thickness	Material Specification	MID #	Heat Number	WPS/Weider's Symbol's / Fit up			
								Cat. B	Cat. C	Cat. D	Repad
M1	300# RFHB x 406Lg	DN 600 24"	2.810" 71.37mm	2.801	SA-350-LF2 Cl.1	-	G419BN	-	-	STE	-
	RF Blind	DN 600 24"	300#	-	SA-350-LF2 Cl.1	-	24635	-	-	RS	-
N1	300# RFHB X 305Lg	DN 150 6"	1.810" 45.97mm	1.806	SA-350-LF2 Cl.1	-	A629BN	-	-	& RS	-
N2	300# RFHB X 305Lg	DN 150 6"	1.810" 45.97mm	1.801	SA-350-LF2 Cl.1	-	A629BN	-	-	& RS	-
N3	300# RFHB X 305Lg	DN100 4"	1.400" 35.56mm	1.419	SA-350-LF2 Cl.1	-	A649BN	-	-	& RS	-
N4	300# RFHB X 305Lg	DN100 4"	1.400" 35.56mm	1.387	SA-350-LF2 Cl.1	-	A651BN	-	-	TWS	-
	RF Blind	DN 100 4"	300#	-	SA-350-LF2 Cl.1	-	12179999	-	-	RS	-
N5a	300# RFHB X 305Lg	DN100 4"	1.400" 35.56mm	1.410	SA-350-LF2 Cl.1	-	A649BN	-	-	& RS	-
N5b	300# RFHB X 305Lg	DN100 4"	1.400" 35.56mm	1.391	SA-350-LF2 Cl.1	-	A649BN	-	-	F& RS	-
N5c	300# RFHB X 305Lg	DN100 4"	1.400" 35.56mm	1.399	SA-350-LF2 Cl.1	-	A649BN	-	-	T&F RS	-
N6a	300# RFLWN x 229Lg	DN50 2"	0.660" 16.76mm	.700	SA-350-LF2 Cl.1	-	C959BN	-	-	TS RS	-
N6b	300# RFLWN x 229Lg	DN50 2"	0.660" 16.76mm	.704	SA-350-LF2 Cl.1	-	C959BN	-	-	F& RS	-

MATERIAL TEST REPORTS

Issuing Date : 04/26/2013 B/L No. : 355893 Load No. : 358536 Our Order No. : 110447/3 Cust. Order No. : U 01389
 Vehicle No: NOKL 725043 Sold To : Samuel, Son & Co., LTD Ship To : ARROW RELOAD
 Specification : 1.5000" x 120.000" x 480.000" 2360 Dixie Road 6380 OGDENDALE RD SE
 ASTM A516 70/65/60-10/ASME SA516-70/65/60 PVQ 2011 Addenda MISSISSAUGA, ON L4Y 1Z7 CALGARY, AB T2C 3A9
 Normalized Plate NACE MR0175 Annex 2.1.2, MR0103 Section 2.1.2
 Compliant

Heat No. Marking	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
3503128	0.20	1.07	0.009	0.001	0.18	0.21	0.08	0.06	0.02	0.029	0.004	0.001	0.002	0.0071	0.0000	0.0003	0.009	0.41	0.28
3503129	0.19	1.07	0.009	0.001	0.19	0.25	0.10	0.06	0.02	0.029	0.004	0.002	0.002	0.0064	0.0000	0.0001	0.011	0.41	0.27

Plate Serial No	Pieces	Tons	Dir.	Tensile Test				Heat Treat				Charpy Impacts										BHN
				Yield (psi)	Tensile (psi)	Elong. % in 2"	Elong. % in 8"	Norm "F	Time (min)	Temper "F	Time (min)	Absorbed Energy (Ft-lbs)				Lateral Expansion (In.)				Temp "F		
3503128-03	2	24.50	T	47,200	75,300	53.0		1650	58			H-L	76.1	78.2	67.4	73.9	15	PID: 13085 UT=1.530				-50
#1 3503128-04	1	12.25	T	48,100	76,600	55.4		1650	58			H-L	69.4	51.1	45.9	55.5	15	PID: 13087 UT=1.509				-50
3503128-05	1	12.25	T	49,100	76,200	54.9		1650	58			H-L	92.1	99.1	60.9	84.0	15	PID: 13086 UT=1.506				-50
#3 3503129-02	1	12.25	T	50,000	78,000	50.2		1650	58			H-L	76.1	85.0	87.5	82.9	15	PID: 13089 UT=1.506				-50



Shells 1, 3

Piece frequency charpy;

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. 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.

Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast discrete plate, unless otherwise noted in Specification.

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

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

Melted and manufactured in the USA. ISO 9001:2008 certified (#008063) by SRI Quality System Registrar (#0985-09). PED 97/23/EC 7/2 Annex 1, Para. 4.3 Compliant.

DIN 50049 3.1.B/EN 10204 3.1B(2004), DIN EN 10204 3.1(2005) compliant. For ABS grades only, Quality Assurance certificate 09-MMPQA-546

T. A. Depretis
T. A. Depretis, Metallurgist

05/08/2013 11:16:40 AM

1.59
PZH 1049B

Mill Test Report
Page 1

Issuing Date : 04/27/2013 B/L No. : 355928 Load No. : 358586 Our Order No. : 110447/1 Cust. Order No. : U 01389
 Vehicle No: ATW 53005 Sold To : Samuel, Son & Co., LTD Ship To : ARROW RELOAD
 Specification : 0.3750" x 120.000" x 480.000" 2360 Dixie Road 6380 OGDENDALE RD SE
 ASTM A516 70/65/60-10/ASME SA516-70/65/60 PVQ 2011 Addenda MISSISSAUGA, ON L4Y 1Z7 CALGARY, AB T2C 3A9
 Normalized Plate NACE MR0175 Annex 2.1.2, MR0103 Section 2.1.2
 Compliant

Heat No.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	CEQ	PCM
3501515	0.19	1.12	0.016	0.001	0.25	0.28	0.09	0.11	0.02	0.032	0.004	0.001	0.002	0.0084	0.0020	0.0002	0.012	0.43	0.28
3503129	0.19	1.07	0.009	0.001	0.19	0.25	0.10	0.06	0.02	0.029	0.004	0.002	0.002	0.0064	0.0000	0.0001	0.011	0.41	0.27

Plate Serial No	Pieces	Tons	Dir.	Tensile Test				Heat Treat				Charpy Impacts								BHN								
				Yield (psi)	Tensile (psi)	Elong. % in 2"	Elong. % in 8"	Norm °F	Time (min)	Temper °F	Time (min)	Absorbed Energy (Ft-lbs)				Lateral Expansion (In.)					Temp °F							
3501515-03	2	6.12	T	53,800	77,100	45.3		1650	18			H-L	72.6	72.4	97.4	80.8	15	1	2	3	Ave	Min	1	2	3	Ave	Min	-50
3503129-04	2	6.12	T	53,600	77,500	32.5		1650	18			H-L	53.8	56.7	68.9	59.8	15	1	2	3	Ave	Min	1	2	3	Ave	Min	-50
#2 3503129-05	3	9.18	T	55,100	79,800	33.5		1650	18			H-L	75.7	76.7	67.9	73.4	15	1	2	3	Ave	Min	1	2	3	Ave	Min	-50



Shell 2

Piece frequency charpy;

Manufactured to fully killed fine grain practice by Electric Arc Furnace. Welding or weld repair was not performed on this material. Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast discrete plate, unless otherwise noted in Specification.

Yield by 0.5EUL method unless otherwise specified. $Ceq = C + (Mn/6) + ((Cr+Mo+V)/5) + ((Cu+Ni)/15)$
 $Pcm = C + (Si/30) + (Mn/20) + (Cu/20) + (Ni/60) + (Cr/20) + (Mo/15) + (V/10) + 5B$
 Melted and manufactured in the USA. ISO 9001:2008 certified (#008063) by SRI Quality System Registrar (#0985-09). PED 97/23/EC 7/2 Annex 1, Para. 4.3 Compliant.
 DIN 50049 3.1.B/EN 10204 3.1B(2004), DIN EN 10204 3.1(2005) compliant. For ABS grades only, Quality Assurance certificate 09-MMPQA-546

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

T. A. Depretis
 T. A. Depretis, Metallurgist

05/08/2013 11:15:39 AM

Heads 1+2



Edmonton exchanger
& manufacturing ltd.

CERTIFICATE OF COMPLIANCE

5545-89 Street Edmonton, Alberta Canada T6E 5W9 www.edmontonexchanger.com tel 780.468.6722 • QC fax 780.466.4668 • sales fax 780.466.5155

Customer FOREMOST UNIVERSAL LP PO 148204 -REV. 1 Work Order C100531 Date 2013/10/15 CofC# 44388 Page 1 of 1

Item#	Description	Qty	Heat#	Required Min Thk	Recorded Min Thk	Form. Proc.
H100531-1	HEAD(S) - Semi-Elliptical 2:1 - 1.6250" NOM (1.5000" MIN) X 72" ID (Material Spec: SA 516-70 Normalized)	2	M24219-PA13300901 <i>UT=1.646</i> <i>PID:13109</i>	1.5000"	1.5750"	1

Forming Procedure:

1. Hot Formed @ 1650F/899C and Air Cooled

Supplementary Requirements

Normalized Material Identification Marking:

'MT' indicates normalized by the mill per ASME Code Section II, Part A, SA 20, Paragraph 13.1.1.
'GMT' indicates normalized by Edmonton Exchanger per ASME Code Section II, Part A, SA 20, Paragraph 13.1.2.
'GT' indicates normalized by Edmonton Exchanger per ASME Code Section VIII Division 1, UG-85 or ASME Code Section I, PG-77.4.

The Item(s) listed above comply with the requirements of ASME Code Section I, PG-29, PG-81 and ASME Code Section VIII, Division 1, UCS-79(d), UG-79 & UG-81. All welders and procedures are qualified to ASME Code Section IX. Material being supplied conforms to the latest ASME Code Section II, Part A, 2010 Edition, Addenda July 1, 2011.

Supplementary Examination - Items

Edmonton Exchanger	
UT: SA 578-B	
(for -1)	
Acceptable to ASME Code	
EE Procedure:	UIP-001 REV.10
Equipment:	Krautkramer USN-58L
Serial No.:	010X9H
Transducer:	Benchmark
Calibration:	Plate
Grid:	4"
Material:	SA 516-70 N
Examination Surface / Side:	Tight Scale
Trans Type:	1", 2 1/4 MHz, 0 deg
Primary Ref. Res. dB 100%:	45
Scanning Sens. dB:	57
Range Cal. In.:	5
Coaxial Cables:	BNC 8 ft long
Search Unit Serial No.:	00V5J3
Couplant:	Water
Tech:	Tracy Enman (#11226)
CGSB / SNT:	Level II
Time:	Day Shift
Date:	2013/09/19

Edmonton Exchanger	
MPI - Dry MPI	
(for -1)	
Acceptable to ASME Code	
X SEC. VIII, DIV.1	SEC. IV
- SEC. VIII, DIV.2	B31.1
- SEC. I	B31.3
- Bevelled Edge	- Backgouge
- Completed Welds	
X Knuckle/SF Outside Surface	
EE Procedure:	MPI-001 REV.13
Material:	SA 516-70 N
Thickness:	1.625"
Parker B300 Yoke	
Magnaflux 8A-Red (Dry)	
AC Continuous	
Light: Natural	
Tech:	Tracy Enman (#11226)
CGSB / SNT:	Level II
Date:	2013/10/11
Time:	Day Shift



edmonton exchanger
& manufacturing ltd.

CERTIFICATE OF COMPLIANCE

MTR List

5545-89 Street Edmonton, Alberta Canada T6E 5W9 www.edmontonexchanger.com tel 780.468.6722 • QC fax 780.466.4668 • sales fax 780.466.5155

Customer FOREMOST UNIVERSAL LP po 148204-REV.1 Work Order C100531 Date 2013/10/15 Co/C# 44388 Page 1 of 1

Email to sean.hanson@foremost.ca

Email to jreimer@edmontonexchanger.com

MTR ID	Pages	Heat#	Thickness	Material Grades
16296	2	M24219-PA13300901	1.625"	SA 516-70 N <i>HID:13109 VT=1.646</i>

Heat#	Material Grades	MTR ID
M24219-PA13300901	SA 516-70 N	16296

AID: 13109
U7=1.646

검사증명서

MILL TEST CERTIFICATE



당진제철소: 충남 당진군 송악읍 고대리 167-32
Godae-Ri, Songak-Eup, Dangjin-Gun, Chungnam, Korea

문번호 : F110500079
 명 : Hot Rolled Steel Plate 고객사 : EDMONTON EXCHANGER
 규격 : ASME SA516-70-N 주문자 : HYUNDAI CORPORATION
 증명서 번호 : 20110701-PS-014-014
 발행일자 : 2011-07-21

제품치수 Dimension	수량 Quantity	중량 Weight (LBS)	제강번호 Heat No.	제품번호 Product No.	Position	인장시험 Tensile Test						충격시험 Impact Test VNotch-50.8 °F		화학성분 Chemical Composition(%)																				
						YP	TS	EL	YP-EL	RA	YR	N	Energy	SF	Division	C	Si	Mn	P	S	Cr	Ni	B	Cu	Mo	N	Nb	Al	Si	Al	CEQ			
						(KSI)	(%)	(%)	(%)	(%)	(%)		(Ft-Lbs)	(%)		4	3	3	4	4	2	2	4	3	2	4	3	3	3	3	3	3		
1.625" x 97" x 480"	1	21,457	M24219	PA13300701	T	47.0	72.1	34					1:300 2:297 3:284 A:294		L	1,423	329	1,174	124	30	16	16	2	16	16	2	112	0	24	14	2	2	30	368
1.625" x 97" x 480"	1	21,457	M24219	PA13300801	T	47.7	72.9	37					1:291 2:288 3:294 A:291		L	1,423	329	1,174	124	30	16	16	2	16	17	1	112	0	18	15	2	1	30	384
1.625" x 97" x 480"	1	21,457	M24219	PA13300901	T	48.8	72.3	38					1:296 2:290 3:294 A:294		L	1,423	329	1,174	124	30	16	16	2	16	1	111	0	24	14	2	2	30	368	
1.625" x 97" x 480"	1	21,457	M24220	PA13338601	T	50.6	76.5	33					1:257 2:251 3:265 A:257		L	1,570	355	1,234	149	31	18	17	2	116	0	29	14	2	2	29	418			
													2:230 3:294 A:294		C	1,336	318	1,165	107	23	16	16	1	111	0	20	12	1	1	28	378			
													1:257 2:251 3:265 A:257		C	1,511	349	1,237	140	29	17	17	1	114	0	25	15	1	1	30	410			

단위 Unit
2:x100 3:x1,000
4:x10,000 5:x100,000

*** Sub Total(009) *** 4 85,828(LBS)

NOTE
 * Position - T:Top, M:Middle, B:Bottom
 * Tensile test - Direction:Transverse, Gauge length:50mm (Round), YP method : 0.2% off-set
 * Impact test - Direction:Longitudinal, Size:10mmX10mm, SF:Shear fracture
 * Division - C:Check analysis, L:Ladle analysis
 * The plate is fully killed and fine grained steel. Basic oxygen process and Vacuum degassing process were applied.
 * Applicable Code is ASME Section II Part A 2010 Edition. The Certificate has been issued in compliance with EN 10204(2004) 3. 1.



상기의 제품은 검사의 결과 지정된 규격에 합격한 것을 증명합니다.
 WE HEREBY CERTIFY THAT THE MATERIAL HAS BEEN MADE AND TESTED IN ACCORDANCE WITH THE ABOVE SPECIFICATION AND THE REQUIREMENTS

Signature: *C. S. Han*
 SURVEYOR TO: CHIEF OF QUALITY ASSURANCE TEAM

검사증명서 MILL TEST CERTIFICATE



당진제철소: 충남 당진군 송악읍 고대리 167-32
Godae-Ri, Songak-Eup, Dangjin-Gun, Chungnam, Korea

주문번호 : F110500079
Order No.

품명 : Hot Rolled Steel Plate
Commodity

제품규격 : ASME SA516-70-N
Specification

고객사 : EDMONTON EXCHANGER
Customer

주문자 : HYUNDAI CORPORATION
Contractor

증명서 번호 : 20110701-PS-014-015
Certificate No.

발행일자 : 2011-07-21
Date of Issue

제품치수 Dimension	수량 Quantity	중량 Weight (LBS)	제강번호 Heat No.	제품번호 Product No.	Position	인장시험 Tensile Test							충격시험 Impact Test V Notch -50.8 °F		화학성분 Chemical Composition(%)																		
						YP	TS	EL	YP-EL	RA	YR	N	Energy	SF	Division	C	Si	Mn	P	S	Cr	Ni	B	Cu	Mo	Nb	N	Nb	As	Sr	Sc	Al	CEO
						(KSI)	(%)	(%)	(%)	(%)	(%)		(R-Lbs)	(%)		4	3	3	4	4	2	2	4	3	2	4	3	2	4	3	3	3	3	3
** Heat Treatment: Normalized : 1634.0°F 72 Min.																																	
1.75" x 97" x 480"	1	23,106	M22941	PA12890101	T	49.8	73.9	34					1:297		L	1,327	348	1,204	118	12	20	18	3	125	0	42	14	2	1	33	294		
													2:300		C	1,308	343	1,182	107	11	20	18	1	122	0	42	13	2	1	34	368		
													3:295																				
													A:297																				
1.75" x 97" x 480"	1	23,106	M23660	PA13057201	T	53.0	77.5	33					1:230		L	1,527	329	1,189	138	26	19	17	3	129	0	44	16	1	1	27	409		
													2:243		C	1,511	341	1,215	135	19	19	17	2	131	0	37	16	1	1	29	412		
													3:138																				
													A:204																				
1.75" x 97" x 480"	1	23,106	M23660	PA13057301	T	53.2	77.5	33					1:228		L	1,527	329	1,189	138	26	19	17	3	129	0	44	16	1	1	27	409		
													2:253		C	1,505	334	1,193	128	21	19	17	2	129	0	35	15	1	1	29	407		
													3:240																				
													A:240																				
1.75" x 97" x 480"	1	23,106	M23659	PA13145901	T	50.0	77.1	35					1:255		L	1,484	341	1,218	132	26	17	16	3	108	0	39	13	1	1	32	403		
													2:265		C	1,488	336	1,222	124	22	18	17	1	113	0	28	13	1	1	32	408		
													3:263																				
													A:261																				

NOTE

- Position - T:Top, M:Middle, B:Bottom
- Tensile test - Direction:Transverse, Gauge length:50mm (Round), YP method : 0.2% off-set
- Impact test - Direction:Longitudinal, Size:10mmX10mm, SF:Shear fracture
- Division - C:Check analysis, L:Ladle analysis

- The plate is fully killed and fine grained steel. Basic oxygen process and Vacuum degassing process were applied.
- Applicable Code is ASME Section II Part A 2010 Edition. The Certificate has been issued in compliance with EN 10204(2004) 3. 1.

상기와 제품은 검사외 결과 지정된 규격에 합격한 것을 증명합니다.
WE HEREBY CERTIFY THAT THE MATERIAL HAS BEEN MADE AND TESTED IN ACCORDANCE WITH THE ABOVE SPECIFICATION AND THE REQUIREMENTS



SURVEYOR TO: CHIEF OF QUALITY ASSURANCE TEAM

G. S. Han

M

Material Test Report

FVC
an **AFGlobal** Company

FVC Heat Nbr: G419BN

FVC Canada Ltd.
An AFGlobal Company

7410A-5 Street S.E. Calgary, Alberta T2H-2L9

ISO 9001:2008 Certified

Sales: (403) 255-9011 Fax: (403) 255-7239

FOREMOST UNIVERSAL 00011761	PO: 150215	Sales Order: C13166	Line: 1
6614 50th AVENUE	Item Code: HBN240300160A004A1	Qty: 1	
T9V 2W8 LLOYDMINSTER, AB	Item Desc: HBN, SA350LF2, 300#, 24"x16", RF	Mill Heat: 208899	
CA			
Spec: ASME SA350-LF2-CL1: 2013 Edition			

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.19 ✓				Cb	Columbium (N)	0.001 ✓			
Mn	Manganese	1.20 ✓		✓	7439-96-5	Sn	Tin	0.011			
P	Phosphorous	0.006 ✓				Ti	Titanium	0.0036 ✓		✓	7440-02-0
S	Sulphur	0.002 ✓				Al	Aluminum	0.034			
Si	Silicon	0.27 ✓				Ca	Calcium	0.15			
Cu	Copper	0.15 ✓		✓	7440-50-8	As	Arsenic	0.006		✓	7440-38-2
Ni	Nickel	0.10 ✓		✓	7440-02-0	Sb	Antimony	0.001		✓	7440-36-0
Cr	Chromium	0.10 ✓		✓	7440-47-3	CE	C+Mn/6+ (Cr+M)	0.44 ✓			
Mo	Molybdenum	0.04 ✓				Cu+Ni+Cr+Mo+V		0.42			
V	Vanadium	0.032 ✓				Cr+Mo		0.14			



Mechanical Testing		Heat Treat	
Test Lab	AMF 52484	Heat Treatment	Normalized
BHN (QTC)	140 - 140 ✓	Other	
Elg (%)	34.0 ✓	Country of Origin	Italy
RA (%)	70.0	Manufactured In	USA
Tensile (ksi)	70.634 ✓	Production Method	EF
Yield (ksi)	40.916 ✓	Reduction Ratio (Mill) x:1	3
Specimen Orientation	Longitudinal	Gr.Sz.	7
Charpy (ft-lbs)	53 - 49 - 81	Made to Fine Grain Practice	YES
Charpy Temp (F)	-50		
Avg Energy 3 Specimens (ft-lbs)	61		
Min Energy 1 Specimens (ft-lbs)	49		
Shear (%)	30-30-40		
LatExp (Mils)	46-41-59		

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

Certification No.: 1083846
 Certification Date: 10/17/2013
 Issued By: Bryun Jantzen

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

Material Test Report

FVC Heat Nbr: G419BN

FVC Canada Ltd.

An AFGlobal Company

7410A-5 Street S.E. Calgary, Alberta T2H-2L9

ISO 9001:2008 Certified

Sales: (403) 255-9011 Fax: (403) 255-7239

FOREMOST UNIVERSAL 00011761 6614 50th AVENUE T9V 2W8 LLOYDMINSTER, AB CA	PO: 150215	Sales Order: C13166	Line: 1
	Item Code: HBN240300160A004A1	Qty: 1	
	Item Desc: HBN, SA350LF2, 300#, 24"x16", RF		
	Mill Heat: 208899		
Spec: ASME SA350-LF2-CL1: 2013 Edition			

MATERIAL MEETS NACE MR0175 & MR0103 LATEST EDITIONS, $CE=C+(Mn/6)+((Cr+Mo+V)/5)+((Ni+Cu)/15)$,

Elongation in 2" round specimen.

YIELD STRENGTH MEASURED AT 0.2% OFFSET.

FVC STANDARD MANUFACTURING PRACTICES:

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

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1988) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1083846

Certification Date: 10/17/2013

Issued By: Bryun Jantzen

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


Bryun Jantzen

24" CL 300 BLIND FLANGE RF

Foremost PO# 148923 Item# 241
Heat Number: 24635
Trans Am Piping Products Ltd.
Shipmt/Seg #: 13 - 1034
Rev'd By: SB

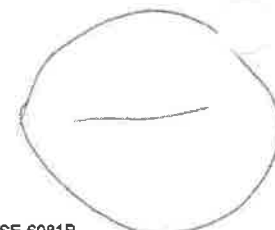


SAN ENG STEEL FORGING CO LTD
311, Jen Hein Road, Jen Wu District
Kaohsiung, Taiwan, R.O.C.
TEL:07-3724249 ; FAX:07-3712923
URL: www.saneng.com.tw
e-mail: saneng@kate.seed.net.tw

MILL TEST CERTIFICATE

EN10204-3.1.B(DIN50049/3.1.B)
Customer: TRANS AM PIPING PRODUCTS LTD.
Order No.: 7006081(2)-TA

Certificate No.: SE-6081B
Date: 01/11/2013
Page: 1 QF 1



PRODUCT		MATERIAL SPECIFICATIONS										DIMENSIONAL SPECIFICATIONS					
FORGED CARBON STEEL FLANGES		ASTM A350 LF2-11 CL.1/ASME SA350 LF2-11 CL.1										ASME B16.5-09 CSA Z245.12					
Item No.	CODE NO	DESCRIPTION	QUANTITY	CHEMICAL COMPOSITION (%)													
				C	Si	Mn	P	S	Cu	Cr	Ni	Mo	V	Nb	N	CE(*3)	
1		600 WNRFS S80 18" LF2	3 PCE	0.210	0.200	1.170	0.022	0.009	0.220	0.150	0.070	0.020	0.010	0.002	0.008	0.460	
2		300 BLRF-24" LF2	5 PCE	0.210	0.200	1.180	0.011	0.006	0.090	0.050	0.040	0.005	0.002	0.001	0.010	0.427	
3		300 BLRF 24" LF2	10 PCE	0.200	0.210	1.130	0.018	0.003	0.200	0.130	0.070	0.030	0.010	0.002	0.007	0.440	

Item No.	Heat No.	T.S.(**1) (MPA)	Y.S.(**1) (MPA)	E.L.(**1) (%)	Hardness (HB)	R.A.(**1) (%)	Impact Test Temp: -46°C Minimum: 20.0 Joule			Material Supplier	HEAT TREATMENT(**2)	
							1	2	3		<input checked="" type="checkbox"/> N	REMARKS
1	B02900	545.0	381.0	33.2	155/153	66.8	79.0	85.0	81.0	SEAH BESTEEL	<input checked="" type="checkbox"/> N	
2	24635	537.0	380.0	35.6	154/152	69.5	47.0	44.0	36.0	EVRAZ ZSMK	890°C X 3HRS	
3	B02893	543.0	378.0	36.0	155/153	70.4	105.0	100.0	73.0	SEAH BESTEEL	CONFORMS WITH NACE MR0103-12 AND NACE MR0175/ISO15156.2-09 CLAUSE 7.2.1.4 REGION 3 AND ANNEX A. CONFORMS WITH Z245.12 CAT II GR248 SOUR SERVICE-09 AND GR290 CATHI M45C SS(FOR USE AS WELDING NECK AND BLIND FLANGES ONLY). TEST SPECIMEN SIZE: 10X10 TEST SPECIMEN ORIENTATION: TRANSVERSE IMPACT TEST TEMP.: -46°C	

*1: T.S. = Tensile Strength, Y.S.=Yield Strength, E.L.=Elongation, R.A.=Reduction of Area.
*2: N=Normalized, A=Annealed, Q=Quenched, T=Tempered, S.T=Solution Treated, S.R=Stress Relieved, A.C=Air Cooled, F.C=Furnace Cooled, W.C=Water Cooled, O.C=Oil Cooled.
*3: C.E. Value = C + (Mn / 6) + (Cr + Mo + V) / 5 + (Ni + Cu) / 15

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



Manager of Quality Assurance Dept



M1 BLIND

N1, N2



Material Test Report

FVC Heat Nbr: A629BN

FVC Canada Ltd.

An Ameriforge Group Company

7410A-5 Street S.E. Calgary, Alberta T2H-2L9

ISO 9001:2008 Certified

Sales: (403) 255-9011 Fax: (403) 255-7239

FOREMOST UNIVERSAL 00011761 6614 50th AVENUE T9V 2W8 LLOYDMINSTER, AB CA	PO: 140089	Sales Order: C12602	Line: 2
	Item Code: HBN060300280A004A1	Qty: 2	
	Item Desc: 6-300-28-2-1-4 HBN, SA350LF2, 300#, 6x28",		
	Mill Heat: MM10101729		
Spec: ASME SA350-LF2-CL1: 2010 Edition; 2011 Addenda			

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18 ✓				Cb	Columbium (Nb)	0.004 ✓			
Mn	Manganese	1.23 ✓		✓	7439-96-5	Sn	Tin	0.009 ✓			
P	Phosphorous	0.011 ✓				Al	Aluminum	0.021 ✓			
S	Sulphur	0.007 ✓				As	Arsenic	0.006 ✓		✓	7440-38-2
Si	Silicon	0.21 ✓				CE	C+Mn/6+(Cr+M)	0.43 ✓			
Cu	Copper	0.20 ✓		✓	7440-50-8	Cu+Ni+Cr+Mo+V		0.40 ✓			
Ni	Nickel	0.07 ✓		✓	7440-02-0	Cr+Mo		0.11 ✓			
Cr	Chromium	0.09 ✓		✓	7440-47-3	Cr+Cu+Ni		0.36 ✓			
Mo	Molybdenum	0.02 ✓				Cb+V		0.024 ✓			
V	Vanadium	0.020 ✓									



Mechanical Testing			Heat Treatment		
Test Lab		AMF	Heat Treatment		NORMALIZED
BHN		146 - 146 ✓		Other	
Elg (%)		36 ✓	Country of Origin		USA
RA (%)		69 ✓	Manufactured In		USA
Tensile (ksi)		72.76 ✓	Production Method		EAF
Yield (ksi)		47.11 ✓	Reduction Ratio (Mill) x:1		4:1
Specimen Orientation		Longitudinal	Gr.Sz.		5
Charpy (ft-lbs)		41 - 48 - 56	Made to Fine Grain Practice		YES
Charpy Temp (F)		-50			
Avg Energy 3 Specimens (ft-lbs)		48			
Min Energy 1 Specimens (ft-lbs)		41			
Shear (%)		30-30-60			
LatExp (Mils)		38-43-48			

MATERIAL MEETS NACE MR0175 & MR0103 LATEST EDITIONS. CE=C+(Mn/6)+((Cr+Mo+V)/5)+((Ni+Cu)/15), Elongation in 2" round specimen. YIELD STRENGTH MEASURED AT 0.2% OFFSET.
 FVC STANDARD MANUFACTURING PRACTICES:
 1) FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5.
 2) SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.
 3) MATERIAL SPECIFICATION COMPLIES WITH ASME SECT. II PART A.
 4) ALL FVC MATERIAL MANUFACTURED PER FINE GRAIN PRACTICE.
 5) ALL FVC MATERIAL CERTIFIED PER EN 10204 Type 3.1 UNLESS OTHERWISE SPECIFIED.
 6) CERTIFICATE OF INSURANCE AVAILABLE UPON REQUEST.
 7) PRODUCT FREE OF MERCURY CONTAMINATION.

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1996) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1064526
 Certification Date: 4/17/2013
 Issued By: Bryun Jantzen
 This report is issued in compliance with the requirements of EN10204 3.1 / ISO 10474 3.1 b

Bryun Jantzen

N3, N5a-c



Material Test Report

FVC Heat Nbr: A649BN

FVC Canada Ltd.

An Amerforge Group Company

7410A-5 Street S.E. Calgary, Alberta T2H-2L9

Sales: (403) 255-9011 Fax: (403) 255-7239

ISO 9001:2008 Certified

FOREMOST UNIVERSAL 00011761	PO: 150215	Sales Order: C13166	Line: 7
6614 50th AVENUE	Item Code: HBN040300120A004A1		Qty: 4
T9V 2W8 LLOYDMINSTER, AB	Item Desc: HBN, SA350LF2, 300#, 4"x12", RF		
CA	Mill Heat: R8390		
Spec: ASME SA350-LF2-CL1: 2013 Edition			

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.20				Cr	Chromium	0.05		✓	7440-47-3
Mn	Manganese	0.94		✓	7439-96-5	Mo	Molybdenum	0.02			
P	Phosphorous	0.008				V	Vanadium	0.001			
S	Sulphur	0.015				Cb	Columbium (Nb)	0.001			
Si	Silicon	0.28				Al	Aluminum	0.030			
Cu	Copper	0.14		✓	7440-50-8	CE	C+Mn/6+ (Cr+M)	0.38			
Ni	Nickel	0.07		✓	7440-02-0	Cb+V		0.002			

Mechanical Testing			Heat Treat		
Test Lab		P&B 197787.0	Heat Treatment		Normalized
BHN (QTC)		137 - 137			
Elg (%)		35			
RA (%)		64			
Tensile (ksi)		70.900	Country of Origin		USA
Yield (ksi)		43.200	Manufactured In		USA
Charpy (ft-lbs)		25 - 12 - 22	Production Method		EF
Charpy Temp (F)		-50	Fully Killed		YES
Avg Energy 3 Specimens (ft-lbs)		19	Made to Fine Grain Practice		YES
Min Energy 1 Specimens (ft-lbs)		12			
Shear (%)		20-10-10			
LatExp (Mils)		19-9-17			



MATERIAL MEETS NACE MR0175 & MR0103 LATEST EDITIONS. Elongation in 2" round specimen. YIELD STRENGTH MEASURED AT 0.2% OFFSET. CE=C+(Mn/6)+((Cr+Mo+V)/5)+((Ni+Cu)/15), FVC STANDARD MANUFACTURING PRACTICES:

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

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

Certification No.: 1082492

Certification Date: 10/3/2013

Issued By: Bryun Jantzen

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

[Signature]
Bryun Jantzen



Material Test Report

FVC Heat Nbr: **A651BN**

FVC Canada Ltd.

An Ameriforge Group Company

7410A-5 Street S.E. Calgary, Alberta T2H-2L9

ISO 9001:2008 Certified

Sales: (403) 255-9011 Fax: (403) 255-7239

FOREMOST UNIVERSAL 00011761	PO: 150215	Sales Order: C13166	Line: 7
6614 50th AVENUE	Item Code: HBN040300120A004A1		Qty: 1
T9V 2W8 LLOYDMINSTER, AB	Item Desc: HBN, SA350LF2, 300#, 4"x12", RF		
CA	Mill Heat: MM11103197		
Spec: ASME SA350-LF2-CL1: 2013 Edition			

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.17				Sn	Tin	0.008			
Mn	Manganese	1.21		✓	7439-96-5	B	Boron	0.0002			
P	Phosphorous	0.011				Ti	Titanium	0.001		✓	7440-02-0
S	Sulphur	0.005				Al	Aluminum	0.020			
Si	Silicon	0.18				Ca	Calcium	0.0003			
Cu	Copper	0.21		✓	7440-50-8	N	Nitrogen	0.0091			
Ni	Nickel	0.08		✓	7440-02-0	As	Arsenic	0.005		✓	7440-38-2
Cr	Chromium	0.08		✓	7440-47-3	CE	C+Mn/6+(Cr+M	0.42			
Mo	Molybdenum	0.03				Cu+Ni+Cr+Mo+V		0.42			
V	Vanadium	0.016				Cr+Mo		0.11			
Cb	Columbium (N	0.002									

Mechanical Testing			Heat Treat		
Test Lab		AMF 50865	Heat Treatment		Normalized
BHN (QTC)		146 - 146			
Elg (%)		36.00			
RA (%)		74.00	Other		
Tensile (ksi)		72.380	Country of Origin		USA
Yield (ksi)		40.561	Manufactured In		USA
Charpy Temp (F)		-50	Reduction Ratio (Mill) x:1		8.3
Charpy (ft-lbs)		54 - 55 - 79	Made to Fine Grain Practice		Y
Avg Energy 3 Specimens (ft-lbs)		63			
Min Energy 1 Specimens (ft-lbs)		54			
Shear (%)		20-20-30			
LatExp (Mils)		47-46-65			



MATERIAL MEETS NACE MR0175 & MR0103 LATEST EDITIONS. Elongation in 2" round specimen. YIELD STRENGTH MEASURED AT 0.2% OFFSET. CE=C+(Mn/6)+((Cr+Mo+V)/5)+((Ni+Cu)/15), FVC STANDARD MANUFACTURING PRACTICES:

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

EPCRA Supplier Notification: This product may contain one or more toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1996) and 40 C.F.R. Part 372. Potentially reportable chemicals are indicated with a checkmark in the "EPCRA" column and a Chemical Abstract Services (CAS) registry number is provided for each such chemical in addition to the percent by weight of the chemical present in this product. It is your responsibility alone to determine whether your facility is required to submit a Toxic Release Inventory Report under EPCRA Section 313.

Certification No.: 1082494

Certification Date: 10/3/2013

Issued By: Bryun Jantzen

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

Bryun Jantzen
Bryun Jantzen

Heat Number: 12/79999 Trans Am Piping Products Ltd. Shipmment/Seq #: S 12 - 1436

4" CL 300 BLIND FLANGE RF

A350-LF2 CL 1

Rev'd By: SB



STAMPAGGIO A CALDO DI ACCIAI COMUNI - LEGATI E INOSSIDABILI

SEDE AMMINISTRATIVA E STABILIMENTO:
23861 CESANA BRIANZA (LC) - Italy
Via G. Parini, 28
Tel. +39 031.655441
Fax +39 031.655149
quality.mlf@farmas.com

COMPANY WITH QUALITY MANAGEMENT
SYSTEM CERTIFIED BY DHV
= ISO 9001:2008 =

CERTIFICATO DI COLLAUDO SECONDO EN 10204 - 3.1 INSPECTION CERTIFICATE

Certif. N. 2245	Del/Dated 08.05.2012	Fattura / Invoice N. 1543	Del/Dated 07.05.2012
DDT / Del Note N. 1798	Del/Dated 07.05.2012	Ns.Ord. / Our ref. N.	Del/Dated
TRANS AM PIPING PRODUCTS LTD		Dest.: F.F.F. c/o TRANS AM PIPING PRODUCTS LTD	
9335 ENDEAVOR DRIVE S.E. T3S 0A1 CALGARY, ALBERTA CA		9335 Endeavor Drive S.E. T3S 0A1 CALGARY, ALBERTA CA	

Pag. 5 - 8

SALA PROVE E ANALISI MATERIALI / MATERIAL TEST DEPARTMENT

COD. COL. COLATA POS. VS.ORDINE Q.TA' DESCRIZIONE DIM.IN ACC. A VISIVO E DIMENS.	HEAT CODE HEAT ITEM YOUR REFERENCE Q.TY DESCRIPTION DIM. ACCORDANCE TO VIS. & DIMENS.																	SATISFACTORY		
		ASME/ANSI B16.5 -2009																		
MATERIALE / MATERIAL		C%	Si%	Mn%	S%	P%	Cr%	Ni%	Mo%	Ti%	Cu%	V%	Nb%	N%	Al%	C.E.%				
12/79999	087	3812/TRANS AM	68,00	BLIND 300 RF 4" LF2CL1																
ASTM A350 LF2 CL1/2 (LADLE)		0,200	0,210	0,950	0,003	0,012	0,060	0,040	0,010	0,020	0,100	0,001	0,002	0,010	0,026	0,382				
PROVETTA / TEST SPECIMEN SEZ. mm2 LUNG. mm	FORMA SHAPE 1=O 2=D	SNERVAMENTO YIELD POINT N/mm2 >=0,2%	ROTTURA TENSILE STRENGTH N/mm2 >=	ALLUNGAMENTO ELONGATION %>=	CONTRAZIONE REDUCTION OF AREA %>=	DUREZZA HARDNESS HBW		RESILLENZA / IMPACT TEST - JOULE/cm2						SNERVAMENTO YIELD POINT N/mm2 >=1,0%	Ns.Rif. OUR REF.					
126,60	50,80	1	328,0	31,0	58,0	159,0 - 163,0		TIPO / TYPE 10x10mm	°C	1	2	3	66	68	66	0,0				
MATERIALE IN ACCORDO A / MATERIAL IN ACC. TO		TRATTAMENTO TERMICO / HEAT TREATMENT																FORNO / FURNACE	ORIGINE / ORIGIN	
ASTM/ASME A 350/SA 350 M - 11 ASME CODE SECT. II, PART A, ED. 2010		NORMALIZED AT 930 C - COOLED IN STILL AIR																ELECTRIC FURNACE	EUROPE	
CSA Z245.12 GRADE 248 CAT.II																				

COD. COL. COLATA POS. VS.ORDINE Q.TA' DESCRIZIONE DIM.IN ACC. A VISIVO E DIMENS.	HEAT CODE HEAT ITEM YOUR REFERENCE Q.TY DESCRIPTION DIM. ACCORDANCE TO VIS. & DIMENS.																	SATISFACTORY		
		ASME/ANSI B16.5 -2009																		
MATERIALE / MATERIAL		C%	Si%	Mn%	S%	P%	Cr%	Ni%	Mo%	Ti%	Cu%	V%	Nb%	N%	Al%	C.E.%				
12/39959	141	3876/TRANS AM	240,00	S/O 150 RF 3" A105N																
ASTM A105 (LADLE)		0,200	0,240	0,970	0,010	0,009	0,100	0,050	0,010	0,018	0,130	0,002	0,002	0,000	0,025	0,396				
PROVETTA / TEST SPECIMEN SEZ. mm2 LUNG. mm	FORMA SHAPE 1=O 2=D	SNERVAMENTO YIELD POINT N/mm2 >=0,2%	ROTTURA TENSILE STRENGTH N/mm2 >=	ALLUNGAMENTO ELONGATION %>=	CONTRAZIONE REDUCTION OF AREA %>=	DUREZZA HARDNESS HBW		RESILLENZA / IMPACT TEST - JOULE/cm2						SNERVAMENTO YIELD POINT N/mm2 >=1,0%	Ns.Rif. OUR REF.					
126,60	50,80	1	350,0	526,0	30,0	59,0	159,0 - 163,0		TIPO / TYPE 10x10mm	°C	1	2	3	86	80	84	0,0			
MATERIALE IN ACCORDO A / MATERIAL IN ACC. TO		TRATTAMENTO TERMICO / HEAT TREATMENT																FORNO / FURNACE	ORIGINE / ORIGIN	
ASTM/ASME A 105/SA 105 M - 11 ASME CODE SECT. II, PART A, ED. 2010		NORMALIZED AT 920 C - COOLED IN STILL AIR																ELECTRIC FURNACE	EUROPE	
CSA Z245.12 GRADE 248 CAT. I																				

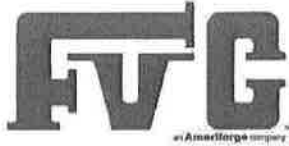
APPROVED TO
ASME SEC. II PART A
2010 ED 11a Addenda
DATE: JUN 26 2012
APPROVED BY: *[Signature]*
MALONEY INDUSTRIES

APPROVED TO
ASME SEC. II PART A
2010 ED
DATE: JUN 26 2012
APPROVED BY: *[Signature]*
MALONEY INDUSTRIES

APPROVED TO
ASME SEC. II PART A
2007 ED 09 addenda
DATE: JUN 26 2012
APPROVED BY: *[Signature]*
MALONEY INDUSTRIES

NOTE MANUFACTURING IN ACCORDANCE WITH ORDER AND SPECIFICATION NOTES MATERIAL IN ACCORDANCE WITH NACE MR-0175/2003 ISO 15156-2009 MATERIAL IN ACCORDANCE WITH NACE MR-0103/2010	UFFICIO CONTROLLO QUALITA' QUALITY CONTROL DEPARTEMENT	ENTE UFFICIALE DI COLLAUDO INSPECTION AUTHORITY	MARCHIO PRODUZIONE MANUFACTURER'S SYMBOL
	<i>[Signature]</i> S. Corti		

N4 BLIND



Material Test Report

FVC Heat Nbr: C959BN

FVC Canada Ltd.

An Ameriforge Group Company

7410A-5 Street S.E. Calgary, Alberta T2H-2L9

ISO 9001:2008 Certified

Sales: (403) 255-9011 Fax: (403) 255-7239

FOREMOST UNIVERSAL 00011761	PO: 150215	Sales Order: C13166	Line: 8
6614 50th AVENUE	Item Code: LWN020300090A004A1		Qty: 2
T9V 2W8 LLOYDMINSTER, AB	Item Desc: LWN, SA350LF2, 300#, 2"x9", RF		
CA	Mill Heat: A130958		
Spec: ASME SA350-LF2-CL1: 2013 Edition			

Element	(%wt)	Ladle	Product	EPCRA	CAS#	Element	(%wt)	Ladle	Product	EPCRA	CAS#
C	Carbon	0.18				B	Boron	0.0002			
Mn	Manganese	1.11		✓	7439-96-5	Ti	Titanium	0.001		✓	7440-02-0
P	Phosphorous	0.009				Al	Aluminum	0.028			
S	Sulphur	0.005				Ca	Calcium	0.0043			
Si	Silicon	0.22				N	Nitrogen	0.0079			
Cu	Copper	0.16		✓	7440-50-8	As	Arsenic	0.005		✓	7440-38-2
Ni	Nickel	0.07		✓	7440-02-0	Sb	Antimony	0.002		✓	7440-36-0
Cr	Chromium	0.10		✓	7440-47-3	CE	C+Mn/6+(Cr+M	0.41			
Mo	Molybdenum	0.02				Cu+Ni+Cr+Mo+V		0.38			
V	Vanadium	0.026				Cr+Mo		0.12			
Cb	Columbium (N	0.001				Cb+V		0.027			
Sn	Tin	0.010									



Mechanical Testing		Heat Treat	
Test Lab	AMF 55085	Heat Treatment	Normalized
BHN (QTC)	143 - 143		
Elg (%)	38.00	Other	
RA (%)	70.00	Country of Origin	USA
Tensile (ksi)	72.869	Manufactured In	USA
Yield (ksi)	47.605	Production Method	EAF
Specimen Orientation	Longitudinal	Fully Killed	YES
Charpy Temp (F)	-50	Reduction Ratio (Mill) x:1	14.9:1
Charpy (ft-lbs)	38 - 118 - 79	Gr.Sz.	6
Avg Energy 3 Specimens (ft-lbs)	78	Made to Fine Grain Practice	YES
Min Energy 1 Specimens (ft-lbs)	38		
Shear (%)	30-50-30		
LatExp (Mils)	30-80-60		

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

Certification No.: 1082496

Certification Date: 10/3/2013

Issued By: Bryun Jantzen

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

Material Test Report

FVC Heat Nbr: C959BN

FVC Canada Ltd.

An Ameriforge Group Company

7410A-5 Street S.E. Calgary, Alberta T2H-2L9

ISO 9001:2008 Certified

Sales: (403) 255-9011 Fax: (403) 255-7239

FOREMOST UNIVERSAL 00011761 6614 50th AVENUE T9V 2W8 LLOYDMINSTER, AB CA	PO: 150215	Sales Order: C13166	Line: 8
	Item Code: LWN020300090A004A1	Qty: 2	
	Item Desc: LWN, SA350LF2, 300#, 2"x9", RF		
	Mill Heat: A130958		
Spec: ASME SA350-LF2-CL1: 2013 Edition			

MATERIAL MEETS ~~NACE MR0175 & MR0103 LATEST EDITIONS~~: Elongation in 2" round specimen.
YIELD STRENGTH MEASURED AT 0.2% OFFSET. $CE=C+(Mn/6)+((Cr+Mo+V)/5)+((Ni+Cu)/15)$,
FVC STANDARD MANUFACTURING PRACTICES:
1) FLANGE DIMENSIONS & BOLTING COMPLY - ASME B16.5.
2) SELF-REINFORCING NOZZLES COMPLY WITH SPECIFICATION OF SECTION VIII DIV. 1 OR DIV. 2 PER CUSTOMER DESIGN/FVC DESIGN.
3) MATERIAL SPECIFICATION COMPLIES WITH ASME SECT. II PART A.
4) ALL FVC MATERIAL MANUFACTURED PER FINE GRAIN PRACTICE.
5) ALL FVC MATERIAL CERTIFIED PER EN 10204 Type 3.1 UNLESS OTHERWISE SPECIFIED.
6) CERTIFICATE OF INSURANCE AVAILABLE UPON REQUEST.
7) PRODUCT FREE OF MERCURY CONTAMINATION.

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

Certification No.: 1082496
Certification Date: 10/3/2013
Issued By: Bryun Jantzen


Bryun Jantzen

RADIOGRAPHY REPORTS

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: No 55953

CLIENT: MALONEY INDUSTRIES

JOB LOCATION: CALGARY, ALBERTA

JOB #: 30789-101

P.O. #: _____ DATE: 2013-10-23

ISOTOPE: IR¹⁹² FILM: GAVERT D4
FILM/CASS: 1 D5
TECH #1 D7
EFSS: 3.5mm± OTHER: _____

CODE: UW51 MATERIAL: CS SS
 UW52
 B31.3 NS SC VEI WING SW EXPOSURE
 OTHER DW

ABBREVIATIONS: (LEGEND)
IF - INCOMPLETE FUSION P - POROSITY BT - BURN THROUGH LC - LOW COVER
IP - INCOMPLETE PENETRATION I - ICICLES C - CRATER CR - CRACK
S - SLAG UC - UNDERCUT HL - HIGH-LOW

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
L-1	0-15											✓			25 1/2	72	24	1 1/2	1 1/2	1	XMAS
	15-30											✓									
	30-45											✓		FM 30							
	45-60					1						✓									
	60-75					2						✓		68 1/2							
	75-90											✓									
	90-105											✓									
	105-120											✓									
L-3	0-15											✓									
	15-30					2						✓		22"							
	30-45											✓									
	45-60											✓									
	60-75					1						✓		FM							
	75-90					2						✓		16 SFD 82 1/2							
	90-105											✓									
	105-120											✓		FM 105							

INSPECTOR: [Signature]

CLIENT REPRESENTATIVE: [Signature] 10/24/13

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
ASNT III
CGSB II T. Grigales #1270

COMMENTS: 16-4 1/2 x 17

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: **No 55947**

CLIENT: MALONEY INDUSTRIES

JOB LOCATION: CALGARY, ALBERTA

JOB #: 30789-101

P.O. #: _____ DATE: 2013-10-21

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51 MATERIAL: CS SS
 UW52
 B31.3 NS SC VEIWING SW EXPOSURE
 OTHER DW

ABBREVIATIONS: (LEGEND)

IF - INCOMPLETE FUSION	P - POROSITY	BT - BURN THROUGH	LC - LOW COVER
IP - INCOMPLETE PENETRATION	I - ICICLES	C - CRATER	CR - CRACK
S - SLAG	UC - UNDERCUT	HL - HIGH-LOW	

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS	
															25 1/2	72	24	1 1/2	1 1/2	1	SX11	
2-2	0-15											✓										
	15-30											✓										
	30-45											✓										
	45-60											✓										
	60-75					1						✓										
	75-90					1						✓		WATER MARK								
	90-105											✓										
	105-120											✓										

INSPECTOR: *[Signature]*

CLIENT REPRESENTATIVE: *[Signature]* 10/22/13

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II

T. GRIGGS # 1270

COMMENTS:
 8-4 1/2 x 17

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: № 55992

CLIENT: MALONEY INDUSTRIES

JOB LOCATION: CALGARY, ALBERTA

JOB #: 30789-101

P.O. #: _____ DATE: 2013-11-04

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51 MATERIAL: CS SS
 UW52
 B31.3 NS SC VEIWING SW EXPOSURE
 OTHER DW

ABBREVIATIONS: (LEGEND)

IF - INCOMPLETE FUSION
 IP - INCOMPLETE PENETRATION
 S - SLAG

P - POROSITY
 I - ICICLES
 UC - UNDERCUT

BT - BURN THROUGH
 C - CRATER
 HL - HIGH-LOW

LC - LOW COVER
 CR - CRACK

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
															37 1/2	72	36	1 1/2	1 1/2	1	X.M.
C-1	0-15				1							✓		FM 6-7							
	15-30				1							✓									
	30-45											✓									
	45-60											✓									
	60-75			2								✓		67 3/4							
	75-90											✓									
	90-105											✓		FM 97 1/2-100							
	105-120				2							✓		110							
	120-135											✓									
	135-150											✓									
	150-165											✓									
	165-180											✓									
	180-195				1							✓		190							
	195-210				1							✓		197 1/4							
	210-225				2							✓		215 3/4							
	225-236				1							✓									

INSPECTOR: 

CLIENT REPRESENTATIVE: VL 11/5/13

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II

TIGRIBROS #1270

COMMENTS:
16-4 1/2 x 17

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: **No 55993**

CLIENT: **MALONEY INDUSTRIES**

JOB LOCATION: **CALGARY, ALBERTA**

JOB #: **30789-101**

P.O. #: _____ DATE: **2013-11-04**

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51
 UW52
 B31.3 NS SC
 OTHER
 MATERIAL: CS SS
 VEIWING: SW EXPOSURE
 DW

ABBREVIATIONS: (LEGEND)

IF - INCOMPLETE FUSION
 IP - INCOMPLETE PENETRATION
 S - SLAG

P - POROSITY
 I - ICICLES
 UC - UNDERCUT

BT - BURN THROUGH
 C - CRATER
 HL - HIGH-LOW

LC - LOW COVER
 CR - CRACK

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
C-2	0-15											✓			37 1/2	72	36	1 1/2	1 1/2	1	X.M.
	15-30			2								✓		24							
	30-45											✓									
	45-60			2								✓		45 3/4							
	60-75			1								✓									
	75-90											✓									
	90-105											✓									
	105-120											✓		Fm.							
	120-135											✓									
	135-150											✓		Fm 134							
	150-165						2					✓		155							
	165-180											✓									
	180-195			2								✓		185							
	195-210			1								✓									
	210-225											✓		Fm							
	225-236			1								✓									

INSPECTOR: 

CLIENT REPRESENTATIVE: 

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II T. GRIBER # 1270

COMMENTS: **16-4 1/2 x 17**

SPECTRUM NDT LTD.
Radiographic Inspection Report

RR #: **No 55997**

CLIENT: MALONEY INDUSTRIES

JOB LOCATION: CALGARY, ALBERTA

JOB #: 30789-101

P.O. #: _____ DATE: 2013-11-06

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51 MATERIAL: CS SS
 UW52
 B31.3 NS SC VEIWING SW EXPOSURE
 OTHER DW

ABBREVIATIONS: (LEGEND)
 IF - INCOMPLETE FUSION P - POROSITY BT - BURN THROUGH LC - LOW COVER
 IP - INCOMPLETE PENETRATION I - ICICLES C - CRATER CR - CRACK
 S - SLAG UC - UNDERCUT HL - HIGH-LOW

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
															37 1/2	72	36	1 1/2	1 1/2	1	X.M.
C3	0-15											✓									
	15-30											✓									
	30-45											✓									
	45-60											✓									
	60-75											✓									
	75-90											✓									
	90-105					1						✓		FM 90							
	105-120					1	1					✓									
	120-135					1						✓									
	135-150											✓		FM							
	150-165											✓									
	165-180											✓									
	180-195											✓		FM							
	195-210											✓									
	210-225											✓									
	225-238											✓									

INSPECTOR: [Signature]

CLIENT REPRESENTATIVE: M 11/7/13

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II T. GRIGES # 1270

COMMENTS: 16-4 1/2 x 17

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: **No 56032**

CLIENT: **MALONEY INDUSTRIES**

JOB LOCATION: **CALGARY, ALBERTA**

JOB #: **30789-101**

P.O. #: _____ DATE: **2013-11-26**

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51 MATERIAL: CS SS
 UW52
 B31.3 NS SC VEIHING SW EXPOSURE
 OTHER DW

ABBREVIATIONS: (LEGEND)
 IF - INCOMPLETE FUSION P - POROSITY BT - BURN THROUGH LC - LOW COVER
 IP - INCOMPLETE PENETRATION I - ICICLES C - CRATER CR - CRACK
 S - SLAG UC - UNDERCUT HL - HIGH-LOW

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS	
															31/2	72	36	1 1/2	1 1/2	1	XC	
C4	0-15				1	1						<input checked="" type="checkbox"/>										
	15-30											<input checked="" type="checkbox"/>										
	30-45			X	1								X	30 1/2								
	45-60						X						X	Int UCe 55-59								
	60-75				1							<input checked="" type="checkbox"/>		FM-								
	75-90				1							<input checked="" type="checkbox"/>										
	90-105							1		1		<input checked="" type="checkbox"/>										
	105-120											<input checked="" type="checkbox"/>										
	120-135							1				<input checked="" type="checkbox"/>										
	135-150						X						X	Int UCe 145								
	150-165						X						X	Int UCe 160-74								
	165-180			X									X	Se 179-180								
	180-195											<input checked="" type="checkbox"/>										
	195-210				1	1						<input checked="" type="checkbox"/>										
	210-225				2	2						<input checked="" type="checkbox"/>	X	St Pe 213-214								
	225-236											<input checked="" type="checkbox"/>										

INSPECTOR:

CLIENT REPRESENTATIVE: 11/27/13

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II

T. GRIGGS # 1270

COMMENTS:
 16-4 1/2 x 17

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: **No 56034**

CLIENT: **MALONEY INDUSTRIES**

JOB LOCATION: **CALGARY, ALBERTA**

JOB #: **30789-101**

P.O. #: _____ DATE: **2013-11-27**

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51
 UW52
 B31.3 NS SC
 OTHER
 MATERIAL: CS SS
 VEIWING: SW EXPOSURE
 DW

ABBREVIATIONS: (LEGEND)

- | | | | |
|-----------------------------|---------------|-------------------|----------------|
| IF - INCOMPLETE FUSION | P - POROSITY | BT - BURN THROUGH | LC - LOW COVER |
| IP - INCOMPLETE PENETRATION | I - ICICLES | C - CRATER | CR - CRACK |
| S - SLAG | UC - UNDERCUT | HL - HIGH-LOW | |

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
C4R1	30 1/2											<input checked="" type="checkbox"/>			37 1/2	72	36	1 1/2	1 1/2	1	8
	55-59											<input checked="" type="checkbox"/>									
	145											<input checked="" type="checkbox"/>									
	160 3/4											<input checked="" type="checkbox"/>									
	179-180											<input checked="" type="checkbox"/>									
	213-214											<input checked="" type="checkbox"/>									

INSPECTOR: TAB

CLIENT REPRESENTATIVE: [Signature] 11/28/13

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II

T. GRIGGS #1270

COMMENTS: 6-4 1/2 x 17

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: No 56088

CLIENT: MALONEY INDUSTRIES

JOB LOCATION: CALGARY, ALBERTA

JOB #: 30789-101 PWHT

P.O. #: _____ DATE: 2013-12-23

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51 MATERIAL: CS SS
 UW52
 B31.3 NS SC VEIHING SW EXPOSURE
 OTHER DW

ABBREVIATIONS: (LEGEND)
 IF - INCOMPLETE FUSION
 IP - INCOMPLETE PENETRATION
 S - SLAG

P - POROSITY
 I - ICICLES
 UC - UNDERCUT

BT - BURN THROUGH
 C - CRATER
 HL - HIGH-LOW

LC - LOW COVER
 CR - CRACK

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
C-1	0-15											<input checked="" type="checkbox"/>			37 1/2	72	36	1 1/2	1 1/2	1	
	15-30											<input checked="" type="checkbox"/>									
	30-45											<input checked="" type="checkbox"/>									
	45-60											<input checked="" type="checkbox"/>									
	60-75											<input checked="" type="checkbox"/>									
	75-90											<input checked="" type="checkbox"/>									
	90-105											<input checked="" type="checkbox"/>									
	105-120											<input checked="" type="checkbox"/>									
	120-135											<input checked="" type="checkbox"/>									
	135-150					I	I					<input checked="" type="checkbox"/>		144							
	150-165											<input checked="" type="checkbox"/>									
	165-180											<input checked="" type="checkbox"/>		FM 165							
	180-195											<input checked="" type="checkbox"/>									
	195-210											<input checked="" type="checkbox"/>									
	210-225											<input checked="" type="checkbox"/>		FM 210							
	225-236											<input checked="" type="checkbox"/>									
L-1	0-15											<input checked="" type="checkbox"/>			25 1/2	72	24	1 1/2	1 1/2	1	
	15-30											<input checked="" type="checkbox"/>									
	30-45											<input checked="" type="checkbox"/>									
	45-60											<input checked="" type="checkbox"/>									
	60-75											<input checked="" type="checkbox"/>									
	75-90											<input checked="" type="checkbox"/>		fm 76							
	90-105											<input checked="" type="checkbox"/>									
	105-120					I						<input checked="" type="checkbox"/>									

INSPECTOR: T.G. Ricles

CLIENT REPRESENTATIVE: [Signature] 12/24/13

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II T.G. Ricles #1270

COMMENTS: 24-4 1/2 x 17, ONE HOUR IN POSITION

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #:
No 56089

CLIENT: **MALONEY INDUSTRIES**

JOB LOCATION: **CALGARY, ALBERTA**

JOB #: **30789-101 PWHT**

P.O. #: _____ DATE: **2013-12-30**

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51 MATERIAL: CS SS
 UW52
 B31.3 NS SC VEIWIWG SW EXPOSURE
 OTHER DW

ABBREVIATIONS: (LEGEND)
 IF - INCOMPLETE FUSION P - POROSITY BT - BURN THROUGH LC - LOW COVER
 IP - INCOMPLETE PENETRATION I - ICICLES C - CRATER CR - CRACK
 S - SLAG UC - UNDERCUT HL - HIGH-LOW

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
C-2	0-15											<input checked="" type="checkbox"/>			37 1/2	72	36	1 1/2	1 1/2	1	XM
	15-30											<input checked="" type="checkbox"/>									
	30-45											<input checked="" type="checkbox"/>									
	45-60			1								<input checked="" type="checkbox"/>		46							
	60-75											<input checked="" type="checkbox"/>									
	75-90											<input checked="" type="checkbox"/>									
	90-105											<input checked="" type="checkbox"/>		Fm 96 1/2-97							
	105-120											<input checked="" type="checkbox"/>									
	120-135			1								<input checked="" type="checkbox"/>		125							
	135-150											<input checked="" type="checkbox"/>									
	150-165											<input checked="" type="checkbox"/>		Fm							
	165-180											<input checked="" type="checkbox"/>									
	180-195											<input checked="" type="checkbox"/>									
	195-210			1								<input checked="" type="checkbox"/>		203							
	210-225											<input checked="" type="checkbox"/>									
	225-236			1								<input checked="" type="checkbox"/>		231							
L-2	0-15				1							<input checked="" type="checkbox"/>			25 1/2	72	24	1 1/2	1 1/2	1	SXM
	15-30											<input checked="" type="checkbox"/>									
	30-45											<input checked="" type="checkbox"/>									
	45-60											<input checked="" type="checkbox"/>									
	60-75											<input checked="" type="checkbox"/>		Fme 60							
	75-90				1							<input checked="" type="checkbox"/>		79"							
	90-105											<input checked="" type="checkbox"/>		Fme 90-91							
	105-120				1							<input checked="" type="checkbox"/>									

INSPECTOR: **T.G.**

CLIENT REPRESENTATIVE: **W 1/2/14**

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II

T. GRIGORIS # 1270

COMMENTS: **24-4 1/2 x 17, ONE HOUR IN POSITION.**

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: No 56090

CLIENT: MALONEY INDUSTRIES

JOB LOCATION: CALGARY, ALBERTA

JOB #: 30789-101 PWHT

P.O. #: _____ DATE: 2014-01-02

ISOTOPE: IR¹⁹² FILM: GAVERT D4
 FILM/CASS: 1 D5
 TECH #1 D7
 EFSS: 3.5mm± OTHER: _____

CODE: UW51 MATERIAL: CS SS
 UW52
 B31.3 NS SC VEIWING SW EXPOSURE
 OTHER DW

ABBREVIATIONS: (LEGEND)
 IF - INCOMPLETE FUSION
 IP - INCOMPLETE PENETRATION
 S - SLAG

P - POROSITY
 I - ICICLES
 UC - UNDERCUT

BT - BURN THROUGH
 C - CRATER
 HL - HIGH-LOW

LC - LOW COVER
 CR - CRACK

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
C-3	0-15											✓			31 1/2	72	36	1 1/2	1 1/2	1	XM
	15-30											✓									
	30-45											✓									
	45-60											✓									
	60-75											✓									
	75-90											✓									
	90-105											✓									
	105-120												✓								
	120-135												✓								
	135-150												✓								
	150-165												✓								
165-180						1	1					✓		17 1/4							
180-195												✓									
195-210												✓									
210-225												✓									
225-236												✓		Fm							
L-3	0-15											✓			25 1/2	72	24	1 1/2	1 1/2	1	SMX
	15-30											✓									
	30-45											✓									
	45-60											✓									
	60-75											✓									
	75-90											✓									
	90-105											✓									
105-120												✓									

INSPECTOR: [Signature]

CLIENT REPRESENTATIVE: [Signature] 1/3/14

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
 ASNT III
 CGSB II T. GRIGGS # 1270

COMMENTS: ONE HOUR 24-4 1/2 x 17, IN POSITION

SPECTRUM NDT LTD.

Radiographic Inspection Report

RR #: **Nº 56091**

CLIENT: **MALONEY INDUSTRIES**

JOB LOCATION: **CALGARY, ALBERTA**

JOB #: **30789-101 PWHT**

P.O. #: _____ DATE: **2014-01-02**

ISOTOPE: IR¹⁹² FILM: GAVERT D4
FILM/CASS: 1 D5
TECH #1 D7
EFSS: 3.5mm± OTHER: _____

CODE: UW51
UW52
B31.3 NS SC
OTHER
MATERIAL: CS SS
VEIWING SW EXPOSURE
 DW

ABBREVIATIONS: (LEGEND)

IF - INCOMPLETE FUSION
IP - INCOMPLETE PENETRATION
S - SLAG

P - POROSITY
I - ICICLES
UC - UNDERCUT

BT - BURN THROUGH
C - CRATER
HL - HIGH-LOW

LC - LOW COVER
CR - CRACK

FILM NO.	LOCATION	IF	IP	S	P	I	UC	BT	C	LC	CR	OK	REJ	REMARKS	SFD	DIA.	SOD	MSSOFD	THICK	# EXP	WS
															37 1/2	72	36	1 1/2	1 1/2	1	XC
*C4	0-15				1	1															
	15-30																				
	30-45																				
	45-60				1																
	60-75																				
	75-90				1																
	90-105																				
	105-120																				
	120-135																				
	135-150				2									138 1/2							
	150-165																				
	165-180				1																
	180-195																				
	195-210				1									FM							
	210-225																				
	225-236																				

*: FILM PLACEMENT OBSTRUCTED BY INSULATION RING

INSPECTOR: TRG

CLIENT REPRESENTATIVE: [Signature] 1/3/14

FINAL INTERPRETATION OF RADIOGRAPHS SHALL BE THE RESPONSIBILITY OF THE CLIENT OR THEIR REPRESENTATIVE.

ASNT II
ASNT III
CGSB II

T. GRIGGS # 1270

COMMENTS: 16-4 1/2 x 17

ULTRASONIC REPORTS



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

Client FOREMOST/ MALONEY		JOB # SER #	13-030789-101 N/A	Report # Work Sheet #	141426 31712	
Address Calgary, Alberta		Requested by Mr. P. Correia		Demo # Procedure#	1018 UP4 Rev. 1	
Work Description Inspection of Category 'D' welds			Code ASME V Art.4	Acceptance criteria ASME VIII Div.1, App.12		
Material / Thickness Carbon Steel, 1.6"	Surface Condition As Ground Flush		Temperature 18 Deg. C.	Surface Preparation Buff Grinding		
Instrument GE	Model USN 58L	Serial # 020L7T		Calibration Std IIW Block-A14827		
Sensitivity 1/8" Diameter SDH set at 80% FSH DAC			Couplant UT-X	Inspector K. Han		
Search Unit	Serial Number	Size	Ref Sensitivity	Scan Sensitivity		
0 Deg. 2.25 Mhz GAMMA	022877	1.0" Diameter	BWE 80%	+6 dB		
70 Deg. 2.25 Mhz GE	SE1058	.5" Diameter	80% FSH DAC	+ 6 dB		
60 Deg. 2.25 Mhz GE	SE1058	.5" Diameter	80% FSH DAC	+ 6 dB		
45 Deg. 2.25 Mhz GE	SE1058	.5" Diameter	80% FSH DAC	+ 6 dB		
Identification		Description			Result	
M1		Inspected from outside, Cat. 'D' nozzle weld.			- REJECTABLE -	
Ind #	Depth (inch)	Length (inch)	Amplitude (dB)	Probe(s)	Remarks	Classification
1	1	1/2	+6	45	LF	C
2	3/4	1/4	-6	60	SL	B
3	3/4	1/4	-8	60	SL	B
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication						
CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.						
CLIENT 	INSPECTOR 		LEVEL CGSB L2 #16012 / ASNT L3 #148347		DATE Nov 13, 2013	



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

Client MALONEY INDUSTRIES		Job # 13-030789	Report # 32844			
Address CALGARY; ALBERTA		Requested by Mr. A. JAMES	Work Sheet # 49280			
Work Description INSPECTION OF CAT. D WELDMENTS		Acceptance Criteria ASME VIII DIV. 1 APP 12	Demo # 1018			
Material CARBON STEEL	Surface GOOD	Thickness 1.5"	Procedure# UP4 REV1			
Instrument GE	Model USN 58L	Serial # 02240X	Code ASME V ART 4			
Sensitivity 1/8" DIA HOLE SET AT 80% FSH + 6db		Couplant EXOSEN	Scanning Surface OD			
Calibration Std IIW BLOCK-996262		Inspector A. DACHY				
Search Unit	Serial Number	Size	Ref Sensitivity			
45 Deg 4 mHz SSW	C4468	8 X 9 mm	48 dB			
60 Deg 4 mHz SSW	C3570	8 X 9 mm	50 dB			
70 Deg 4 mHz SSW	B7880	8 X 9 mm	55 dB			
0 Deg 5 mHz Long	02217X	1/2" Dia	75 % BWE			
Scan Sensitivity						
			+ 6 Db			
			+ 6 dB			
			+ 6 dB			
			+ 6 dB			
Identification		Description	Remarks			
M1R1		REPAIR AREA	ACCEPTED			
Ind #	Depth (Inch)	Length (Inch)	Amplitude (dB's)	Probe(s)	Remarks	Classification
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication						
CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.						
CLIENT 	INSPECTOR 	LEVEL CGSB II # 14261 / SNT II	DATE NOV 13, 2013			



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

Client FOREMOST UNIVERSAL L P		Job # 030789	Report # 158349 Rev1
Address CALGARY AB.		SER #	Work Sheet # 54150
Requested by MR. A JAMES			Demo # 1018
			Procedure# UP4 REV 1
Work Description U/T NOZZLES BEFORE POST WELD HEAT TREATMENT		Acceptance Criteria APP 12	Code ASME V & VIII DIV I
Material CARBON STEEL	Surface SMOOTH	Size 1.5" NOM.	Scanning Surface OUTER
Instrument GENERAL ELECTRIC	Model USN 58L	Serial # 02456T	Calibration Std 11W BLOCK
Sensitivity 1/8" HOLE AT 80% DAC		Couplant UT-X	Inspectors K GOWLER
Search Unit	Serial Number	Size	Ref Sensitivity
45DEG	50192	8X9 MM	51 DB
60 DEG	51674	8X9 MM	48 DB
0 DEG	ODFIV5	.250 "	75% BWE
			Scan Sensitivity
			+6db
			+6db
			0
Identification	Description	Remarks	
N-3	NO REJECTABLE INDICATIONS	ACCEPTABLE	
N-6B	NO-REJECTABLE INDICATIONS	ACCEPTABLE	
N-5B	NO-REJECTABLE INDICATIONS	ACCEPTABLE	
NOTE:			
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication			
Reg Hrs 1	OTX1 Hrs	OTX2 Hrs	Consumables
CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.			
CLIENT 	INSPECTOR 	LEVEL CGSB LEVEL II 1259 SNT LEVEL II	DATE NOV 28 2013



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

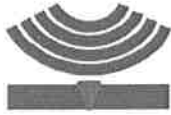
Client FOREMOST UNIVERSAL L P		Job # 030789		Report # 158356	
		SER #		Work Sheet # 54152	
Address CALGARY AB.		Requested by MR. A JAMES		Demo # 1018	
				Procedure# UP4 REV 1	
Work Description U/T NOZZLES BEFORE POST WELD HEAT TREATMENT			Acceptance Criteria APP 12		Code ASME V & VIII DIV I
Material CARBON STEEL		Surface SMOOTH		Size 1.5" NOM.	
Instrument GENERAL ELECTRIC		Model USN 58L		Serial # 02456T	
Sensitivity 1/8" HOLE AT 80% DAC		Couplant UT-X		Calibration Std 11W BLOCK	
				Inspectors K GOWLER	
Search Unit		Serial Number		Ref Sensitivity	
45DEG		50192		51 DB	
60 DEG		51674		48 DB	
0 DEG		ODF1V5		75% BWE	
		Size		Scan Sensitivity	
		8X9 MM		+6db	
		8X9 MM		+6db	
		.250 "		0	
Identification		Description			Remarks
N-2		NO REJECTABLE INDICATIONS			ACCEPTABLE
N-6A		NO-REJECTABLE INDICATIONS			ACCEPTABLE
N-1		NO-REJECTABLE INDICATIONS			ACCEPTABLE
N-5A		NO-REJECTABLE INDICATIONS			ACCEPTABLE
NOTE:					
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication					
Reg Hrs 1.5		OTX1 Hrs		OTX2 Hrs	
				Consumables	
CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.					
CLIENT 		INSPECTOR 		LEVEL CGSB LEVEL II 1259 SNT LEVEL II	
				DATE DEC 2 2013	



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

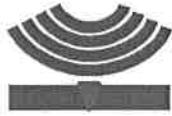
Client FOREMOST UNIVERSAL L P		Job # SER #	13-030789	Report # Work Sheet #	158361Rev 1 54155
Address CALGARY AB.		Requested by MR. A JAMES		Demo # Procedure#	1018 UP4 REV 1
Work Description U/T NOZZLES BEFORE POST WELD HEAT TREATMENT			Acceptance Criteria APP 12	Code ASME V & VIII DIV I	
Material CARBON STEEL	Surface SMOOTH		Size 1.5" NOM.	Scanning Surface OUTER	
Instrument GENERAL ELECTRIC	Model USN 58L		Serial # 02456T	Calibration Std 11W BLOCK	
Sensitivity 1/8" HOLE AT 80% DAC			Couplant UT-X	Inspectors K GOWLER	
Search Unit	Serial Number	Size	Ref Sensitivity	Scan Sensitivity	
45DEG	50192	8X9 MM	51 DB	+6db	
60 DEG	51674	8X9 MM	48 DB	+6db	
0 DEG	ODF1V5	.250 "	75% BWE	0	
Identification	Description		Remarks		
N-4	NO REJECTABLE INDICATIONS		ACCEPTABLE		
N-5C	NO REJECTABLE INDICATIONS		ACCEPTABLE		
NOTE:					
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication					
Reg Hrs 1	OTX1 Hrs	OTX2 Hrs	Consumables		
CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.					
CLIENT 	INSPECTOR 	LEVEL CGSB LEVEL II 1259 SNT LEVEL II	DATE DEC 5 2013		



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

Client FOREMOST Universal LP		JOB # 13-030789-101	Report # 141482			
Address Calgary, Alberta		SER # PWHT	Work Sheet # 31741	Demo # 1018		
Requested by Mr. P. Correia		Procedure# UP4 Rev. 1				
Work Description Inspection of Category 'D' welds after PWHT		Code ASME V Art.4	Acceptance criteria ASME VIII Div.1, App.12			
Material / Thickness Carbon Steel, 1.5"	Surface Condition As Ground Flush	Temperature 16 Deg. C.	Surface Preparation Buff Grinding			
Instrument GE	Model USN 58L	Serial # 020L7T	Calibration Std IIW Block-A14827			
Sensitivity 1/8" Diameter SDH set at 80% FSH DAC		Couplant UT-X	Inspector K. Han			
Search Unit	Serial Number	Size	Ref Sensitivity	Scan Sensitivity		
0 Deg. 2.25 Mhz GAMMA	022877	1.0" Diameter	BWE 80%	+6 dB		
70 Deg. 2.25 Mhz GE	SE1058	.5" Diameter	80% FSH DAC	+ 6 dB		
60 Deg. 2.25 Mhz GE	SE1058	.5" Diameter	80% FSH DAC	+ 6 dB		
45 Deg. 2.25 Mhz GE	SE1058	.5" Diameter	80% FSH DAC	+ 6 dB		
Identification	Description		Result			
M1, N1, N2, N3, N4, N5A, N5B, N5C, N6A, N6B	Inspected from outside, Cat. 'D' nozzle welds.		- ACCEPTABLE -			
Ind #	Depth (inch)	Length (inch)	Amplitude (dB)	Probe(s)	Remarks	Classification
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication						
CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.						
CLIENT <i>P.L.H.</i>	INSPECTOR <i>K.D. Han</i>		LEVEL CGSB L2 #16012 ASNT L3 #148347		DATE Dec 19, 2013	



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

Client FOREMOST / MALONEY		JOB # SER #	13-030789-101 N/A	Report # Work Sheet #	141331 31682	
Address Calgary, Alberta		Requested by Mr. P. Correia		Demo # Procedure#	1018 UP4 Rev. 1	
Work Description Inspection of Pressure Vessel			Code ASME V./ SA-578	Acceptance criteria Level B		
Material / Thickness Carbon Steel / 1.5"	Surface Condition As rolled	Temperature 18 °C		Surface Preparation Wipe		
Instrument GE	Model USN 58L	Serial # 020L7T	Calibration Std IIW Block-A14827			
Sensitivity B1 echo set at 80% FSH DAC		Couplant UT-X		Inspector K. Han		
Search Unit	Serial Number	Size	Ref Sensitivity	Scan Sensitivity		
0 Deg. 2.25 Mhz GAMMA	022877	1.0" Diameter	BWE 80%	+6 dB		
Identification		Description		Result		
C1, PID 13087		Inspected along 4" grid lines.		- ACCEPTABLE -		
C3, PID 13089		Inspected along 4" grid lines.		- ACCEPTABLE -		
Ind #	Depth (inch)	Length (inch)	Amplitude (dB)	Probe(s)	Remarks	Classification
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.						
CLIENT 	INSPECTOR 		LEVEL CGSB L2 #16012 ASNT L3 #148347	DATE Oct 9, 2013		



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

Client FOREMOST / MALONEY		JOB # SER #	13-030789-101 N/A	Report # Work Sheet #	141306 31677		
Address Calgary, Alberta		Requested by Mr. P. Correia		Demo # Procedure#	1018 UP4 Rev. 1		
Work Description Inspection of Pressure Vessel			Code ASME V./ SA-578	Acceptance criteria Level B			
Material / Thickness Carbon Steel / 1.5"	Surface Condition As rolled		Temperature 18 °C	Surface Preparation Grinding			
Instrument GE	Model USN 58L	Serial # 020L7T		Calibration Std IIW Block-A14827			
Sensitivity B1 echo set at 80% FSH DAC			Couplant UT-X	Inspector K. Han			
Search Unit	Serial Number	Size	Ref Sensitivity	Scan Sensitivity			
0 Deg. 2.25 Mhz GAMMA	022877	1.0" Diameter	BWE 80%	+6 dB			
Identification		Description			Result		
13-030789-101 C2 PID 13081		Inspected along 4" grid lines.			- ACCEPTABLE -		
Ind #		Depth (inch)	Length (inch)	Amplitude (dB)	Probe(s)	Remarks	Classification
<p>A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.</p>							
CLIENT <i>P. Correia</i>		INSPECTOR <i>K. D. Han</i>		LEVEL CGSB L2 #16012 ASNT L3 #148347		DATE Oct 4, 2013	

MAGNETIC PARTICLE INSPECTION REPORTS



SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client FOREMOST	Job # 13-030789-101	Report # 153717
	Req # or PO #	Work Sheet # 50266
Address CALGARY, ALBERTA	Requested by QC. DEPT.	Demo # 1017
		Procedure # MP2 REV4
Work Description INSPECTION OF ALL INTERNAL FINAL WELDS, ATTACHMENT WELDS, TEMPORARY ATTACHMENTS, ARC STRIKES, GROUND AREAS AND NOZZLE CAT D WELDS.	Material CARBON STEEL	Surface AS WELDED
Code ASME	Acceptance Criteria SECT VIII DIV1 APP6	Ambient Temp 16 DEG C
Technique CONTINUOUS MAGNETISM	Equipment/Serial # HAND YOKE / 21608	Power AC 110 V
Particle type MI-GLO 778	Batch # 16772	Particle Size 6 Um AVG.
Light Source Spectroline SB-100PX SN# 1718343	Light intensity 3100 MW/CM ²	Inspection surface ALL SURFACES
		Inspector S. Taffs / K.Gowler

Identification	Description	Comments
VESSEL # 13-030789-101	Inspected all internal final welds, nozzle cat D welds, ground areas, arc strikes, attachment welds and temporary attachments	2 indications found at time of inspection. -REJECTED-

Ind No	Position	Length	Remarks

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT <i>[Signature]</i>	INSPECTOR <i>[Signature]</i>	LEVEL CGSB II # 1259 / SNT II	DATE Dec. 11, 2013
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SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client FOREMOST	Job # 13-030789-101	Report # 153720
Address CALGARY, ALBERTA	Requested by QC. DEPT.	Work Sheet # 50267
Work Description INSPECTION OF INTERNAL VESSEL AFTER REPAIRS. (REF. REPORT 153717)	Material CARBON STEEL	Surface AS WELDED
Code ASME	Acceptance Criteria SECT VIII DIV1 APP6	Ambient Temp 16 DEG C
Technique CONTINUOUS MAGNETISM	Equipment/Serial # HAND YOKE / 21608	Power AC 110 V
Particle type MI-GLO 778	Batch # 16772	Particle Size 6 Um AVG.
Light Source Spectroline SB-100PX SN# 1718343	Light intensity 3100 MW/CM ²	Inspection surface INTERNAL
		Inspector S. Taffs / S. Foote

Identification	Description	Comments
VESSEL # 13-030789-101	Inspected repairs to internal vessel. (X2)	No indications remain at time of inspection. -ACCEPTABLE-

Ind No	Position	Length	Remarks

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.			
CLIENT 	INSPECTOR 	LEVEL CGSB II # 1259 / SNT II	DATE Dec. 12, 2013



SPECTRUM N.D.T. LTD

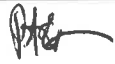

MAGNETIC PARTICLE TEST REPORT

Client FOREMOST	Job # 13-030789-101	Report # 153721	Work Sheet # 50267
Address CALGARY, ALBERTA	Requested by Q.C. DEPT.		Demo # 1014
			Procedure # MP2 REV4
	Work Description INSPECTION OF ALL EXTERNAL VESSEL FINAL WELDS, NOZZLE CAT. D AND CAT. C WELDS, LIFTING LUGS, ATTACHMENT WELDS, TEMPORARY ATTACHMENTS, GROUND AREAS AND ARC STRIKES BEFORE PWHT.		Material CARBON STEEL	Surface AS WELDED
Code ASME	Acceptance Criteria SECT VIII DIV1 APP6	Ambient Temp 16 DEG C	Background / Batch WCP2 / 13H19K / 02458
Technique CONTINUOUS MAGNETISM	Equipment/Serial # HAND YOKE / 21608	Power AC 110 V	Lifting Capability Check 10 LB OK
Particle type MI-GLOW 820	Batch # 17381	Particle Size <20 Um AVG.	Particle Manufacture CIRCLE SYSTEMS
Light Source GE 12V AUTO BULB	Light intensity 1100 LUX	Inspection surface ALL SURFACES	Inspector S. Taffs / S. Foote

Identification	Description	Comments
Vessel # 13-030789-101	Inspected all external vessel final welds, lift lugs and attachment welds	Multiple rounded and linear indications found at time of inspection and marked on vessel. -REJECTED-
	Inspected all external vessel ground areas, arc strikes, temporary attachments	Multiple rounded and linear indications found at time of inspection and marked on vessel. -REJECTED-

Ind No	Position	Length	Remarks

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT 	INSPECTOR 	LEVEL CGSB II # 1259 / SNT II	DATE Dec. 12, 2013
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SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client FOREMOST		Job # 13-030789-101	Report # 153726
Address CALGARY, ALBERTA		Req # or PO #	Work Sheet # 50268
Requested by Q.C. DEPT.		Demo # 1014	Procedure # MP2 REV4
Work Description INSPECTION OF ALL EXTERNAL REPAIRS TO VESSEL FINAL WELDS, NOZZLE CAT. D AND CAT. C WELDS, LIFTING LUGS, ATTACHMENT WELDS, TEMPORARY ATTACHMENTS, GROUND AREAS AND ARC STRIKES BEFORE PWHT.		Material CARBON STEEL	Surface AS WELDED
Code ASME	Acceptance Criteria SECT VIII DIV1 APP6	Ambient Temp 16 DEG C	Background / Batch WCP2 / 13H19K / 02460
Technique CONTINUOUS MAGNETISM	Equipment/Serial # HAND YOKE / 21608	Power AC 110 V	Lifting Capability Check 10 LB OK
Particle type MI-GLOW 820	Batch # 17381	Particle Size <20 Um AVG.	Particle Manufacture CIRCLE SYSTEMS
Light Source GE 12V AUTO BULB	Light intensity 1100 LUX	Inspection surface ALL SURFACES	Inspector S. Taffs / S. Foote
Identification		Description	Comments
Vessel # 13-030789-101		Inspected all external vessel final welds, lift lugs and attachment welds	All indications repaired at time of inspection. No indications remain. -ACCEPTABLE-
		Inspected all external vessel ground areas, arc strikes, temporary attachments	All indications repaired at time of inspection. No indications remain. -ACCEPTABLE-
Ind No	Position	Length	Remarks
CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.			
CLIENT 	INSPECTOR 	LEVEL CGSB II # 1259 / SNT II	DATE Dec. 13, 2013



SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client FOREMOST	Job #	13-030789-101	Report #	153761
	Req # or PO #		Work Sheet #	50275
Address CALGARY, ALBERTA	Requested by QC. DEPT.		Demo #	1017
			Procedure #	MP2 REV4
Work Description INSPECTION OF ALL INTERNAL FINAL WELDS, ATTACHMENT WELDS, TEMPORARY ATTACHMENTS, ARC STRIKES, GROUND AREAS AND NOZZLE CAT D WELDS AFTER PWHT.			Material CARBON STEEL	Surface AS WELDED
Code ASME	Acceptance Criteria SECT VIII DIV1 APP6	Ambient Temp 16 DEG C	Background / Batch N/A	
Technique CONTINUOUS MAGNETISM	Equipment/Serial # HAND YOKE / 21608	Power AC 110 V	Lifting Capability Check 10 LB OK	
Particle type MI-GLO 778	Batch # 16772	Particle Size 6 Um AVG.	Particle Manufacture CIRCLE SYSTEMS INCORPORATED	
Light Source Spectroline SB-100PX SN# 1718343	Light intensity 3100 MW/CM ²	Inspection surface ALL SURFACES	Inspector S. Taffs / S. Foote	

Identification	Description	Comments
VESSEL # 13-030789-101	Inspected all internal final welds, nozzle cat D welds, ground areas, arc strikes, attachment welds and temporary attachments	No indications found at time of inspection. -ACCEPTABLE-

Ind No	Position	Length	Remarks

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT <i>P. Chen</i>	INSPECTOR 	LEVEL CGSB II # 1259 / SNT II	DATE Dec. 19, 2013
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SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client FOREMOST	Job #	13-030789-101	Report #	153760
	Req # or PO #		Work Sheet #	50275
Address CALGARY, ALBERTA	Requested by Q.C. DEPT.		Demo #	1014
			Procedure #	MP2 REV4
Work Description INSPECTION OF ALL EXTERNAL VESSEL FINAL WELDS, NOZZLE CAT. D AND CAT. C WELDS, LIFTING LUGS, ATTACHMENT WELDS, TEMPORARY ATTACHMENTS, GROUND AREAS AND ARC STRIKES AFTER PWHT.			Material CARBON STEEL	Surface AS WELDED
Code ASME	Acceptance Criteria SECT VIII DIV1 APP6	Ambient Temp 16 DEG C	Background / Batch WCP2 / 13H19K / 02269	
Technique CONTINUOUS MAGNETISM	Equipment/Serial # HAND YOKE / 21608	Power AC 110 V	Lifting Capability Check 10 LB OK	
Particle type MI-GLOW 820	Batch # 17381	Particle Size <20 Um AVG.	Particle Manufacture CIRCLE SYSTEMS	
Light Source GE 12V AUTO BULB	Light intensity 1100 LUX	Inspection surface ALL SURFACES	Inspector S. Taffs / S. Foote	

Identification	Description	Comments
Vessel # 13-030789-101	Inspected all external vessel final welds, lift lugs and attachment welds	No indications found at time of inspection. -ACCEPTABLE-
	Inspected all external vessel ground areas, arc strikes, temporary attachments	No indications found at time of inspection. -ACCEPTABLE-

Ind No	Position	Length	Remarks

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR	LEVEL	DATE
<i>[Signature]</i>	<i>[Signature]</i>	CGSB II # 1259 / SNT II	Dec. 19, 2013

PRODUCTION IMPACT TEST REPORT



LUDWIG

LABORATORY TEST REPORT

CUSTOMER: Foremost Universal LP
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C13-1521.1
Date: November 13, 2013
P.O. No.: PO-152314

Attention: Philip Correia

Work Order No.: 13-030789-101 (Date welded: October 23, 2013 - Long seams)
Description: For longs and circs. except closing circ.
WPS Number: MI-GSS-4 (SMAW / SAW)
Material: SA 516 Gr. 70N (Heat Code.: PID 13089)
Thickness: 1.5 in.
Thermal Condition: PWHT @ 1150 °F for 105 minutes

Governing Specification: ASME Section VIII, Div. 1, UG-84 - 2010 edition and latest addenda.

CHARPY V-NOTCH IMPACT TEST

Machine: Satec, SI-1C SN:1363 **Specimen Size:** 10 x 10 mm (0.394 x 0.394 in.)
Capacity: 325 J (240 ft-lbf) **Orientation:** Transverse
Verified Range: 1.7 - 260 J (1.3 - 192 ft-lbf) **Test Temp.:** -40 °C (-40 °F)

Specimen Number	Notch Location	Impact Values	
		Joules	(ft-lbf)
F2.1	Weld Metal within 1/16 in. of surface	148	(109)
F2.2		66	(49)
F2.3		140	(103)
F3.1	HAZ	81	(60)
F3.2		58	(43)
F3.3		57	(42)

Note: Joules values calculated by direct conversion from ft-lbf.

Laboratory Test Conducted In Calgary By: Xin (Vincent) Su, T.T.

Laboratory Test Certified By: 
Dan Nguyen, C.E.T.

L-A-B Accredited Certificate Number L2057-1 Testing

This report (or certificate) is issued by the Company under its General Conditions for Inspection and Testing Services (copy available upon request). The issuance of this report (or certificate) does not exonerate buyers or sellers from exercising all their rights and discharging all their liabilities under the Contract of Sale. Stipulations to the contrary are not binding on the Company. The Company's responsibility under this report (or certificate) is limited to proven negligence and will in no case be more than ten times the amount of the fees or commission. Except by special arrangement, samples, if drawn, will not be retained by the Company for more than 30 days. The information stated in this report (or certificate) is derived from the results of inspection or testing procedures carried out in accordance with the instructions of our Client, and/or our assessment of such results on the basis of any technical standards, trade custom or practice, or other circumstances which should in our professional opinion be taken into account.

LABORATORY TEST REPORT

CUSTOMER: Foremost Universal LP
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C13-1633.1
Date: December 5, 2013
P.O. No.: PO-153509

Attention: Philip Correia

Work Order No.: 13-030789-101 / 13-030625-101 (Date welded: November 26, 2013) - *closing circ*
WPS Number: MI-GSS-4 (SMAW / SAW)
Material: SA 516 Gr. 70N (Heat Code.: PID 13089)
Thickness: 1.500 in.
Thermal Condition: PWHT @ 1150 °F for 105 minutes

Governing Specification: ASME Section VIII, Div. 1, UG-84 - 2010 edition and latest addenda.

CHARPY V-NOTCH IMPACT TEST

Machine: Satec, SI-1C SN:1363 **Specimen Size:** 10 x 10 mm (0.394 x 0.394 in.)
Capacity: 325 J (240 ft-lbf) **Orientation:** Transverse
Verified Range: 1.7 - 260 J (1.3 - 192 ft-lbf) **Test Temp.:** -40 °C (-40 °F)

Specimen Number	Notch Location	Impact Values	
		Joules	(ft-lbf)
T2.1	Weld Metal within 1.5 mm (1/16 in.) of surface	164	(121)
T2.2		174	(128)
T2.3		199	(147)
T3.1	HAZ	104	(77)
T3.2	HAZ	66	(49)
T3.3	HAZ	85	(63)

Note: Joules values calculated by direct conversion from ft-lbf.

Laboratory Test Conducted In Calgary By: Xin (Vincent) Su, T.T.

Laboratory Test Certified By:  L-A-B Accredited Certificate Number L2057-1 Testing
Dan Nguyen, C.E.T.

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HYDROSTATIC REPORTS

FOREMOST UNIVERSAL LP

HYDROSTATIC/PNEUMATIC TEST REPORT

DATE: January 6th 2014 DRAWING/WORK ORDER NUMBER: 13 - 030625 - 101, 13 - 030789 - 101

CUSTOMER: Suncor Energy c/o Equinox Engineering Ltd.

VESSEL TYPE-OR PIPING: Slug Catcher

TEST PRESSURE: 956 PSI 6591 KPA

TEST MEDIUM: WATER HOLDING TIME: 1 HOUR

TRANSMITTER PRESSURE RANGE: 0 - 3000psi CHART RECORDER NUMBER: 12748

TEST TEMPERATURE: 86 ° F 30 ° C

GAUGE NUMBERS USED: 0329, 0359, 0431, 0431 FLANGE RATING PIPING ONLY: N/A

LIST ITEMS TESTED BELOW

13 - 030625 - 101,

13 - 030789 - 101

THIS REPORT IS TO VERIFY THAT THE COMPONENTS LISTED ABOVE HAVE SATISFACTORILY PASSED A



HYDROSTATIC TEST



PNEUMATIC TEST

AND COMPLIES WITH ALL REQUIRED CODES, SPECIFICATIONS AND PROCEDURES.

CUSTOMER REPRESENTATIVE: _____ DATE: _____

FULP QC REPRESENTATIVE: Mc _____ DATE: January 6th 2014

OTHER SIGNATURES: _____ DATE: _____

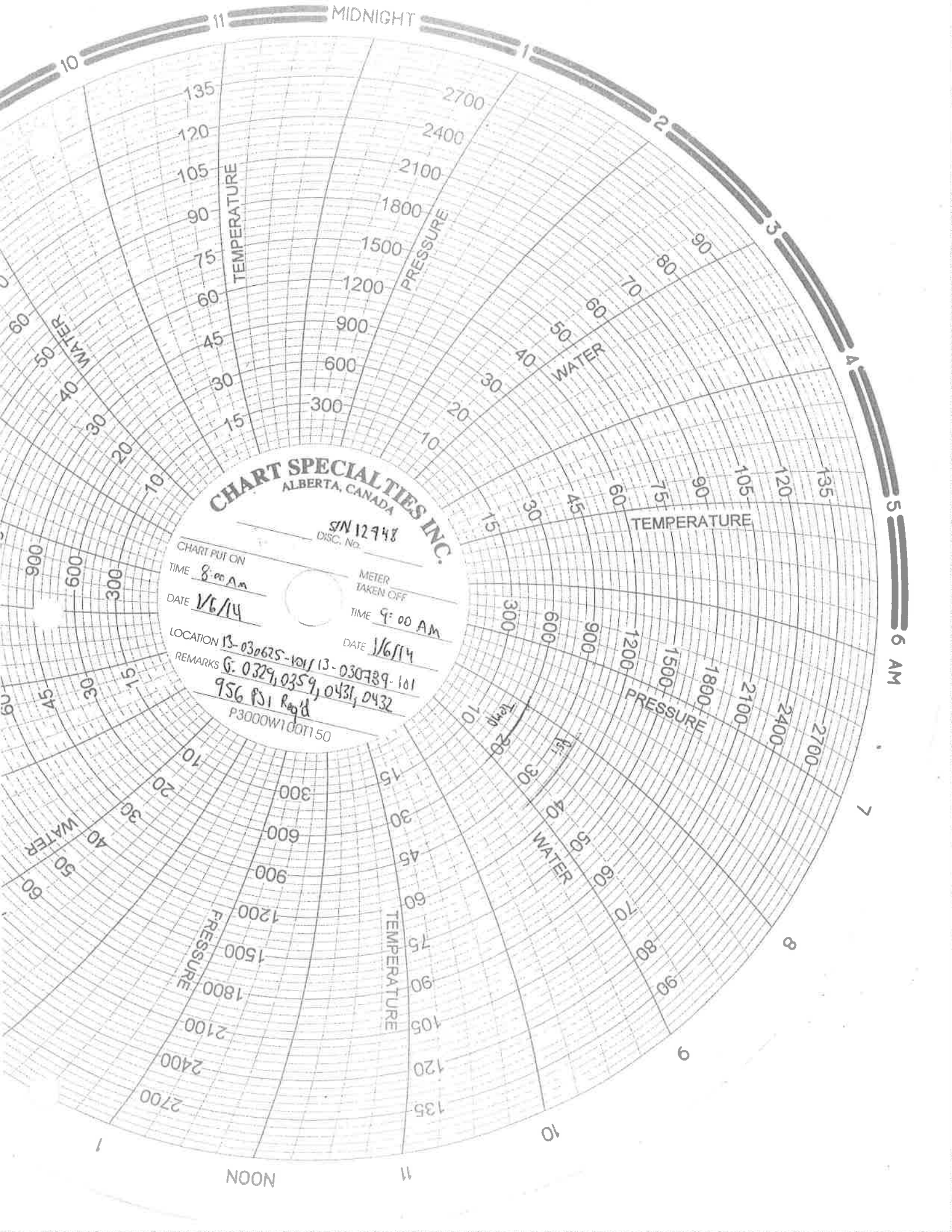


CHART SPECIALTIES INC.
 ALBERTA, CANADA

S/N 12948
 DISC. No.

CHART PUT ON
 TIME 8:00 AM

METER
 TAKEN OFF
 TIME 9:00 AM

DATE 1/6/14

DATE 1/6/14

LOCATION 13-030625-101/13-030789-101

REMARKS G. 0329, 0359, 0431, 0432
 956 PSI Reg'd

P3000W100T150

NOON

11

5 6 AM

7

8

9

10

1

POST WELD HEAT TREATMENT

FOREMOST UNIVERSAL L.P.
HEAT TREATMENT INSTRUCTION FORM

Customer: Suncor Energy Date: December 17th 2013
Serial Number: 13 - 030625 -101 Item Title: Slug Catcher
Drawing Number: 030625 - D101 Revision Number: 3

Diameter: 1829mm (72"ID) Length: 9144mm (30'-0") Weight: 49604lbs
Shell Thickness: 1.500" Material: SA-516-70N
Head Thickness: 1.480"min Material: SA-516-70N
Miscellaneous Thickness: 0.375" - saddle weir plate Material: SA-516-70N
Type of Heat Treatment: Stress Relieving

Program Number: 6 Starting Gas Reading _____ Ending Gas Reading _____

- Temperature to be raised to 800° F at a maximum rate.
- Temperature is to be raised from 800 °F to 1150 °F at a maximum rate of 225 °F per hour.
(Calculated rate = 400°F/hour divided by the governing metal thickness.)
Note: The heating rate must not exceed 400°F per hour.
- Temperature is to be held at 1150 °F, + 50 °F, - 50 °F for 1Hr 45min Hour/s . Minutes
- Temperature to be lowered from 1150 °F to 800 °F at a maximum rate of 285 °F Per hour.
(Calculated rate = 500°F/hour divided by the governing thickness.)
Note: The cooling rate must not exceed 500°F per hour.
- Below 800°F cool in still air.
- Additional Comments


Signature:  Title: Quality Control Inspector Date: Dec 16 2013

This heat treatment procedure conforms to the requirements of ASME Section VIII, Division 1 or ASME B31.3

Additional Items Placed in the Oven: Manway Blind x2
13 - 030789 -101

** See ADDITIONAL REQUIREMENTS for Thermocouple Installation and Location.

YOKOGAWA μ R 180
Model: 4179
Serial No.: T4176PF928
Calibrated: August 15, 2013
Due for Re-calibration: February 15, 2014

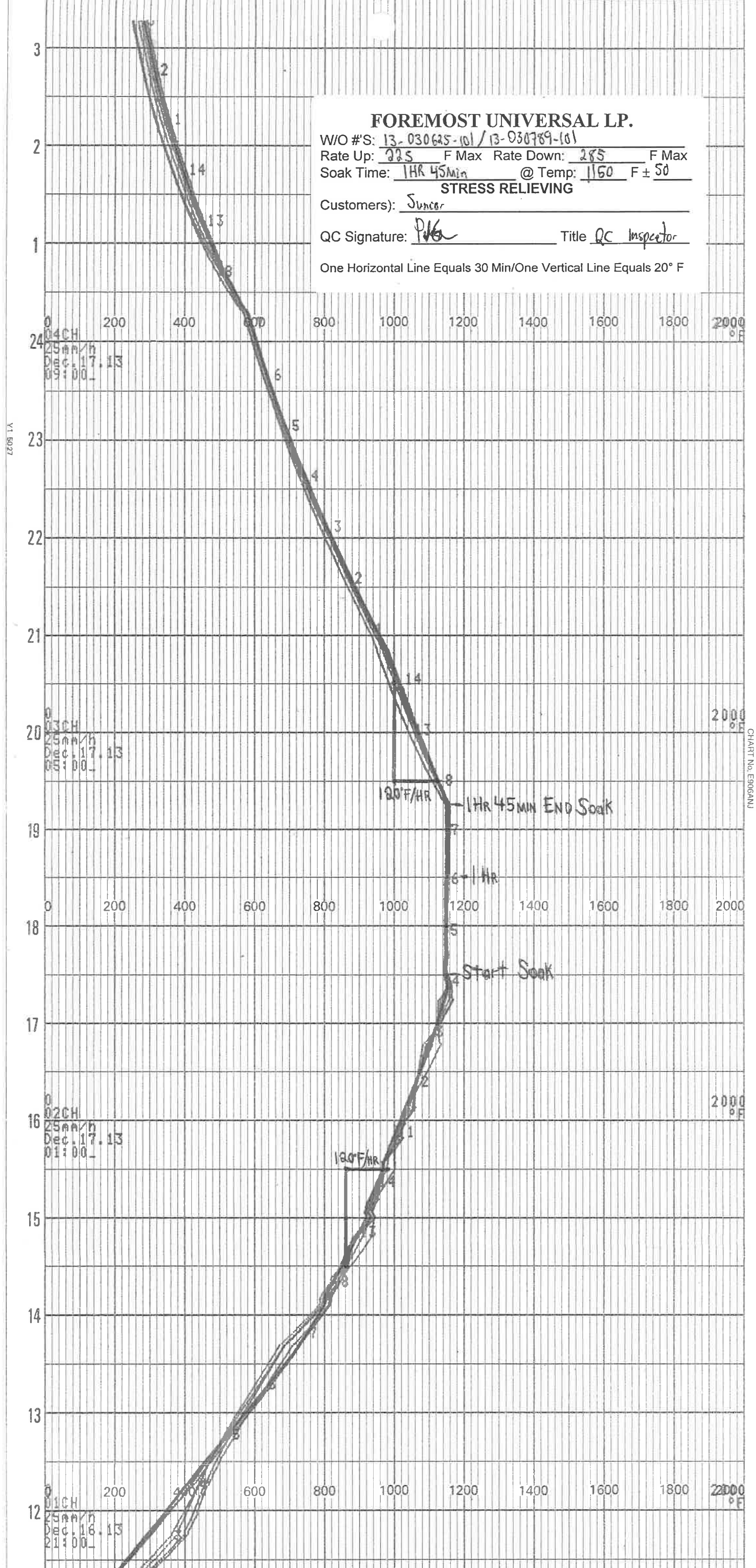


Dec 17 '13

CHART RECORDER CALIBRATION DETAILS OPERATORS SIGNATURE DATE OF HEAT TREATMENT
BY SIGNING THE ABOVE THE OPERATOR IS ACKNOWLEDGING THAT THE THERMOCOUPLES ARE ATTACHED
AS REQUIRED AND THAT ALL COMPONENTS THAT ARE IN THE OVEN ARE INCLUDED ON THIS FORM

ADDITIONAL REQUIREMENTS:

- Job number and description required on heat treatment charts along with the operator's signature & date.
- Reporting of thermocouple attachment method and location, and verification of furnace thermocouple calibration is required.
- Thermocouples are to be attached directly to the piece by the capacitor discharge flash contact method. The thermocouple reference point is to be fully insulated from the direct heat.
- Thermocouples shall be located as follows: where one or more pressure vessel assemblies and / or pressure vessel parts and / or piping are to be Post Weld Heat Treated in one (1) furnace charge the thermocouples shall be placed on the vessel on each head, on the shell and / or pipe at each end as well as one in the centre, (i.e. at the bottom left, at the centre and at the top right, or in the other zones of possible temperature variation so that the temperature indicated shall be true for all the vessels and / or parts in the zones unless additional locations have been specified by the client. A minimum of three (3) thermocouples shall be used per load.
- During the heating period, there shall not be a greater variation in temperature throughout the portion of the vessel being heated than 250°F (139°C) within any 15 FT. (4.6m) interval of length. An adequate number of thermocouples must be used to ensure this code requirement is met. This limitation is also applicable to the temperature variations between the different thicknesses of various vessel components.
- During the holding period, there shall not be greater difference than 150°F (83°C) between the highest and lowest temperature throughout the portion of the vessel being heat treated, except where the range is further limited by these instructions.
- The method of thermocouple removal shall not damage the heat-treated item.



FOREMOST UNIVERSAL LP.

W/O #S: 13-030625-101 / 13-030789-101
 Rate Up: 225 F Max Rate Down: 285 F Max
 Soak Time: 1HR 45Min @ Temp: 1150 F ± 50

STRESS RELIEVING

Customers): Suncor

QC Signature: [Signature] Title QC Inspector

One Horizontal Line Equals 30 Min/One Vertical Line Equals 20° F

04CH
25mm/h
Dec. 17. 13
09:00

03CH
25mm/h
Dec. 17. 13
05:00

02CH
25mm/h
Dec. 17. 13
01:00

01CH
25mm/h
Dec. 16. 13
21:00

FOREMOST UNIVERSAL LP
 Stress Relief Operator Verification

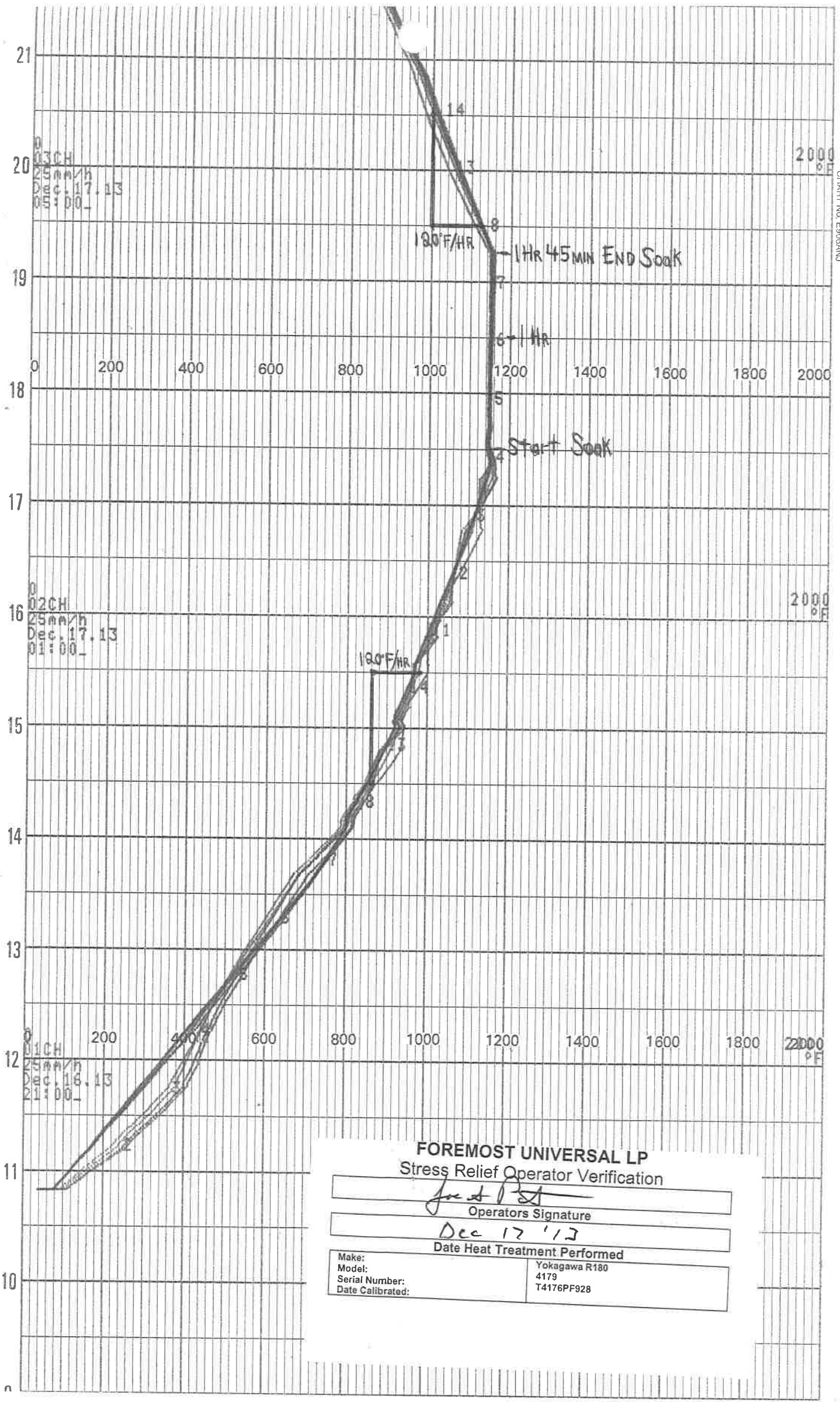
[Signature]
 Operators Signature

Y1 5027

Y1 5027

CHART No. E806AN1

Y1 5027



FOREMOST UNIVERSAL LP
Stress Relief Operator Verification

[Signature]
Operators Signature

Dec 17 '13
Date Heat Treatment Performed

Make:	Yokagawa R180
Model:	4179
Serial Number:	T4176PF928
Date Calibrated:	

CHART No. E906ANU

CALCULATIONS

FOREMOST

VESSEL CALCULATION PACKAGE

FOR

VESSEL: Slug Catcher
TAG:
WORK ORDER NO.: 030625
CUSTOMER: Suncor Energy c/o Equinox
DRAWING NO.: 030789-D101 Sheet 1 & 2
DOCUMENT NO.: 030789-D101-VC

Calculations Reviewed And Are In Accordance With

ASME Sec. VIII Div. 1 Edition 2010 Addendum 2011a

PERFORMED BY:


(Signature)

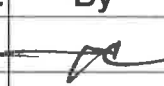
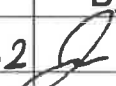
2013 Oct 2
(Date)

APPROVED BY:


(Signature)

Oct 2/13
(Date)

DESIGN CALCULATION REVISION BLOCK

Rev. No.	Description	Accomp. Dwg. Rev.	Performed By	Date	Approved By	Date
0	IFC.	0/0		013-10-2		Oct 2/13

FOREMOST

VESSEL CALCULATION PACKAGE

FOR

VESSEL: Slug Catcher
TAG:
WORK ORDER NO.: 030625
CUSTOMER: Suncor Energy c/o Equinox
DRAWING NO.: 030625-D101 Sheet 1 / 2
DOCUMENT NO.: 030625-D101-VC

Calculations Reviewed And Are In Accordance With

ASME Sec. VIII Div. 1 Edition 2010 Addendum 2011a

PERFORMED BY:

(Signature)

(Date)

APPROVED BY:

(Signature)

(Date)

DESIGN CALCULATION REVISION BLOCK

Rev. No.	Description	Accomp. Dwg. Rev.	Performed By	Date	Approved By	Date
0	Issued for Construction	0/0	[Signature]	013.9.17	[Signature]	Sept 2013

COPY OF ORIGINAL DOCUMENT

Reference for W/O 030789

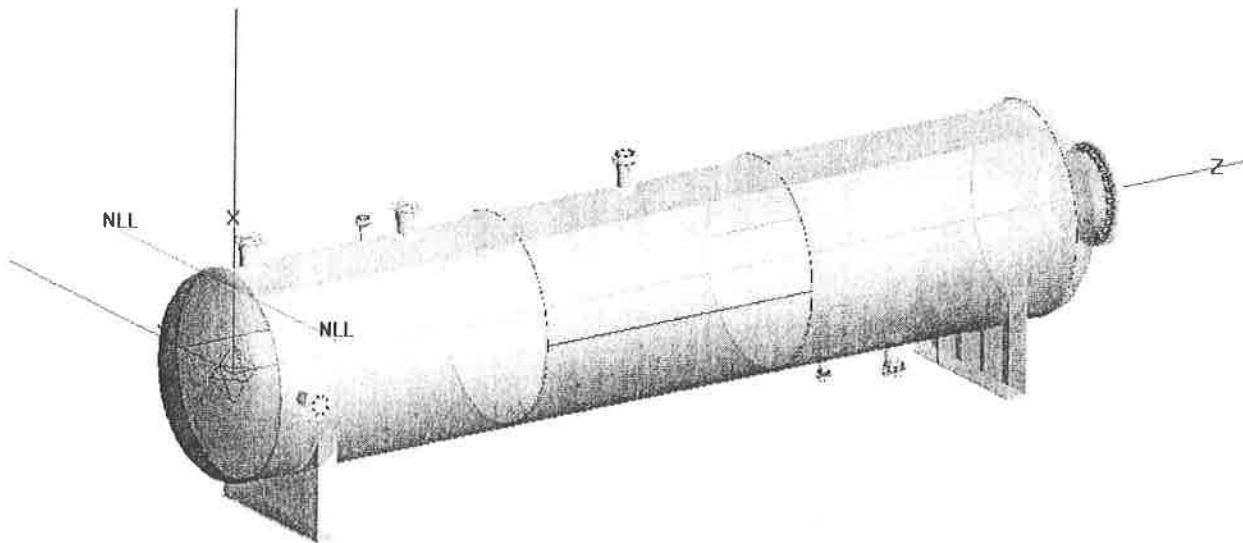
Issued by: [Signature] Date: 2013 Oct 2

Foremost Universal LP

8825 Shepard Rd.,S.E.

Calgary, AB. T2C 4N9

Canada



COMPRESS Pressure Vessel Design Calculations

Item: Inlet Slug Catcher
Vessel No: V-
Customer: Suncor Energy c/o Equinox Engineering
Contract: Liquid Handling Upgrades C-97-G/94-B-9, Kobes BC
Designer: E Cheung

Vessel is on a 3-Degree Slope w/ the Manway at the Low End. MAEWP is limited to 104 KPa @ DT by Design; MAWP is limited to 5070 KPaG @ DT w/ Maximum Operating Hydrostatic Pressure by Head Minimum Specified Thickness; Vessel is Shop Hydrostatically Tested to MAWP X 1.3.

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15. Saddles

Settings Summary

COMPRESS 2013 Build 7320

Units: SI

Datum Line Location: 50.00 mm from right seam

Design

ASME Section VIII Division 1, 2010 Edition, A11 Addenda Metric

Design or Rating:	Get Thickness from Pressure
Minimum thickness:	1.5 mm 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:	100 mm
Juncture calculations for $\alpha > 30$ only:	Yes
Preheat P-No 1 Materials $> 1.25"$ and $\leq 1.50"$ thick:	Yes
UG-37(a) shell tr calculation considers longitudinal stress:	No

Butt welds are tapered per Figure UCS-66.3(a).

Hydro/Pneumatic Test

Shop Hydrotest Pressure: 1.3 times vessel MAWP
 Test liquid specific gravity: 1.00
 Maximum stress during test: 90% of yield

Required Marking - UG-116

UG-116(e) Radiography: RT1
 UG-116(f) Postweld heat treatment: HT

Code Cases\Interpretations

Use Code Case 2547: No
 Apply interpretation VIII-1-83-66: No
 Apply interpretation VIII-1-86-175: No
 Apply interpretation VIII-1-01-37: No
 No UCS-66.1 MDMT reduction: No
 No UCS-68(c) MDMT reduction: No
 Disallow UG-20(f) exemptions: No

UG-22 Loadings

UG-22(a) Internal or External Design Pressure :	Yes
UG-22(b) Weight of the vessel and normal contents under operating or test conditions:	Yes
UG-22(c) Superimposed static reactions from weight of attached equipment (external loads):	No
UG-22(d)(2) Vessel supports such as lugs, rings, skirts, saddles and legs:	Yes
UG-22(f) Wind reactions:	Yes
UG-22(f) Seismic reactions:	Yes
UG-22(j) Test pressure and coincident static head acting during the test:	Yes

Note: UG-22(b),(c) and (f) loads only considered when supports are present.

Thickness Summary

Component Identifier	Material	Diameter (mm)	Length (mm)	Nominal t (mm)	Design t (mm)	Total Corrosion (mm)	Joint E	Load
<u>Ellipsoidal Head</u>	SA-516 70	1,829 ID	494.75	37.5*	37	3.2	1.00	Internal
<u>Straight Flange on Ellipsoidal Head</u>	SA-516 70	1,829 ID	50	37.8	37.8	3.2	1.00	Internal
<u>Cylinder #3</u>	SA-516 70	1,829 ID	3,048	38.1	37.8	3.2	1.00	Internal
<u>Cylinder #2</u>	SA-516 70	1,829 ID	3,048	38.1	37.8	3.2	1.00	Internal
<u>Cylinder #1</u>	SA-516 70	1,829 ID	3,048	38.1	37.8	3.2	1.00	Internal
<u>Straight Flange on Ellipsoidal Head @ Datum End</u>	SA-516 70	1,829 ID	50	37.8	37.8	3.2	1.00	Internal
<u>Ellipsoidal Head @ Datum End</u>	SA-516 70	1,829 ID	494.75	37.5*	37	3.2	1.00	Internal

Nominal t: Vessel wall nominal thickness

Design t: Required vessel thickness due to governing loading + corrosion

Joint E: Longitudinal seam joint efficiency

* Head minimum thickness after forming

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

Nozzle Schedule

Nozzle mark	Service	Size	Materials		Impact Tested	Normalized	Fine Grain	Flange	Blind
<u>M</u>	DN600/NPS24 Manway	752.35 OD x 71.37	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 24 Class 300 HB A350 LF2 Cl.1	NPS 24 Class 300 A350 LF2 Cl.1
<u>N1</u>	DN150/NPS6 Inlet	238.25 OD x 45.97	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 6 Class 300 HB A350 LF2 Cl.1	No
<u>N2</u>	DN150/NPS6 Vapour Outlet	238.25 OD x 45.97	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 6 Class 300 HB A350 LF2 Cl.1	No
<u>N3</u>	DN100/NPS4 Liquid Outlet	168.15 OD x 35.43	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 4 Class 300 HB A350 LF2 Cl.1	No
<u>N4</u>	DN100/NPS4 Spare	168.15 OD x 35.43	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 4 Class 300 HB A350 LF2 Cl.1	NPS 4 Class 300 A350 LF2 Cl.1
<u>N5a</u>	DN100/NPS4 Equalization	168.15 OD x 35.43	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 4 Class 300 HB A350 LF2 Cl.1	NPS 4 Class 300 A350 LF2 Cl.1
<u>N5b</u>	DN100/NPS4 Equalization	168.15 OD x 35.43	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 4 Class 300 HB A350 LF2 Cl.1	NPS 4 Class 300 A350 LF2 Cl.1
<u>N5c</u>	DN100/NPS4 Equalization	168.15 OD x 35.43	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 4 Class 300 HB A350 LF2 Cl.1	NPS 4 Class 300 A350 LF2 Cl.1
<u>N6a</u>	DN50/NPS2 Hot Water	84.07 OD x 16.64	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 2 Class 300 LWN A350 LF2 Cl.1	NPS 2 Class 300 A350 LF2 Cl.1
<u>N6b</u>	DN50/NPS2 Hot Water	84.07 OD x 16.64	Nozzle	SA-350 LF2 Cl 1	No	No	No	NPS 2 Class 300 LWN A350 LF2 Cl.1	NPS 2 Class 300 A350 LF2 Cl.1

Pressure Summary

Pressure Summary for Chamber bounded by Ellipsoidal Head @ Datum End and Ellipsoidal Head

Identifier	P Design (kPa)	T Design (°C)	MAWP (kPa)	MAEP (kPa)	T _e external (°C)	MDMT (°C)	MDMT Exemption	Impact Tested
<u>Ellipsoidal Head</u>	5,070	38	5,145.59	2,262.33	38	-40	Note 1	Yes
<u>Straight Flange on Ellipsoidal Head</u>	5,070	38	5,071.02	1,382.54	38	-40	Note 2	Yes
<u>Cylinder #3</u>	5,070	38	5,114.15	1,411.2	38	-40.5	Note 3	Yes
<u>Cylinder #2</u>	5,070	38	5,114.15	1,411.2	38	-40.5	Note 3	Yes
<u>Cylinder #1</u>	5,070	38	5,114.15	1,411.2	38	-40.5	Note 3	Yes
<u>Straight Flange on Ellipsoidal Head @ Datum End</u>	5,070	38	5,071.02	1,382.54	38	-40	Note 2	Yes
<u>Ellipsoidal Head @ Datum End</u>	5,070	38	5,145.59	2,262.33	38	-40	Note 4	Yes
<u>Saddles</u>	5,070	38	5,070	N/A	N/A	N/A	N/A	N/A
<u>DN600/NPS24 Manway (M)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN150/NPS6 Inlet (N1)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN150/NPS6 Vapour Outlet (N2)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN100/NPS4 Liquid Outlet (N3)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN100/NPS4 Spare (N4)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN100/NPS4 Equalization (N5a)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN100/NPS4 Equalization (N5b)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN100/NPS4 Equalization (N5c)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN50/NPS2 Hot Water (N6a)</u>	5,070	38	5,070	104	38	-48	Note 5	No
<u>DN50/NPS2 Hot Water (N6b)</u>	5,070	38	5,070	104	38	-48	Note 5	No

Chamber design MDMT is -40 °C

Chamber rated MDMT is -40 °C @ 5,070 kPa

Chamber MAWP hot & corroded is 5,070 kPa @ 38 °C

Chamber MAEP is 104 kPa @ 38 °C

Vacuum rings did not govern the external pressure rating.

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.

Notes for MDMT Rating:

Note	Exemption	Details
------	-----------	---------

#		
1.	<u>Straight Flange</u> governs MDMT	
2.	Material is impact tested per UG-84 to -40 °C	UCS-66(i) reduction of 0 °C applied (ratio = 0.9998).
3.	Material is impact tested per UG-84 to -40 °C	UCS-66(i) reduction of 0.5 °C applied (ratio = 0.9912).
4.	<u>Straight Flange</u> governs MDMT	
5.	Flange rating governs: Flange rated MDMT = -49 °C (Flange impact tested to -49°C (UCS-66(g))) Bolts rated MDMT per Fig UCS-66 note (c) = -48 °C	UG-84 provisions apply

Design notes are available on the [Settings Summary](#) page.

Hydrostatic Test

Shop test pressure determination for Chamber bounded by Ellipsoidal Head @ Datum End and Ellipsoidal Head based on MAWP per UG-99(b)

Shop hydrostatic test gauge pressure is 6,591 kPa at 4 °C (the chamber MAWP = 5,070 kPa)

The shop test is performed with the vessel in the horizontal position.

Identifier	Local test pressure kPa	Test liquid static head kPa	UG-99 (b) stress ratio	UG-99 (b) pressure factor	Stress during test MPa	Allowable test stress MPa	Stress excessive?
Ellipsoidal Head (1)	6,611.74	20.74	1	1.30	145.115	235.8	No
Straight Flange on Ellipsoidal Head	6,611.74	20.74	1	1.30	163.242	235.8	No
Cylinder #3	6,611.74	20.74	1	1.30	161.983	235.8	No
Cylinder #2	6,611.74	20.74	1	1.30	161.983	235.8	No
Cylinder #1	6,611.74	20.74	1	1.30	161.983	235.8	No
Straight Flange on Ellipsoidal Head @ Datum End	6,611.74	20.74	1	1.30	163.242	235.8	No
Ellipsoidal Head @ Datum End	6,611.74	20.74	1	1.30	145.115	235.8	No
DN100/NPS4 Equalization (N5a)	6,593.45	2.45	1	1.30	173.86	351	No
DN100/NPS4 Equalization (N5b)	6,614.57	23.57	1	1.30	174.417	351	No
DN100/NPS4 Equalization (N5c)	6,614.57	23.57	1	1.30	174.417	351	No
DN100/NPS4 Liquid Outlet (N3)	6,614.57	23.57	1	1.30	174.417	351	No
DN100/NPS4 Spare (N4)	6,603.26	12.26	1	1.30	174.058	351	No
DN150/NPS6 Inlet (N1)	6,593.45	2.45	1	1.30	173.139	351	No
DN150/NPS6 Vapour Outlet (N2)	6,593.45	2.45	1	1.30	173.139	351	No
DN50/NPS2 Hot Water (N6a)	6,593.45	2.45	1	1.30	176.576	351	No
DN50/NPS2 Hot Water (N6b)	6,613.88	22.88	1	1.30	177.123	351	No
DN600/NPS24 Manway (M)	6,605.77	14.77	1	1.30	166.532	351	No

Notes:

- (1) Ellipsoidal Head limits the UG-99(b) stress ratio.
- (2) P_L stresses at nozzle openings have been estimated using the method described in PVP-Vol. 399, pages 77-82.
- (3) $1.5 \cdot 0.9 \cdot S_y$ used as the basis for the maximum local primary membrane stress at the nozzle intersection P_L .
- (4) The zero degree angular position is assumed to be up, and the test liquid height is assumed to the top-most flange.

The field test condition has not been investigated for the Chamber bounded by Ellipsoidal Head @ Datum End and Ellipsoidal Head.

The test temperature of 4 °C is warmer than the minimum recommended temperature of -23 °C so the brittle fracture provision of UG-99(h) has been met.

Corroded Hydrostatic Test

The shop test condition has not been investigated for the Chamber bounded by Ellipsoidal Head @ Datum End and Ellipsoidal Head.

Field test pressure determination for Chamber bounded by Ellipsoidal Head @ Datum End and Ellipsoidal Head based on design P per UG-99(b)

Field hydrostatic test gauge pressure is 6,591 kPa at 4 °C (the chamber design P = 5,070 kPa)

The field test is performed with the vessel in the horizontal position.

Identifier	Local test pressure kPa	Test liquid static head kPa	UG-99 (b) stress ratio	UG-99 (b) pressure factor	Stress during test MPa	Allowable test stress MPa	Stress excessive?
Ellipsoidal Head (1)	6,611.78	20.78	1	1.30	159.211	235.8	No
Straight Flange on Ellipsoidal Head	6,611.78	20.78	1	1.30	178.653	235.8	No
Cylinder #3	6,611.78	20.78	1	1.30	177.145	235.8	No
Cylinder #2	6,611.78	20.78	1	1.30	177.145	235.8	No
Cylinder #1	6,611.78	20.78	1	1.30	177.145	235.8	No
Straight Flange on Ellipsoidal Head @ Datum End	6,611.78	20.78	1	1.30	178.653	235.8	No
Ellipsoidal Head @ Datum End	6,611.78	20.78	1	1.30	159.211	235.8	No
DN100/NPS4 Equalization (N5a)	6,593.45	2.45	1	1.30	192.612	351	No
DN100/NPS4 Equalization (N5b)	6,614.57	23.57	1	1.30	193.229	351	No
DN100/NPS4 Equalization (N5c)	6,614.57	23.57	1	1.30	193.229	351	No
DN100/NPS4 Liquid Outlet (N3)	6,614.57	23.57	1	1.30	193.229	351	No
DN100/NPS4 Spare (N4)	6,603.29	12.29	1	1.30	192.828	351	No
DN150/NPS6 Inlet (N1)	6,593.45	2.45	1	1.30	190.777	351	No
DN150/NPS6 Vapour Outlet (N2)	6,593.45	2.45	1	1.30	190.777	351	No
DN50/NPS2 Hot Water (N6a)	6,593.45	2.45	1	1.30	196.934	351	No
DN50/NPS2 Hot Water (N6b)	6,613.88	22.88	1	1.30	197.545	351	No
DN600/NPS24 Manway (M)	6,605.8	14.8	1	1.30	184.543	351	No

Notes:

- (1) Ellipsoidal Head limits the UG-99(b) stress ratio.
- (2) P_L stresses at nozzle openings have been estimated using the method described in PVP-Vol. 399, pages 77-82.
- (3) $1.5 \times 0.9 \times S_y$ used as the basis for the maximum local primary membrane stress at the nozzle intersection P_L .
- (4) The zero degree angular position is assumed to be up, and the test liquid height is assumed to the top-most flange.

Weight Summary

Component	Weight (kg) Contributed by Vessel Elements									
	Metal New*	Metal Corroded*	Insulation	Insulation Supports	Lining	Piping + Liquid	Operating Liquid		Test Liquid	
							New	Corroded	New	Corroded
Ellipsoidal Head	1,147.1	1,054	43.5	50	0	0	967.5	980.1	980	993.2
Cylinder #3	5,320.7	4,882.2	183.4	50	0	0	7,796.1	7,843.6	8,004.8	8,061.4
Cylinder #2	5,329	4,889.7	183.4	50	0	0	7,792.7	7,839.7	8,003	8,059.3
Cylinder #1	5,294.1	4,857.8	183.4	50	0	0	7,795.8	7,843.2	8,011.6	8,068.8
Ellipsoidal Head @ Datum End	1,277.7	1,173.5	43.5	50	0	0	919	930.5	931.5	943.7
Saddles	440	440	0	0	0	0	0	0	0	0
TOTAL:	18,808.6	17,297.1	637.2	250	0	0	25,271.2	25,437.2	25,930.9	26,126.4

* Shells with attached nozzles have weight reduced by material cut out for opening.

Component	Weight (kg) Contributed by Attachments								
	Body Flanges		Nozzles & Flanges		Packed Beds	Trays	Tray Supports	Rings & Clips	Vertical Loads
	New	Corroded	New	Corroded					
Ellipsoidal Head	0	0	1,018.3	994.8	0	0	0	0	0
Cylinder #3	0	0	108.2	102.5	0	0	0	0	0
Cylinder #2	0	0	54.1	51.7	0	0	0	0	0
Cylinder #1	0	0	267.5	254.6	0	0	0	0	0
Ellipsoidal Head @ Datum End	0	0	0	0	0	0	0	0	0
TOTAL:	0	0	1,448	1,403.6	0	0	0	0	0

Vessel operating weight, Corroded: 45,025 kg
 Vessel operating weight, New: 46,415 kg
 Vessel empty weight, Corroded: 19,588 kg
 Vessel empty weight, New: 21,144 kg
 Vessel test weight, New: 46,438 kg
 Vessel test weight, Corroded: 45,077 kg

+ 6% → 22,413 kg say 22,500 kg

Vessel center of gravity location - from datum - lift condition

Vessel Lift Weight, New: 21,144 kg
 Center of Gravity: 4,718.43 mm

Vessel Capacity

Vessel Capacity** (New): 25,889 liters
 Vessel Capacity** (Corroded): 26,082 liters

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

Ellipsoidal Head

ASME Section VIII, Division 1, 2010 Edition, A11 Addenda Metric

Component: Ellipsoidal Head
 Material Specification: SA-516 70 (II-D Metric p.18, ln. 19)
Straight Flange governs MDMT

Internal design pressure: $P = 5,070 \text{ kPa @ } 38 \text{ }^\circ\text{C}$
 External design pressure: $P_e = 104 \text{ kPa @ } 38 \text{ }^\circ\text{C}$

Static liquid head:

$P_s = 16.83 \text{ kPa}$ (SG=1, $H_s=1717.7 \text{ mm}$ Operating head)
 $P_{th} = 20.74 \text{ kPa}$ (SG=1, $H_s=2117.1 \text{ mm}$ Horizontal test head)

Corrosion allowance: Inner C = 3.2 mm Outer C = 0 mm

Design MDMT = -40°C Impact test performed
 Rated MDMT = -40°C Material is normalized
 Material is produced to fine grain practice
 PWHT is performed
 Do not Optimize MDMT / Find MAWP

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

Estimated weight*: new = 1,147.1 kg corr = 1,054 kg
 Capacity*: new = 932.3 liters corr = 944.5 liters

* includes straight flange

Inner diameter = 1829 mm
 Minimum head thickness = 37.5 mm
 Head ratio D/2h = 2 (new)
 Head ratio D/2h = 1.993 (corroded)
 Straight flange length L_{sf} = 50 mm
 Nominal straight flange thickness t_{sf} = 37.8 mm

Insulation thk*: 51 mm density: 192 kg/m^3 weight: 43.475 kg
 Insulation support ring spacing: 3,660 mm individual weight: 50 kg total weight: 50 kg
 * includes straight flange if applicable

Results Summary

The governing condition is internal pressure.
 Minimum thickness per UG-16 = $1.5 \text{ mm} + 3.2 \text{ mm} = 4.7 \text{ mm}$
 Design thickness due to internal pressure (t) = 37 mm
 Design thickness due to external pressure (t_e) = 7.98 mm
 Maximum allowable working pressure (MAWP) = 5,145.59 kPa
 Maximum allowable external pressure (MAEP) = 2,262.33 kPa

K (Corroded)

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

$$\begin{aligned}
 &= (1/6)*[2 + (1,835.4 / (2*460.45))^2] \\
 &= 0.995374 \\
 \mathbf{K \text{ (New)}} \\
 K &= (1/6)*[2 + (D / (2*h))^2] \\
 &= (1/6)*[2 + (1,829 / (2*457.25))^2] \\
 &= 1
 \end{aligned}$$

Design thickness for internal pressure, (Corroded at 38 °C) Appendix 1-4(c)

$$\begin{aligned}
 t &= P*D*K / (2*S*E - 0.2*P) + \text{Corrosion} \\
 &= 5,086.83*1,835.4*0.995374 / (2*138,000*1 - 0.2*5,086.83) + 3.2 \\
 &= 37 \text{ mm}
 \end{aligned}$$

The head internal pressure design thickness is 37 mm.

Maximum allowable working pressure, (Corroded at 38 °C) Appendix 1-4(c)

$$\begin{aligned}
 P &= 2*S*E*t / (K*D + 0.2*t) - P_s \\
 &= 2*138,000*1*34.3 / (0.995374*1,835.4 + 0.2*34.3) - 16.83 \\
 &= 5,145.59 \text{ kPa}
 \end{aligned}$$

The maximum allowable working pressure (MAWP) is 5,145.59 kPa.

Design thickness for external pressure, (Corroded at 38 °C) UG-33(d)

Equivalent outside spherical radius (R_o)

$$\begin{aligned}
 R_o &= K_o*D_o \\
 &= 0.8659*1,904 \\
 &= 1,648.66 \text{ mm}
 \end{aligned}$$

$$\begin{aligned}
 A &= 0.125 / (R_o / t) \\
 &= 0.125 / (1,648.66 / 4.78) \\
 &= 0.000362
 \end{aligned}$$

From Table CS-2 Metric: B = 35.8981 MPa

$$\begin{aligned}
 P_a &= B / (R_o / t) \\
 &= 35,898.08 / (1,648.66 / 4.78) \\
 &= 104 \text{ kPa}
 \end{aligned}$$

$$t = 4.78 \text{ mm} + \text{Corrosion} = 4.78 \text{ mm} + 3.2 \text{ mm} = 7.98 \text{ mm}$$

Check the external pressure per UG-33(a)(1) Appendix 1-4(c)

$$\begin{aligned}
 t &= 1.67*P_e*D*K / (2*S*E - 0.2*1.67*P_e) + \text{Corrosion} \\
 &= 1.67*104*1,835.4*0.995374 / (2*138,000*1 - 0.2*1.67*104) + 3.2 \\
 &= 4.35 \text{ mm}
 \end{aligned}$$

The head external pressure design thickness (t_e) is 7.98 mm.

Maximum Allowable External Pressure, (Corroded at 38 °C) UG-33(d)

Equivalent outside spherical radius (R_o)

$$\begin{aligned}
 R_o &= K_o*D_o \\
 &= 0.8659*1,904
 \end{aligned}$$

$$\begin{aligned}
 &= 1,648.66 \text{ mm} \\
 A &= 0.125 / (R_o / t) \\
 &= 0.125 / (1,648.66 / 34.3) \\
 &= 0.002601
 \end{aligned}$$

From Table CS-2 Metric: $B = 108.7421 \text{ MPa}$

$$\begin{aligned}
 P_a &= B / (R_o / t) \\
 &= 108,742.1 / (1,648.66 / 34.3) \\
 &= 2,262.3315 \text{ kPa}
 \end{aligned}$$

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

$$\begin{aligned}
 P &= 2 * S * E * t / ((K * D + 0.2 * t) * 1.67) - P_{s2} \\
 &= 2 * 138,000 * 1 * 34.3 / ((0.995374 * 1,835.4 + 0.2 * 34.3) * 1.67) - 0 \\
 &= 3,091.27 \text{ kPa}
 \end{aligned}$$

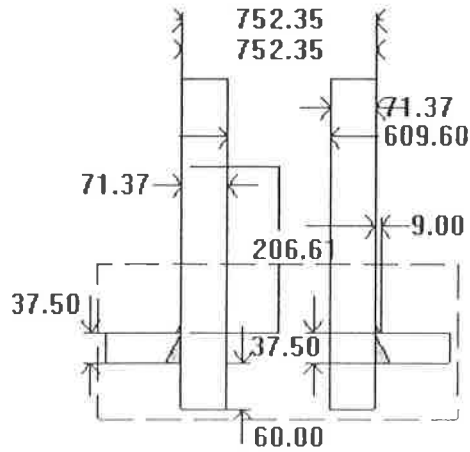
The maximum allowable external pressure (MAEP) is 2,262.33 kPa.

% Extreme fiber elongation - UCS-79(d)

$$\begin{aligned}
 EFE &= (75 * t / R_f) * (1 - R_f / R_o) \\
 &= (75 * 37.8 / 329.83) * (1 - 329.83 / \infty) \\
 &= 8.5953\%
 \end{aligned}$$

DN600/NPS24 Manway (M)

ASME Section VIII Division 1, 2010 Edition, A11 Addenda Metric



$t_{w(lower)} = 37.5 \text{ mm}$

$Leg_{41} = 9 \text{ mm}$

$Leg_{43} = 0 \text{ mm}$

$h_{new} = 60 \text{ mm}$

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

Location and Orientation

Located on:

Ellipsoidal Head

Orientation:

0°

End of nozzle to datum line:

9,894 mm

Calculated as hillside:

No

Distance to head center, R:

0 mm

Passes through a Category A joint:

No

Nozzle

Access opening:

No

Material specification:

SA-350 LF2 CI 1 (II-D Metric p. 18, ln. 10)

Inside diameter, new:

609.6 mm

Wall thickness, t_n :

71.37 mm

Minimum wall thickness:

63.44 mm

Corrosion allowance:

3.2 mm

Projection available outside vessel, L_{pr} :

225.66 mm

Heavy barrel length, L_{hb} :

206.61 mm

Internal projection, h_{new} :

60 mm

Projection available outside vessel to flange face, L_f :

295.51 mm

Local vessel minimum thickness:

37.5 mm

Liquid static head included:

7.8386 kPa

Longitudinal joint efficiency:

1

ASME B16.5-2009 Flange

Description: NPS 24 Class 300 HB A350 LF2 Cl.1 (Nut Stop)
 Bolt Material: SA-193 B7 Bolt <= 64 (II-D Metric p. 334, ln. 32)
 Blind included: Yes
 Rated MDMT: -48°C
 (UG-84 provisions apply)
 (Flange rated MDMT = -49 °C (Flange impact tested to -49°C (UCS-66 (g)))
 Bolts rated MDMT per Fig UCS-66 note (c) = -48 °C)
 Liquid static head: 7.8386 kPa
 MAWP rating: 5,110.01 kPa @ 38°C
 MAP rating: 5,110.01 kPa @ 4°C
 Hydrotest rating: 7,700.01 kPa @ 4°C
 Gasket Description: Flexitallic Spiral Wound CG 304 S.S.
 PWHT performed: Yes

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (cm ²) For P = 5,077.84 kPa @ 38 °C The opening is adequately reinforced							UG-45 Nozzle Wall Thickness Summary (mm) The nozzle passes UG-45	
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
187.2517	195.6933	24.0341	97.0398	73.809	--	0.8103	14.79	63.44

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 (mm)	Actual weld throat size (mm)	Status
Nozzle to shell fillet (Leg ₄₁)	6	6.3	weld size is adequate

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (cm ²) For P _e = 104 kPa @ 38 °C The opening is adequately reinforced							UG-45 Nozzle Wall Thickness Summary (mm) The nozzle passes UG-45	
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
14.7108	370.5942	181.8642	114.1107	73.809	--	0.8103	4.84	63.44

UG-41 Weld Failure Path Analysis Summary

Weld strength calculations are not required for external pressure

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (mm)	Actual weld throat size (mm)	Status
Nozzle to shell fillet (Leg ₄₁)	6	6.3	weld size is adequate

Straight Flange on Ellipsoidal Head

ASME Section VIII Division 1, 2010 Edition, A11 Addenda Metric

Component: Straight Flange
 Material specification: SA-516 70 (II-D Metric p. 18, ln. 19)
 Material is impact tested per UG-84 to -40 °C
 UCS-66(i) reduction of 0 °C applied (ratio = 0.9998).

Internal design pressure: $P = 5,070 \text{ kPa @ } 38 \text{ }^\circ\text{C}$
 External design pressure: $P_e = 104 \text{ kPa @ } 38 \text{ }^\circ\text{C}$

Static liquid head:

$P_s = 16.83 \text{ kPa}$ (SG = 1, $H_s = 1,717.7 \text{ mm}$, Operating head)
 $P_{th} = 20.74 \text{ kPa}$ (SG = 1, $H_s = 2,117.1 \text{ mm}$, Horizontal test head)

Corrosion allowance Inner C = 3.2 mm Outer C = 0 mm

Design MDMT = -40 °C Impact test performed
 Rated MDMT = -40 °C Material is normalized
 Material is produced to Fine Grain Practice
 PWHT is performed

Radiography: Longitudinal joint - Seamless No RT
 Circumferential joint - Full UW-11(a) Type 1

Estimated weight New = 86.8 kg corr = 79.6 kg
 Capacity New = 131.37 liters corr = 132.29 liters

ID = 1,829 mm
 Length $L_c = 50 \text{ mm}$
 $t = 37.8 \text{ mm}$
 Insulation thk: 51 mm density: 192 kg/m^3 Weight: 0 kg

Design thickness, (at 38 °C) UG-27(c)(1)

$$\begin{aligned}
 t &= P \cdot R / (S \cdot E - 0.60 \cdot P) + \text{Corrosion} \\
 &= 5,086.83 \cdot 917.7 / (138,000 \cdot 1.00 - 0.60 \cdot 5,086.83) + 3.2 \\
 &= 37.8 \text{ mm}
 \end{aligned}$$

Maximum allowable working pressure, (at 38 °C) UG-27(c)(1)

$$\begin{aligned}
 P &= S \cdot E \cdot t / (R + 0.60 \cdot t) - P_s \\
 &= 138,000 \cdot 1.00 \cdot 34.6 / (917.7 + 0.60 \cdot 34.6) - 16.83 \\
 &= 5,071.02 \text{ kPa}
 \end{aligned}$$

External Pressure, (Corroded & at 38 °C) UG-28(c)

$$\begin{aligned}
 L / D_o &= 9,550.97 / 1,904.6 = 5.0147 \\
 D_o / t &= 1,904.6 / 12.09 = 157.5008 \\
 \text{From table G: } A &= 0.000125
 \end{aligned}$$

From table CS-2 Metric: B = 12.285 MPa

$$\begin{aligned} P_a &= 4*B / (3*(D_o / t)) \\ &= 4*12,285.05 / (3*(1,904.6 / 12.09)) \\ &= 104 \text{ kPa} \end{aligned}$$

Design thickness for external pressure $P_a = 104 \text{ kPa}$

$$t_a = t + \text{Corrosion} = 12.09 + 3.2 = 15.29 \text{ mm}$$

Maximum Allowable External Pressure, (Corroded & at 38 °C) UG-28(c)

$$\begin{aligned} L / D_o &= 9,550.97 / 1,904.6 = 5.0147 \\ D_o / t &= 1,904.6 / 34.6 = 55.0469 \\ \text{From table G: } A &= 0.000575 \\ \text{From table CS-2 Metric: B} &= 57.0782 \text{ MPa} \end{aligned}$$

$$\begin{aligned} P_a &= 4*B / (3*(D_o / t)) \\ &= 4*57,078.23 / (3*(1,904.6 / 34.6)) \\ &= 1,382.54 \text{ kPa} \end{aligned}$$

% Extreme fiber elongation - UCS-79(d)

$$\begin{aligned} \text{EFE} &= (50*t / R_f) * (1 - R_f / R_o) \\ &= (50*37.8 / 933.4) * (1 - 933.4 / \infty) \\ &= 2.0249\% \end{aligned}$$

The extreme fiber elongation does not exceed 5%.

$$D_o/t = 1,905.2 / 12.09 = 157.5260$$

From table G: A = 0.000125
 From table CS-2 Metric: B = 12.287 MPa

$$P_a = 4*B / (3*(D_o/t))$$

$$= 4*12,287.03 / (3*(1,905.2 / 12.09))$$

$$= 104 \text{ kPa}$$

Design thickness for external pressure $P_a = 104 \text{ kPa}$

$$t_a = t + \text{Corrosion} = 12.09 + 3.2 = 15.29 \text{ mm}$$

Maximum Allowable External Pressure, (Corroded & at 38 °C) UG-28(c)

$$L/D_o = 9,550.97 / 1,905.2 = 5.0131$$

$$D_o/t = 1,905.2 / 34.9 = 54.5909$$

From table G: A = 0.000582
 From table CS-2 Metric: B = 57.779 MPa

$$P_a = 4*B / (3*(D_o/t))$$

$$= 4*57,778.95 / (3*(1,905.2 / 34.9))$$

$$= 1,411.2 \text{ kPa}$$

% Extreme fiber elongation - UCS-79(d)

$$\text{EFE} = (50*t / R_f) * (1 - R_f / R_o)$$

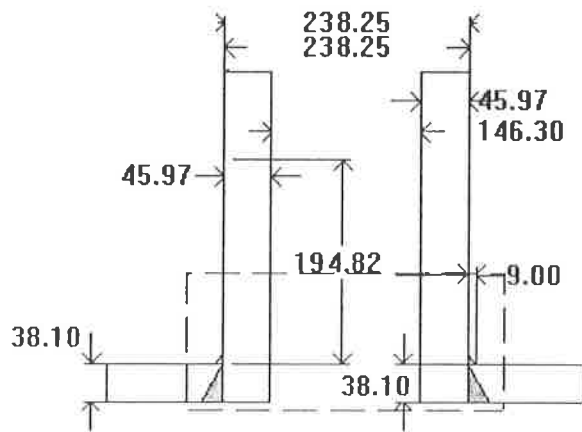
$$= (50*38.1 / 933.55) * (1 - 933.55 / \infty)$$

$$= 2.0406\%$$

The extreme fiber elongation does not exceed 5%.

DN150/NPS6 Inlet (N1)

ASME Section VIII Division 1, 2010 Edition, A11 Addenda Metric



$t_{w(lower)} = 38.1 \text{ mm}$

$Leg_{41} = 9 \text{ mm}$

$Leg_{43} = 0 \text{ mm}$

$h_{new} = 0 \text{ mm}$

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

Location and Orientation

Located on:	Cylinder #1
Orientation:	0°
Nozzle center/shell outer surface intersection to datum:	2,000 mm
End of nozzle to shell center:	1,202.6 mm
Tilted:	-3° from radial
Passes through a Category A joint:	No

Nozzle

Access opening:	No
Material specification:	SA-350 LF2 Cl 1 (II-D Metric p. 18, In. 10)
Inside diameter, new:	146.3 mm
Wall thickness, t_n :	45.97 mm
Minimum wall thickness:	41.21 mm
Corrosion allowance:	3.2 mm
Opening chord length:	152.91 mm
Projection available outside vessel, L_{pr} :	207.52 mm
Heavy barrel length, L_{hb} :	194.82 mm
Projection available outside vessel to flange face, L_f :	244.1 mm
Local vessel minimum thickness:	38.1 mm
Liquid static head included:	0 kPa
Longitudinal joint efficiency:	1

ASME B16.5-2009 Flange

Description: NPS 6 Class 300 HB A350 LF2 Cl.1 (Nut Stop)
 Bolt Material: SA-193 B7 Bolt <= 64 (II-D Metric p. 334, ln. 32)
 Blind included: No
 Rated MDMT: -48°C
 (UG-84 provisions apply)
 (Flange rated MDMT = -49 °C (Flange impact tested to -49°C (UCS-66 (g)))
 Bolts rated MDMT per Fig UCS-66 note (c) = -48 °C)
 Liquid static head: 0 kPa
 MAWP rating: 5,110.01 kPa @ 38°C
 MAP rating: 5,110.01 kPa @ 4°C
 Hydrotest rating: 7,700.01 kPa @ 4°C
 PWHT performed: Yes

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (cm ²) For P = 5,070 kPa @ 38 °C The opening is adequately reinforced							UG-45 Nozzle Wall Thickness Summary (mm) The nozzle passes UG-45	
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
52.7179	71.1044	0.6587	69.6353	--	--	0.8103	11.31	41.21

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 (mm)	Actual weld throat size (mm)	Status
Nozzle to shell fillet (Leg ₄₁)	6	6.3	weld size is adequate

Reinforcement Calculations for External Pressure

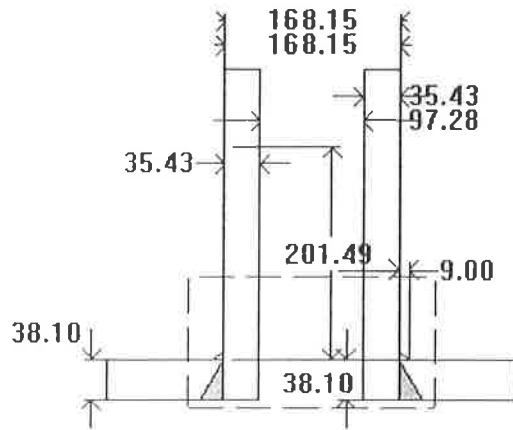
UG-37 Area Calculation Summary (cm ²) For Pe = 104 kPa @ 38 °C The opening is adequately reinforced							UG-45 Nozzle Wall Thickness Summary (mm) The nozzle passes UG-45	
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
9.2471	109.4856	35.427	73.2482	--	--	0.8103	4.7	41.21

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

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (mm)	Actual weld throat size (mm)	Status
Nozzle to shell fillet (Leg ₄₁)	6	6.3	weld size is adequate

DN100/NPS4 Liquid Outlet (N3)

ASME Section VIII Division 1, 2010 Edition, A11 Addenda Metric



$$t_{w(\text{lower})} = 38.1 \text{ mm}$$

$$\text{Leg}_{41} = 9 \text{ mm}$$

Note: Per UW-16(b) minimum inside corner radius $r_1 = \min [1 / 4 * t, 3 \text{ mm}] = 3 \text{ mm}$

Location and Orientation

Located on:	Cylinder #3
Orientation:	180°
Nozzle center/shell outer surface intersection to datum:	8,850 mm
End of nozzle to shell center:	1,202.6 mm
Tilted:	3° from radial
Passes through a Category A joint:	No

Nozzle

Access opening:	No
Material specification:	SA-350 LF2 Cl 1 (II-D Metric p. 18, ln. 10)
Inside diameter, new:	97.28 mm
Wall thickness, t_n :	35.43 mm
Minimum wall thickness:	30.67 mm
Corrosion allowance:	3.2 mm
Opening chord length:	103.83 mm
Projection available outside vessel, L_{pr} :	214.19 mm
Heavy barrel length, L_{hb} :	201.49 mm
Projection available outside vessel to flange face, L_f :	245.94 mm
Local vessel minimum thickness:	38.1 mm
Liquid static head included:	17.1728 kPa
Longitudinal joint efficiency:	1

ASME B16.5-2009 Flange

Description:

NPS 4 Class 300 HB A350 LF2 Cl.1 (Nut Stop)

Bolt Material:

SA-193 B7 Bolt \leq 64 (II-D Metric p. 334, ln. 32)

Blind included:

No

Rated MDMT:

-48°C

(UG-84 provisions apply)

(Flange rated MDMT = -49 °C (Flange impact tested to -49°C (UCS-66 (g)))

Bolts rated MDMT per Fig UCS-66 note (c) = -48 °C)

Liquid static head:

19.6225 kPa

MAWP rating:

5,110.01 kPa @ 38°C

MAP rating:

5,110.01 kPa @ 4°C

Hydrotest rating:

7,700.01 kPa @ 4°C

PWHT performed:

Yes

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (cm ²) For P = 5,087.17 kPa @ 38 °C The opening is adequately reinforced							UG-45 Nozzle Wall Thickness Summary (mm) The nozzle passes UG-45	
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
35.9181	50.0186	0.409	48.7993	--	--	0.8103	9.42	30.67

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 (mm)	Actual weld throat size (mm)	Status
Nozzle to shell fillet (Leg ₄₁)	6	6.3	weld size is adequate

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (cm ²) For P _e = 104 kPa @ 38 °C The opening is adequately reinforced							UG-45 Nozzle Wall Thickness Summary (mm) The nozzle passes UG-45	
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
6.2785	82.3385	30.6193	50.9089	--	--	0.8103	4.7	30.67

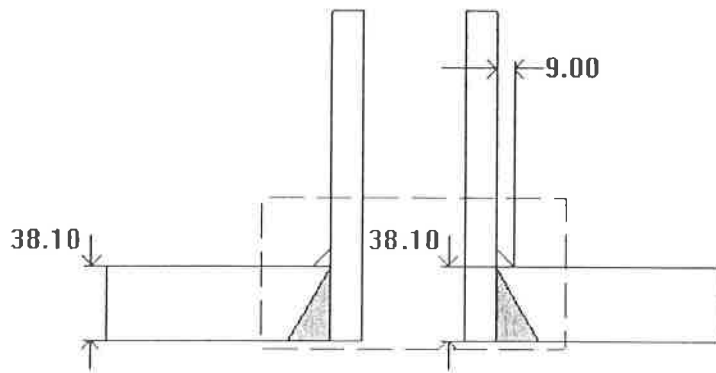
UG-41 Weld Failure Path Analysis Summary

Weld strength calculations are not required for external pressure

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (mm)	Actual weld throat size (mm)	Status
Nozzle to shell fillet (Leg ₄₁)	6	6.3	weld size is adequate

DN50/NPS2 Hot Water (N6b)

ASME Section VIII Division 1, 2010 Edition, A11 Addenda Metric



$$t_{w(\text{lower})} = 38.1 \text{ mm}$$

$$\text{Leg}_{41} = 9 \text{ mm}$$

$$\text{Leg}_{43} = 0 \text{ mm}$$

$$h_{\text{new}} = 0 \text{ mm}$$

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

Location and Orientation

Located on:	Cylinder #3
Orientation:	180°
Nozzle center/shell outer surface intersection to datum:	6,800 mm
End of nozzle to shell center:	1,132.6 mm
Tilted:	3° from radial
Passes through a Category A joint:	No

Nozzle

Access opening:	No
Material specification:	SA-350 LF2 Cl 1 (II-D Metric p. 18, ln. 10)
Inside diameter, new:	50.8 mm
Nominal wall thickness:	16.64 mm
Corrosion allowance:	3.2 mm
Opening chord length:	57.28 mm
Projection available outside vessel, Lpr:	155.69 mm
Projection available outside vessel to flange face, Lf:	178.04 mm
Local vessel minimum thickness:	38.1 mm
Liquid static head included:	17.1728 kPa
Longitudinal joint efficiency:	1

ASME B16.5-2009 Flange

Description:	NPS 2 Class 300 LWN A350 LF2 Cl.1
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Bolt Material: SA-193 B7 Bolt <= 64 (II-D Metric p. 334, ln. 32)
 Blind included: Yes
 Rated MDMT: -48°C
 (UG-84 provisions apply)
 (Flange rated MDMT = -49 °C (Flange impact tested to -49°C (UCS-66 (g)))
 Bolts rated MDMT per Fig UCS-66 note (c) = -48 °C
 Liquid static head: 18.9365 kPa
 MAWP rating: 5,110.01 kPa @ 38°C
 MAP rating: 5,110.01 kPa @ 4°C
 Hydrotest rating: 7,700.01 kPa @ 4°C
 Gasket Description: Flexitallic Spiral Wound CG 304 S.S.
 PWHT performed: Yes

Reinforcement Calculations for Internal Pressure

UG-37 Area Calculation Summary (cm ²) For P = 5,087.17 kPa @ 38 °C							UG-45 Nozzle Wall Thickness Summary (mm) The nozzle passes UG-45	
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							8	16.64

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 (mm)	Actual weld throat size (mm)	Status
Nozzle to shell fillet (Leg ₄₁)	6	6.3	weld size is adequate

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

Reinforcement Calculations for External Pressure

UG-37 Area Calculation Summary (cm ²) For Pe = 104 kPa @ 38 °C							UG-45 Nozzle Wall Thickness Summary (mm) The nozzle passes UG-45	
A required	A available	A ₁	A ₂	A ₃	A ₅	A welds	t _{req}	t _{min}
This nozzle is exempt from area calculations per UG-36(c)(3)(a)							4.7	16.64

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

UW-16 Weld Sizing Summary			
Weld description	Required weld throat size (mm)	Actual weld throat size (mm)	Status
Nozzle to shell fillet (Leg ₄₁)	6	6.3	weld size is adequate

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

Saddles

Saddle material:	SA-516-70
Saddle construction is:	Web at edge of rib
Saddle allowable stress:	$S_s = 137.895 \text{ MPa}$
Saddle yield stress:	$S_y = 262.001 \text{ MPa}$
Saddle distance to datum:	550 mm
Tangent to tangent length:	$L = 9,244 \text{ mm}$
Saddle separation:	$L_s = 7,944 \text{ mm}$
Vessel radius:	$R = 952.6 \text{ mm}$
Tangent distance left:	$A_l = 650 \text{ mm}$
Tangent distance right:	$A_r = 650 \text{ mm}$
Saddle height:	$H_s = 1,400 \text{ mm}$
Saddle contact angle:	$\theta = 120^\circ$
Wind pressure:	0.39 kPa
Wear plate thickness:	$t_p = 9.52 \text{ mm}$
Wear plate width:	$W_p = 300 \text{ mm}$
Wear plate contact angle:	$\theta_w = 132^\circ$
Web plate thickness:	$t_s = 9.53 \text{ mm}$
Base plate length:	$E = 1,700 \text{ mm}$
Base plate width:	$F = 230 \text{ mm}$
Base plate thickness:	$t_b = 19.05 \text{ mm}$
Number of stiffener ribs:	$n = 5$
Largest stiffener rib spacing:	$d_i = 415.12 \text{ mm}$
Stiffener rib thickness:	$t_w = 9.53 \text{ mm}$
Saddle width:	$B = 200 \text{ mm}$
Anchor bolt size & type:	1.25 inch coarse threaded
Anchor bolt material:	SA-307
Anchor bolt allowable shear:	69 MPa
Anchor bolt corrosion allowance:	1.5 mm
Anchor bolts per saddle:	4
Base coefficient of friction:	$\mu = 0.45$

Weight on left saddle: operating corr = 22,796.19 kg, test new = 23,534.19 kg

Weight on right saddle: operating corr = 21,788.76 kg, test new = 22,463.26 kg

Weight of saddle pair = 439.98 kg

Notes:

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

Seismic base shear on vessel

Vessel is assumed to be a rigid structure.

Method of seismic analysis:	NBC Canada 2005
Vertical seismic accelerations considered:	Yes
Force Multiplier:	0.3333

Minimum Weight Multiplier:		0.2
Importance factor:	$I_E =$	1
Spectral response acceleration value at 0.2 s: $S_a(0.2) =$		0.12
Acceleration based site coefficient:	$F_a =$	1
Response modification factor:	$R_p =$	1
Seismic coefficient:	$C_p =$	1
Response factor:	$A_r =$	1
Vessel elevation:	$h_x =$	1,300 mm
Structure total height:	$h_n =$	2,252.6 mm
Weight on Saddle:	$W_p =$	437,229.09 N

$$A_x = \text{Smaller of } (1 + 2 \cdot h_x / h_n) \text{ or } 3$$

$$= \text{Smaller of } (1 + 2 \cdot 1,300 / 2,252.6) \text{ or } 3$$

$$= 2.15$$

$$S_p = \min[C_p \cdot A_r \cdot A_x / R_p, 4]$$

$$= \min[1 \cdot 1 \cdot 2.15 / 1, 4]$$

$$= 2.15$$

$$V_p = 0.3 \cdot F_a \cdot S_a(0.2) \cdot I_E \cdot S_p \cdot W_p$$

$$= 0.3 \cdot 1 \cdot 0.12 \cdot 1 \cdot 2.15 \cdot 437,229.09$$

$$= 33,841.53 \text{ N}$$

Saddle reactions due to weight + seismic

V_v = vertical seismic force acting on left saddle

V = horizontal seismic shear acting on left saddle (worst case if not slotted)

Seismic longitudinal reaction, Q_l (left saddle):

$$Q_l = V \cdot H_s / L_s + V_v$$

$$= 33,841.54 \cdot 1,400 / 7,944 + 44,710.86$$

$$= 50,674.88 \text{ N}$$

Seismic transverse reaction, Q_t (left saddle):

$$Q_t = V \cdot H_s / (R_o \cdot \sin(\theta / 2)) + V_v$$

$$= 17,303.09 \cdot 1,400 / (952.6 \cdot \sin(120 / 2)) + 44,710.86$$

$$= 74,074.56 \text{ N}$$

Q = Weight on saddle + larger of Q_t or Q_l

$$Q = W + Q_t = 223,554.29 + 74,074.56 = 297,628.85 \text{ N}$$

Transverse wind shear on vessel

$$V_{wt} = P_w \cdot G \cdot (C_{f(\text{shell})} \cdot (\text{Projected shell area}) + C_{f(\text{saddle})} \cdot (\text{Projected saddle area}))$$

$$= 0.39 \cdot 0.85 \cdot 1000 \cdot (0.7 \cdot 23.4152 + 2 \cdot 0.179)$$

$$= 5,552.34 \text{ N}$$

End wind shear on vessel

$$\begin{aligned}V_{we} &= P_w * G * (C_{f(\text{shell})} * \pi * R_o^2 + C_{f(\text{saddle})} * (\text{Projected saddle area})) \\ &= 0.39 * 1e3 * 0.85 * (0.5 * \pi * 1.1536^2 + 2 * 1.02) \\ &= 1,370.7 \text{ N}\end{aligned}$$

Load	Vessel condition	Bending + pressure between saddles (MPa)				Bending + pressure at the saddle (MPa)			
		S ₁ (+)	allow (+)	S ₁ (-)	allow (-)	S ₂ (+)	allow (+)	S ₂ (-)	allow (-)
Seismic	Operating	<u>71.662</u>	165.6	4.782	141.372	<u>68.228</u>	165.6	1.347	141.372
Seismic	Vacuum	4.782	165.6	<u>6.149</u>	141.372	1.347	165.6	<u>2.715</u>	141.372
Wind	Operating	70.548	165.6	3.668	141.372	68.003	165.6	1.123	141.372
Wind	Test	82.781	235.8	3.431	141.372	80.414	235.8	1.065	141.372
Wind	Vacuum	3.668	165.6	5.035	141.372	1.123	165.6	2.49	141.372

Load	Vessel condition	Tangential shear (MPa)		Circumferential stress (MPa)		Stress over saddle (MPa)		Splitting (MPa)	
		S ₃	allow	S ₄ (horns)	allow (+/-)	S ₅	allow	S ₆	allow
Seismic	Operating	<u>8.814</u>	110.4	<u>-14.554</u>	207	<u>17.33</u>	131	<u>10.3</u>	91.93
Seismic	Vacuum	8.814	110.4	-14.554	207	17.33	131	10.3	91.93
Wind	Operating	6.636	110.4	-11.162	207	13.291	131	7.899	91.93
Wind	Test	6.179	188.64	-9.717	235.8	15.117	235.8	8.041	235.801
Wind	Vacuum	6.636	110.4	-11.162	207	13.291	131	7.899	91.93

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

$$S_1 = \pm 3 \cdot K_1 \cdot Q \cdot (L / 12) / (\pi \cdot R^2 \cdot t)$$

$$= 3 \cdot 0.6666 \cdot 297,628.85 \cdot (9,244 / 12) / (\pi \cdot 935.15^2 \cdot 34.9)$$

$$= 4.782 \text{ MPa}$$

$$S_p = P \cdot R / (2 \cdot t)$$

$$= 5.09 \cdot 917.7 / (2 \cdot 34.9)$$

$$= 66.88 \text{ MPa}$$

$$\text{Maximum tensile stress } S_{1t} = S_1 + S_p = \underline{71.662} \text{ MPa}$$

$$\text{Maximum compressive stress (shut down) } S_{1c} = S_1 = 4.782 \text{ MPa}$$

Tensile stress is acceptable ($\leq 1.2 \cdot S \cdot E = 165.6 \text{ MPa}$)

Compressive stress is acceptable ($\leq 1.2 \cdot S_c = 141.372 \text{ MPa}$)

Longitudinal stress at the right saddle (Seismic ,Operating)

$$L_e = 2 \cdot (\text{Left head depth}) / 3 + L + 2 \cdot (\text{Right head depth}) / 3$$

$$= 2 \cdot 494.75 / 3 + 9,244 + 2 \cdot 494.75 / 3$$

$$= 9,903.67 \text{ mm}$$

$$\text{Seismic vertical acceleration coefficient } m = 2.584 \cdot 0.0774 = 0.2$$

$$w = W_t \cdot (1 + m) \cdot 10 / L_e = 437,229.09 \cdot (1 + 0.2) \cdot 10 / 9,903.67 = 529.78 \text{ N/cm}$$

Bending moment at the right saddle:

$$\begin{aligned} M_q &= w \cdot (2 \cdot H \cdot A_r / 3 + A_r^2 / 2 - (R^2 - H^2) / 4) \\ &= 529.78 / 10000 \cdot (2 \cdot 494.75 \cdot 650 / 3 + 650^2 / 2 - (952.6^2 - 494.75^2) / 4) \\ &= 13,772.9 \text{ N-m} \end{aligned}$$

$$\begin{aligned} S_2 &= \pm M_q \cdot K_1' / (\pi \cdot R^2 \cdot t) \\ &= 13,772.9 \cdot 1e3 \cdot 9.3799 / (\pi \cdot 935.15^2 \cdot 34.9) \\ &= 1.347 \text{ MPa} \end{aligned}$$

$$\begin{aligned} S_p &= P \cdot R / (2 \cdot t) \\ &= 5.09 \cdot 917.7 / (2 \cdot 34.9) \\ &= 66.88 \text{ MPa} \end{aligned}$$

$$\text{Maximum tensile stress } S_{2t} = S_2 + S_p = \underline{68.228} \text{ MPa}$$

$$\text{Maximum compressive stress (shut down) } S_{2c} = S_2 = 1.347 \text{ MPa}$$

Tensile stress is acceptable ($\leq 1.2 \cdot S = 165.6 \text{ MPa}$)

Compressive stress is acceptable ($\leq 1.2 \cdot S_c = 141.372 \text{ MPa}$)

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

$$\begin{aligned} Q_{\text{shear}} &= Q - w \cdot (a + 2 \cdot H / 3) \\ &= 297,628.85 - 52.98 \cdot (650 + 2 \cdot 494.75 / 3) \\ &= 245,719.4 \text{ N} \end{aligned}$$

$$\begin{aligned} S_3 &= K_{2.2} \cdot Q_{\text{shear}} / (R \cdot t) \\ &= 1.1707 \cdot 245,719.4 / (935.15 \cdot 34.9) \\ &= \underline{8.814} \text{ MPa} \end{aligned}$$

Tangential shear stress is acceptable ($\leq 0.8 \cdot S = 110.4 \text{ MPa}$)

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

$$\begin{aligned} S_4 &= -Q / (4 \cdot t \cdot (b + 1.56 \cdot \text{Sqr}(R_o \cdot t))) - 3 \cdot K_3 \cdot Q / (2 \cdot t^2) \\ &= -297,628.85 / (4 \cdot 34.9 \cdot (200 + 1.56 \cdot \text{Sqr}(952.6 \cdot 34.9))) - 3 \cdot 0.0277 \cdot 297,628.85 / (2 \cdot 34.9^2) \\ &= \underline{-14.554} \text{ MPa} \end{aligned}$$

Circumferential stress at saddle horns is acceptable ($\leq 1.5 \cdot S_a = 207 \text{ MPa}$)

The wear plate was not considered in the calculation of S_4 because the wear plate width is not at least $\{B + 1.56 \cdot (R_o \cdot t_c)^{0.5}\} = 484.44 \text{ mm}$

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

$$\begin{aligned} S_5 &= K_5 \cdot Q / ((t + t_p) \cdot (t_s + 1.56 \cdot \text{Sqr}(R_o \cdot t_c))) \\ &= 0.7603 \cdot 297,628.85 / ((34.9 + 9.52) \cdot (9.53 + 1.56 \cdot \text{Sqr}(952.6 \cdot 34.9))) \\ &= \underline{17.33} \text{ MPa} \end{aligned}$$

Ring compression in shell is acceptable ($\leq 0.5 \cdot S_y = 131 \text{ MPa}$)

Saddle splitting load (left, Seismic ,Operating)

Area resisting splitting force = Web area + wear plate area

$$\begin{aligned} A_e &= H_{\text{eff}} * t_s + t_p * W_p \\ &= 31.7533 * 0.9525 + 0.952 * 30 \\ &= 58.8051 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} S_G &= K_8 * Q / A_e \\ &= 0.2035 * 297,628.85 / 5,880.505 \\ &= \underline{10.3} \text{ MPa} \end{aligned}$$

Stress in saddle is acceptable ($\leq (2/3) * S_s = 91.93 \text{ MPa}$)

Longitudinal stress at the right saddle (Seismic ,Vacuum)

$$\begin{aligned} L_e &= 2 * (\text{Left head depth}) / 3 + L + 2 * (\text{Right head depth}) / 3 \\ &= 2 * 494.75 / 3 + 9,244 + 2 * 494.75 / 3 \\ &= 9,903.67 \text{ mm} \end{aligned}$$

Seismic vertical acceleration coefficient $m = 2.584 * 0.0774 = 0.2$

$$w = W_t * (1 + m) * 10 / L_e = 437,229.09 * (1 + 0.2) * 10 / 9,903.67 = 529.78 \text{ N/cm}$$

Bending moment at the right saddle:

$$\begin{aligned} M_q &= w * (2 * H * A_r / 3 + A_r^2 / 2 - (R^2 - H^2) / 4) \\ &= 529.78 / 10000 * (2 * 494.75 * 650 / 3 + 650^2 / 2 - (952.6^2 - 494.75^2) / 4) \\ &= 13,772.9 \text{ N-m} \end{aligned}$$

$$\begin{aligned} S_2 &= \pm M_q * K_1' / (\pi * R^2 * t) \\ &= 13,772.9 * 1e3 * 9.3799 / (\pi * 935.15^2 * 34.9) \\ &= 1.347 \text{ MPa} \end{aligned}$$

$$\begin{aligned} S_p &= P * R / (2 * t) \\ &= 0.1 * 917.7 / (2 * 34.9) \\ &= 1.367 \text{ MPa} \end{aligned}$$

Maximum tensile stress (shut down) $S_{2t} = S_2 = 1.347 \text{ MPa}$

Maximum compressive stress $S_{2c} = S_2 + S_p = \underline{2.715} \text{ MPa}$

Tensile stress is acceptable ($\leq 1.2 * S = 165.6 \text{ MPa}$)

Compressive stress is acceptable ($\leq 1.2 * S_c = 141.372 \text{ MPa}$)

Shear stress in anchor bolting, one end slotted

Maximum seismic or wind base shear = 33,841.53 N

Thermal expansion base shear = $W * \mu = 225,711.68 * 0.45 = 101,570.26 \text{ N}$

Corroded root area for a 1.25 inch coarse threaded bolt = 4.5387 cm^2 (4 per saddle)

Bolt shear stress = $101,570.26 / (453.8701 * 1 * 4) = 55.947 \text{ MPa}$

Anchor bolt stress is acceptable (≤ 69 MPa)

Shear stress in anchor bolting, transverse

Maximum seismic or wind base shear = 33,841.53 N

Corroded root area for a 1.25 inch coarse threaded bolt = 4.5387 cm² (4 per saddle)

Bolt shear stress = 33,841.53 / (453.8701*2*4) = 9.32 MPa

Anchor bolt stress is acceptable (≤ 69 MPa)

Web plate buckling check (Escoe pg 251)

Allowable compressive stress S_c is the lesser of 137.895 or 121.784 MPa: (121.784)

$$S_c = K_1 \pi^2 E / (12(1 - 0.3^2)(d_i / t_s)^2)$$

$$= 1.28 \pi^2 199.95E+03 / (12(1 - 0.3^2)(415.12 / 9.53)^2)$$

$$= 121.784 \text{ MPa}$$

Allowable compressive load on the saddle

$$b_e = d_i t_s / (d_i t_s + 2 t_w (b - 25.4)) * 25.4$$

$$= 415.12 * 9.53 / (415.12 * 9.53 + 2 * 9.53 * (200 - 25.4)) * 25.4$$

$$= 13.8$$

$$F_b = n (A_s + 2 b_e t_s) S_c$$

$$= 5 (1,814.2744 + 2 * 13.8 * 9.53) * 121.784$$

$$= 1,264,770.03 \text{ N}$$

Saddle loading of 299,786.24 N is $\leq F_b$; satisfactory.

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

$$\sigma_b = V (H_s - x_o) y / I + Q / A$$

$$= 33,841.53 (1,400 - 787.79) * 130.72 / (1e4 * 5,965.55) + 297,628.85 / 24,787.16$$

$$= 57.407 \text{ MPa}$$

The primary bending + axial stress in the saddle ≤ 137.895 MPa; satisfactory.

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

$$\sigma_b = V (H_s - x_o) y / I + Q / A$$

$$= 135,411.79 (1,400 - 787.79) * 130.72 / (1e4 * 5,965.55) + 297,628.85 / 24,787.16$$

$$= 193.668 \text{ MPa}$$

The secondary bending + axial stress in the saddle $< 2 S_y = 524.002$ MPa; satisfactory.

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

where a = 415.12, b = 220.48 mm

$$t_b = (\beta_1 q b^2 / (1.5 S_a))^{0.5}$$

$$= (1.6817 * 0.767 * 220.48^2 / (1.5 * 137.895))^{0.5}$$

$$= 17.41 \text{ mm}$$

The base plate thickness of 19.05 mm is adequate.

Foundation bearing check

$$\begin{aligned} S_f &= Q_{\max} / (F * E) \\ &= 299,786.24 / (230 * 1,700) \\ &= 0.767 \text{ MPa} \end{aligned}$$

Concrete bearing stress ≤ 11.432 MPa ; satisfactory.

DIMENSIONAL INSPECTION REPORT

VESSEL NOZZLE CHECK LIST

JOB # 30789-0 Checked By DARYL S.

NOZZLE	2-HOLE	LEVEL	SQUARE	PROJECTION	RATING	FLANGE CONDITION	COMMENTS
M1	✓	✓	✓	✓ 800 mm	24" 300 HB	✓	
N1	✓	✓	✓	✓ 250 mm	6" 300 HB	✓	
N2	✓	✓	✓	✓ 250 mm	6" 300 HB	✓	
N3	✓	✓	✓	✓ 250 mm	4" 300 HB	✓	
N4	✓	✓	✓	✓ 250 mm	4" 300 HB	✓	
N5A	✓	✓	✓	✓ 250 mm	4" 300 HB	✓	
N5B	✓	✓	✓	✓ 250 mm	4" 300 HB	✓	
N5C	✓	✓	✓	✓ 250 mm	4" 300 HB	✓	
N6A	✓	✓	✓	✓ 180 mm	2" 300 LWN	✓	
N6B	✓	✓	✓	✓ 180 mm	2" 300 LWN	✓	

PAINT REPORTS

MALONEY INDUSTRIES

Painting Record / Data Sheet

Work Order Number: 30789 Date: Jan 8
 Item Being Painted: Vessel

A. Surface Preparation

Surface Cleanliness Standard: SP 6 Cleaning Method: sandblast
 Surface Condition _____
 Blast Profile Average: 3.7 Number of Readings Taken: 2
 Abrasive Type: Sand Abrasive Size: S11 # 9
 Contaminants Free Test: _____ White Blotter Test: _____
 Ambient Temperature: 8°C Dew Point: _____
 Relative Humidity: 56% Surface Temperature: _____
 Blast Operating Pressure (psi) 120

B. Paint Application Equipment

	Primer	2 nd Coat	3 rd Coat	Final Coat
Brush/Roller/Conve. Spray/Airless	✓	✓		
Conventional Gun				
Airless Tip Size	419	419		
Pump Ratio	56-1	56-1		
Supply Pressure (psig)	150	150		

C. Painting Conditions

	Primer	2 nd Coat	3 rd Coat	Final Coat
Relative Humidity (%)	39	32		
Surface Temperature (°C)	18	24		
Ambient Temperature (°C)	24	25		
Dew Point	2	1		
Other Weather Conditions (rain, snow)	inside Paint Bay			

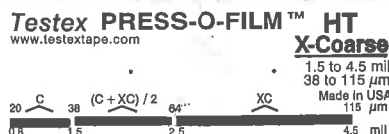
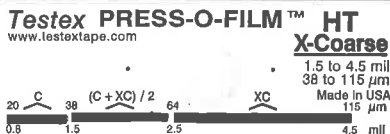
D. Paint and Coating Materials

	Primer	2 nd Coat	3 rd Coat	Final Coat Jobs
Brand Name or Product Code	Cloverdale			
Batch Number	on Back side			
Product Number	83150	83300		
Specified DFT's	4-6	4-6		
Actual DFT's	4-7	4-6		8-12
Number of Readings/Measurements	100	100		

Final Holiday Test Performed (number of holidays found/repaired) _____
 Holidays Repaired _____

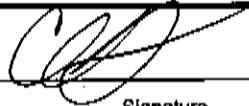
Reviewed By: Carly Date: Jan 10/14

Form Number: FRM-QAPC-01-02 Date Issued: April 25, 2000 Revision: 2 Date Revised: May 3, 2001



INSULATION REPORT

Itemized Inspection Report

Prepared By <u>Chris</u>		Date <u>JAN 24 2014</u>		Page <u>1</u> of <u>1</u>	
Area		Description <u>VESSEL</u>			
Line / Tag number <u>30789</u>		Item completion - % <u>100</u>			
Insulation					
Type <u>FIBERGLASS</u>		Manufacturer _____			
Size / Thickness <u>2"</u>		Single / Double Layer <u>SINGLE</u>			
Insulation Securement		Type <u>BANDING 35</u>		Size <u>3/4"</u>	
		Spacing <u>12"</u>			
Cladding		Type _____		Thickness _____	
		Laps _____		Lap Location _____	
Cladding Securement		Type _____		Size _____	
		Spacing _____			
Valves		Insulated _____		Flanges	
		Not Insulated _____		Insulated _____	
				Not Insulated _____	
Fittings		Insulation _____			
		Cladding _____			
Vessel Shells		Cladding Type <u>ALUM. SMOOTH</u>		Thickness <u>020</u>	
Vessel Heads		Cladding type <u>ALUM. SMOOTH</u>		Thickness <u>020</u>	
Caulking		All penetrations caulked <u>YES</u>			
Notes: _____ _____ _____ _____ _____					
Company Rep. <u>CHRIS BROWN</u>				<u>JAN 24/14</u>	
		Print Name		Signature	
				Date	
QA / QC Rep. _____		_____		_____	
		Print Name		Signature	
				Date	
Client Rep. _____		_____		_____	
		Print Name		Signature	
				Date	

INSPECTION AND TEST PLAN

Foremost Universal LP INSPECTION AND TEST PLAN

MI Document Number: 13-030789-101 ITP	Revision: 0	Date: October 23, 2013
Customer: Suncor Energy c/o Equinox Engineering Ltd	Code of Fabrication ASME Section VIII, Div. 1 Inspection Codes H = Hold W = Witness I = Inspect O = Observe C = Check R = Review	
Customer P.O. Number: P383121-KN-001		
Equipment and Tag No.: Slug Catcher		
Client Document Number:		

Description	Acceptance Criteria	Code	FULP	Date	Code	Suncor	Date
1.0 Materials							
1.1 Receiving inspection of incoming material for any visible damage and compliance to purchase order	Purchase order	I	SH	9/18/13	R		
1.2 Review material test reports for compliance with ASME R.1 Codes and client specification's, All material to meet NACE MR-0175, S≤0.003 for plate material excepts Heads which are S≤0.004 per RFI-1.	ASME Sect II	R	NM	11/29/13	R	<i>[Signature]</i>	JAN 23 2014
2.0 Document Review							
2.1 Pre-fabrication meeting		H	PC	10/10/13	H	<i>[Signature]</i>	JAN 06 2014
2.2 Review welding procedures for job suitability	Approved WPS	R	PC	↓	H	<i>[Signature]</i>	JAN 06 2014
2.3 Verify welders qualifications prior to welding	ASME Section IX	R	PC		C	<i>[Signature]</i>	JAN 06 2014
2.4 Review of Hydrostatic Test Procedure	Approved procedure	R	PC		C	<i>[Signature]</i>	JAN 06 2014
2.5 Review of NDE Procedures	Approved procedure	R	PC		C	<i>[Signature]</i>	JAN 06 2014
2.6 Review Post Weld Heat Treatment Procedure	Approved procedure	R	PC		C	<i>[Signature]</i>	JAN 06 2014
3.0 Fabrication							
3.1 UT all plate to SA-578 Level B – 4" Grid	Approved Procedures	I	PC	10/9/13	R	<i>[Signature]</i>	JAN 23 2014
3.2 MPI on outside of knuckle and flange area for all heads R.1	Approved Procedures	R	PC	10/11/13	R		
3.3 Verify longitudinal weld seam fit up	ASME Section VIII, Div. 1	V	PC	10/18/13	R	<i>[Signature]</i>	JAN 23 2014

Foremost Universal LP INSPECTION AND TEST PLAN

MI Document Number: 13-030789-101 ITP	Revision: 0	Date: October 23, 2013
Customer: Suncor Energy c/o Equinox Engineering Ltd	Code of Fabrication	
Customer P.O. Number: P383121-KN-001	ASME Section VIII, Div. 1	
Equipment and Tag No.: Slug Catcher	Inspection Codes	
Client Document Number:	H = Hold W = Witness I = Inspect	
	O = Observe C = Check R = Review	

Description	Acceptance Criteria	Code	FULP	Date	Code	Suncor	Date
3.4 Verify that welding is in compliance with approved WPS	Approved WPS	R	W.L.S.H.	10/21/13	C		
3.5 Radiograph long seams as per the requirements specified on fabrication drawings – RT-1, UW-11(a) 100% - Before PWHT	ASME Section VIII, Div. 1	R	PE	11/24/13	C	<i>[Signature]</i>	JAN 0 6 2014
3.6 Radiograph long seams as per the requirements specified on fabrication drawings – RT-1, UW-11(a) 100% - After PWHT	ASME Section VIII, Div. 1	R	PC	1/3/14	C	<i>[Signature]</i>	JAN 0 6 2014
3.7 Verify impact results as per the drawing	ASME Section VIII, Div 1	R	PC	11/25/13	C		
3.8 Verify circumferential weld seam fit up	ASME Section VIII, Div. 1, UW 33. Fabrication Drawings	I	SK	11/1/13			
3.9 Radiography of circ seams as specified on fabrication drawings – RT-1, UW-11(a) 100% Before PWHT	ASME Section VIII, Div. 1	R	PC	11/28/13	C	<i>[Signature]</i>	JAN 0 6 2014
3.10 Radiography of circ seams as specified on fabrication drawings – RT-1, UW-11(a) 100% After PWHT	ASME Section VIII, Div. 1	R	PC	1/3/14	C	<i>[Signature]</i>	JAN 0 6 2014
3.11 Radiograph nozzle butt welds prior to installation in vessel as required – RT-1, UW-11(a) 100% Before PWHT	ASME Section VIII, Div. 1	R	—		C		
3.12 Radiograph nozzle butt welds – RT-1, UW-11(a) 100% After PWHT	ASME Section VIII, Div. 1	R	—		C		
3.13 Verify layout of nozzles in heads and shells are in compliance with drawing	Fabrication drawing	I	RS	11/7/13	R-I	<i>[Signature]</i>	JAN 2 3 2014
3.14 Verify that welding of Category D welds are in compliance with approved WPS	Approved WPS	I	SG	12/16/13	C		
3.15 Visual examination of all completed vessel welds interior and exterior for code compliance (before and where accessible after PWHT)	ASME Section VIII, Div. 1	H-I	PC	12/19/13	H-I	<i>[Signature]</i>	Dec 21/13

Foremost Universal LP INSPECTION AND TEST PLAN

MI Document Number: 13-030789-101 ITP	Revision: 0	Date: October 23, 2013
Customer: Suncor Energy c/o Equinox Engineering Ltd	Code of Fabrication	
Customer P.O. Number: P383121-KN-001	ASME Section VIII, Div. 1	
Equipment and Tag No.: Slug Catcher	Inspection Codes	
Client Document Number:	H = Hold W = Witness I = Inspect	
	O = Observe C = Check R = Review	

Description	Acceptance Criteria	Code	FULP	Date	Code	Suncor	Date
3.16 Perform a dimensional inspection to ensure compliance with fabrication drawings	Fabrication Drawing	H-I	RS	12/12/13	R-I	<i>[Signature]</i>	Dec 12-13
3.17 WFMPI inside of vessel all internal welds, Fillet welds, Attachments and areas of temporary attachments removal before PWHT	Approved procedure	R	PC	12/16/13	C	<i>[Signature]</i>	JAN 23 2014
3.18 WFMPI inside of vessel all internal welds, Fillet welds, Attachments and areas of temporary attachments after removal after PWHT where accessible	Approved procedure	R	PC	12/19/13	C	<i>[Signature]</i>	JAN 23 2014
3.19 WVMPI outside of vessel, all Fillet welds, Lifting lugs, Attachments and areas of temporary attachments after removal before PWHT	Approved procedure	R	PC	12/16/13	C	<i>[Signature]</i>	JAN 23 2014
3.20 WVMPI outside of vessel, all Fillet welds, Lifting lugs, Attachments and areas of temporary attachments after removal After PWHT	Approved procedure	R	PC	12/19/13	C	<i>[Signature]</i>	JAN 23 2014
3.21 UT Cat D welds before PWHT	Approved procedure	R	PC	12/15/13	C	<i>[Signature]</i>	JAN 23 2014
3.22 UT Cat D welds after PWHT	Approved procedure	R	PC	12/19/13	C	<i>[Signature]</i>	JAN 23 2014
3.23 Post weld heat treat vessel as per the drawing (time @ 1150±50°F)	Approved procedure	I	PC	12/18/13	R/C	<i>[Signature]</i>	JAN 23 2014
3.24 Hydrostatic test vessel to as required, test must be charted for 1 hour minimum.	Approved procedure	H-I	PC	1/6/14	R-I	<i>[Signature]</i>	JAN 23 2014
3.25 Internal inspection following hydrostatic test to verify that: the vessel is dried and clean where accessible	Visual Inspection	H	PC	1/10/14	W-I	<i>[Signature]</i>	JAN 23 2014
3.26 Inspect installation of internals if required.	Fabrication Drawing	I	PC	12/13/13	C		
4.0 Saddles							
4.1 Verify fit-up	Fabrication Drawing	H	RS	12/12/13	C		

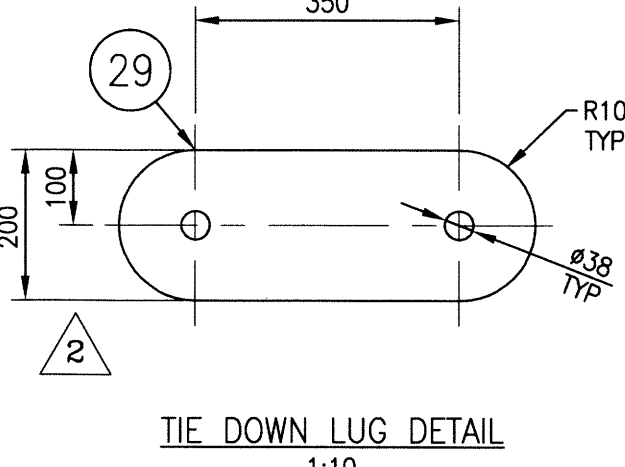
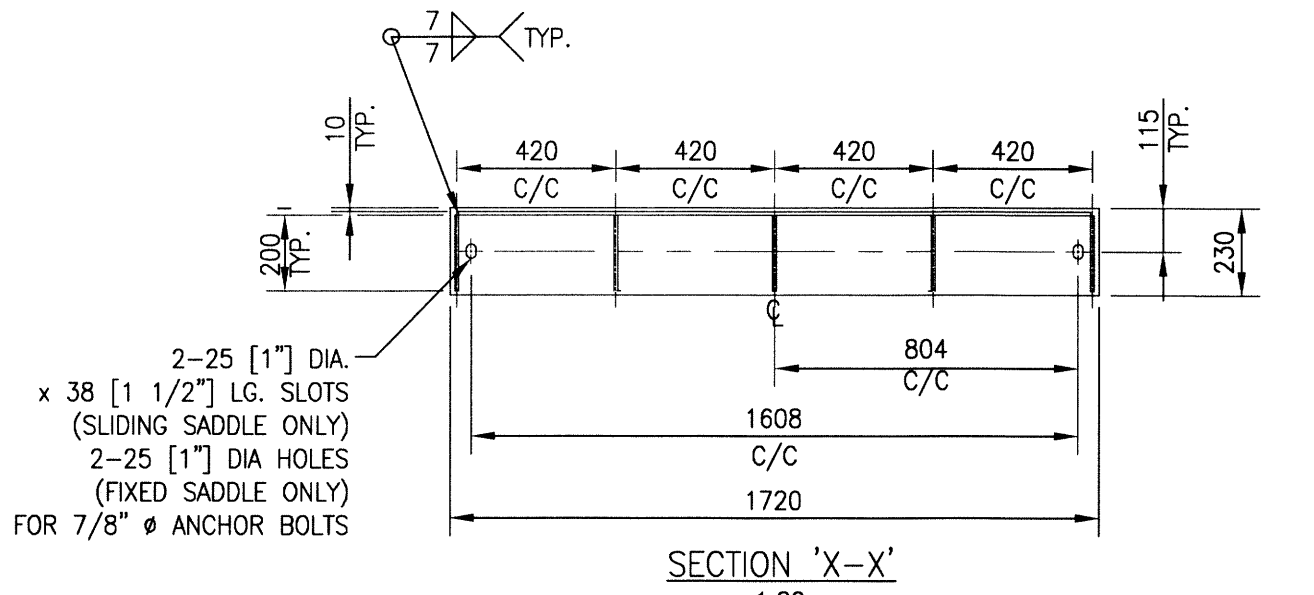
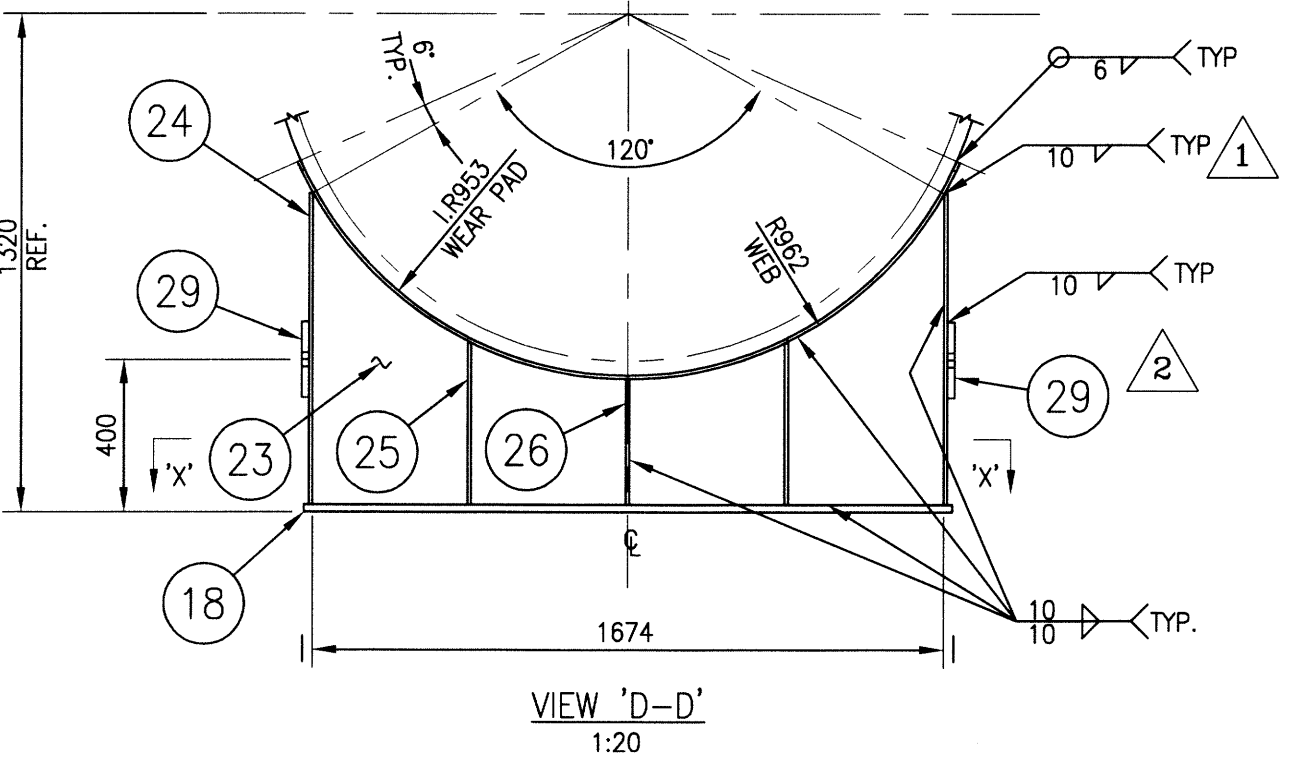
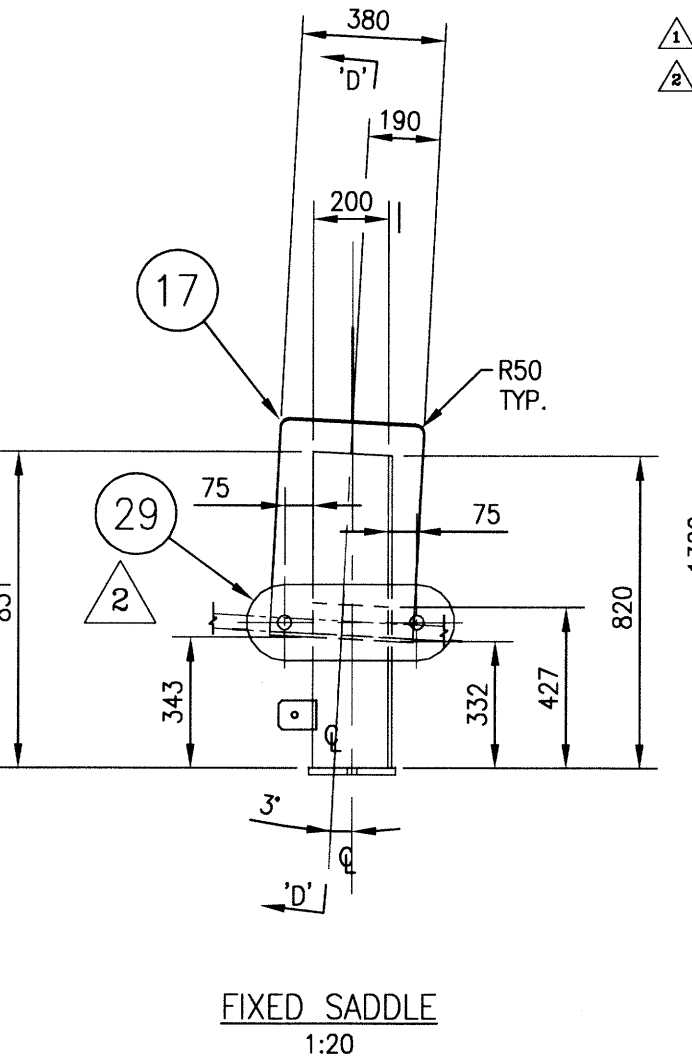
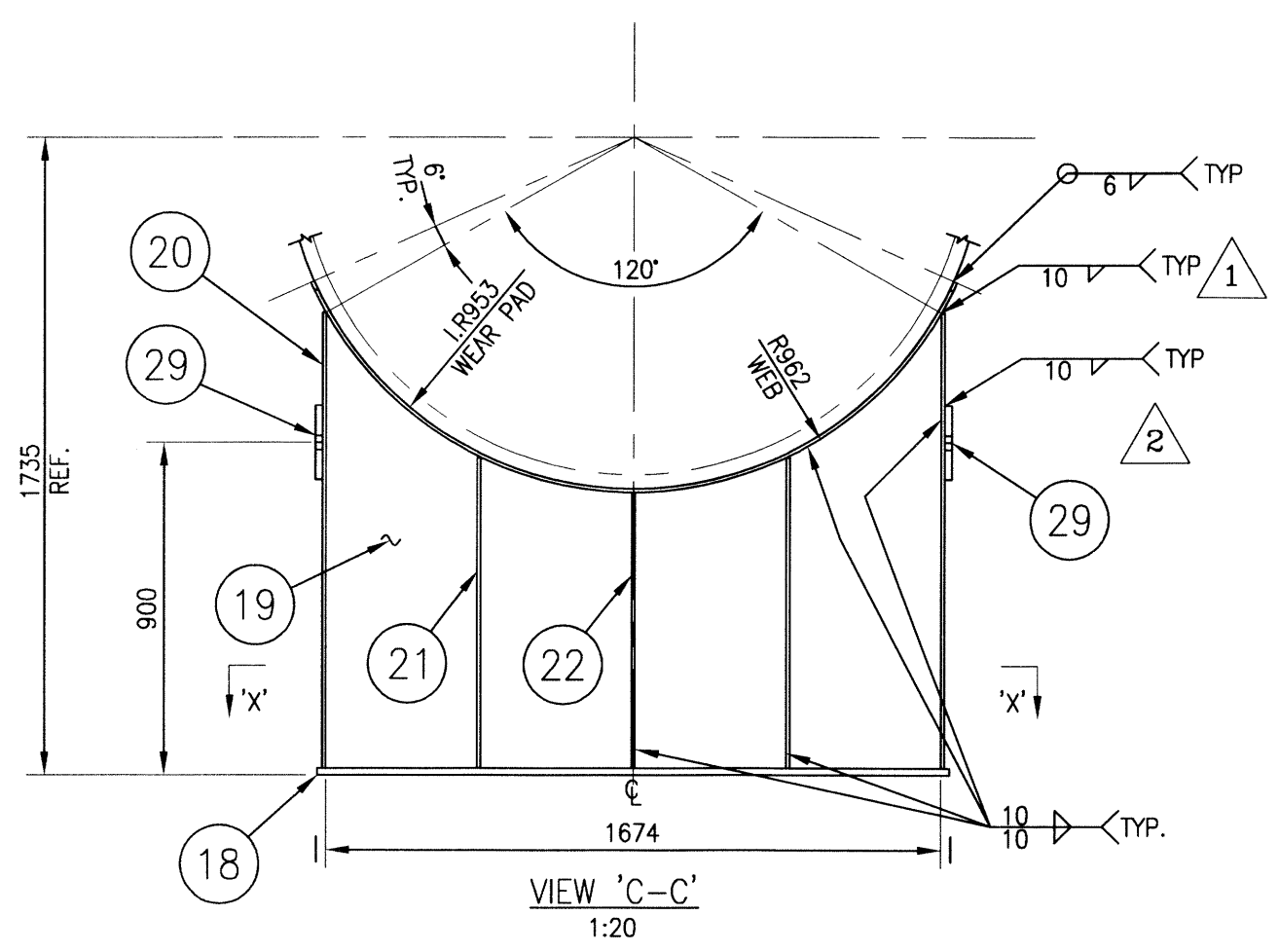
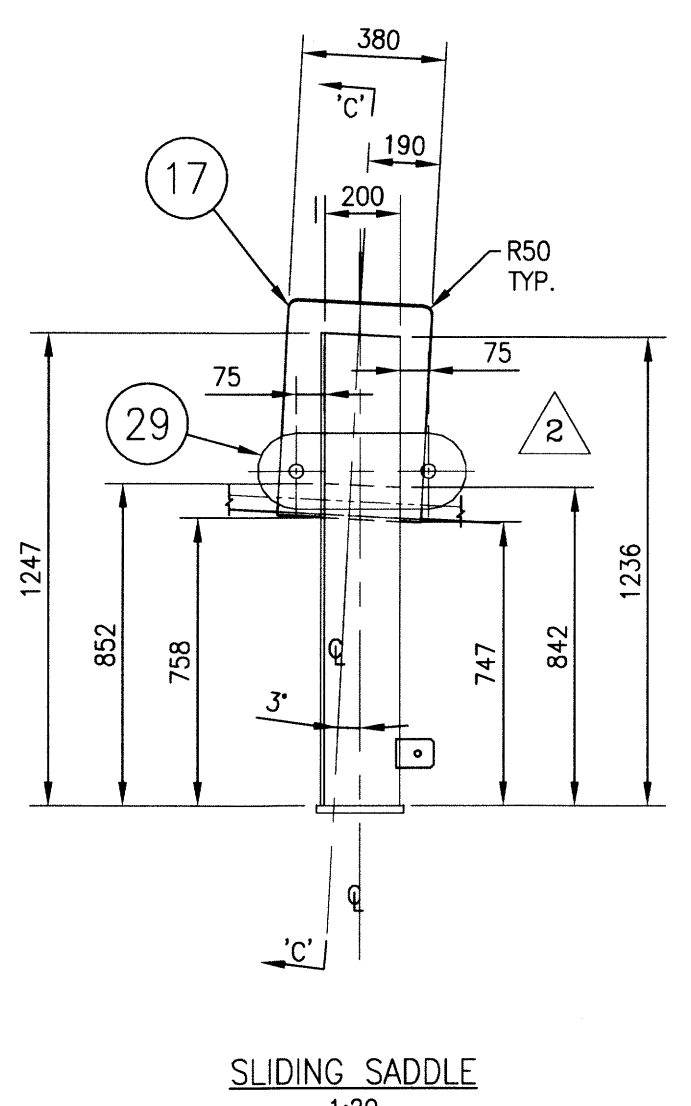
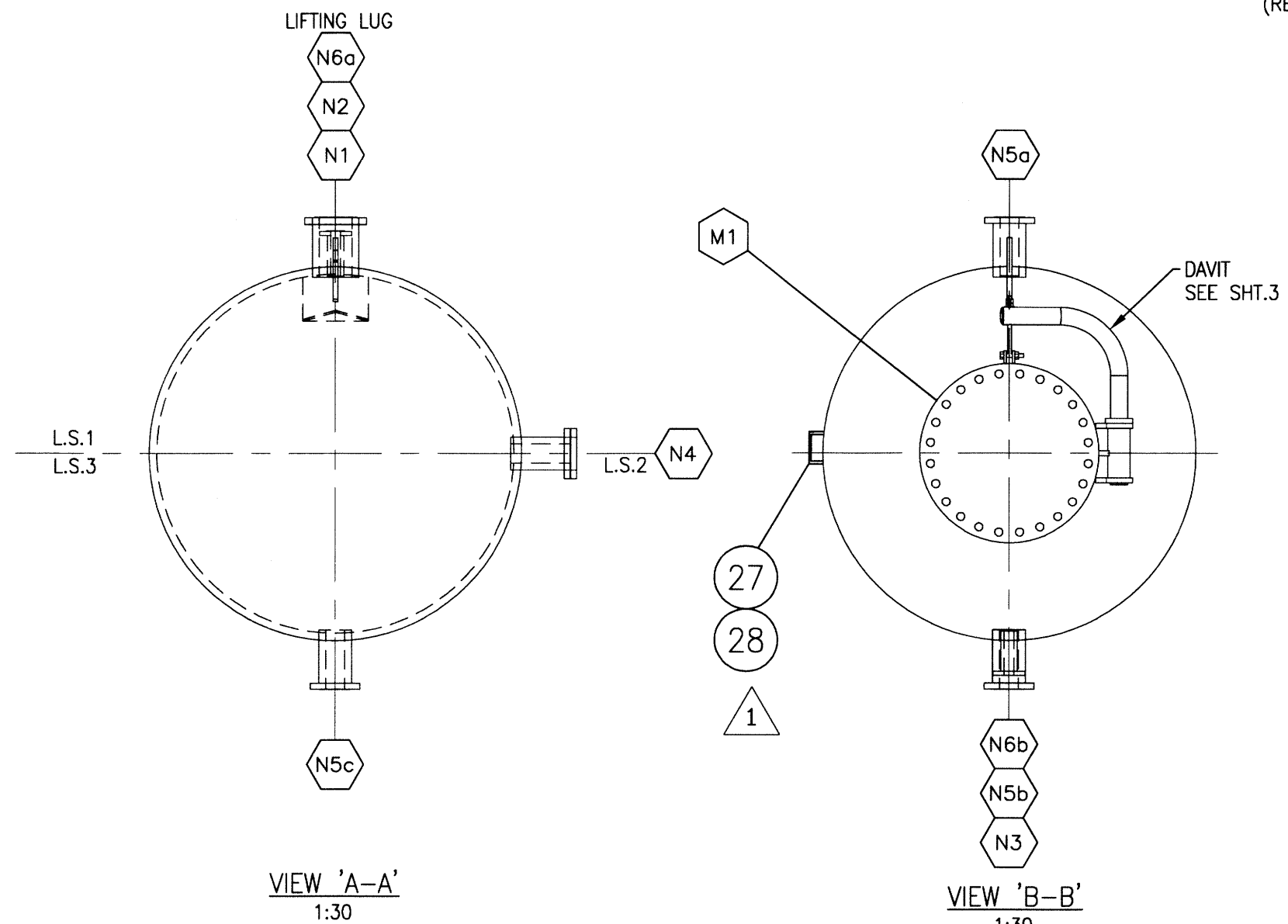
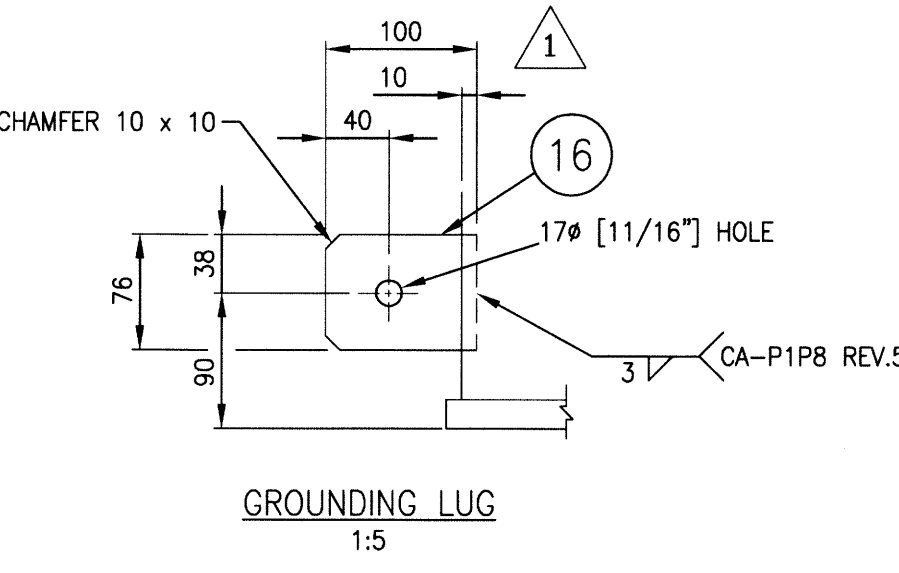
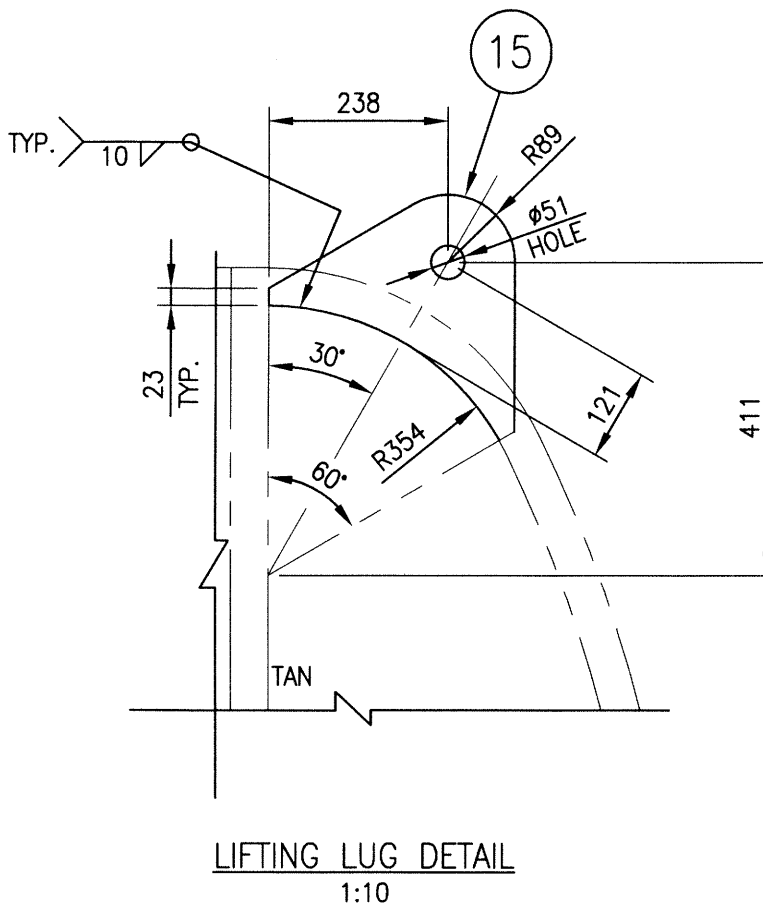
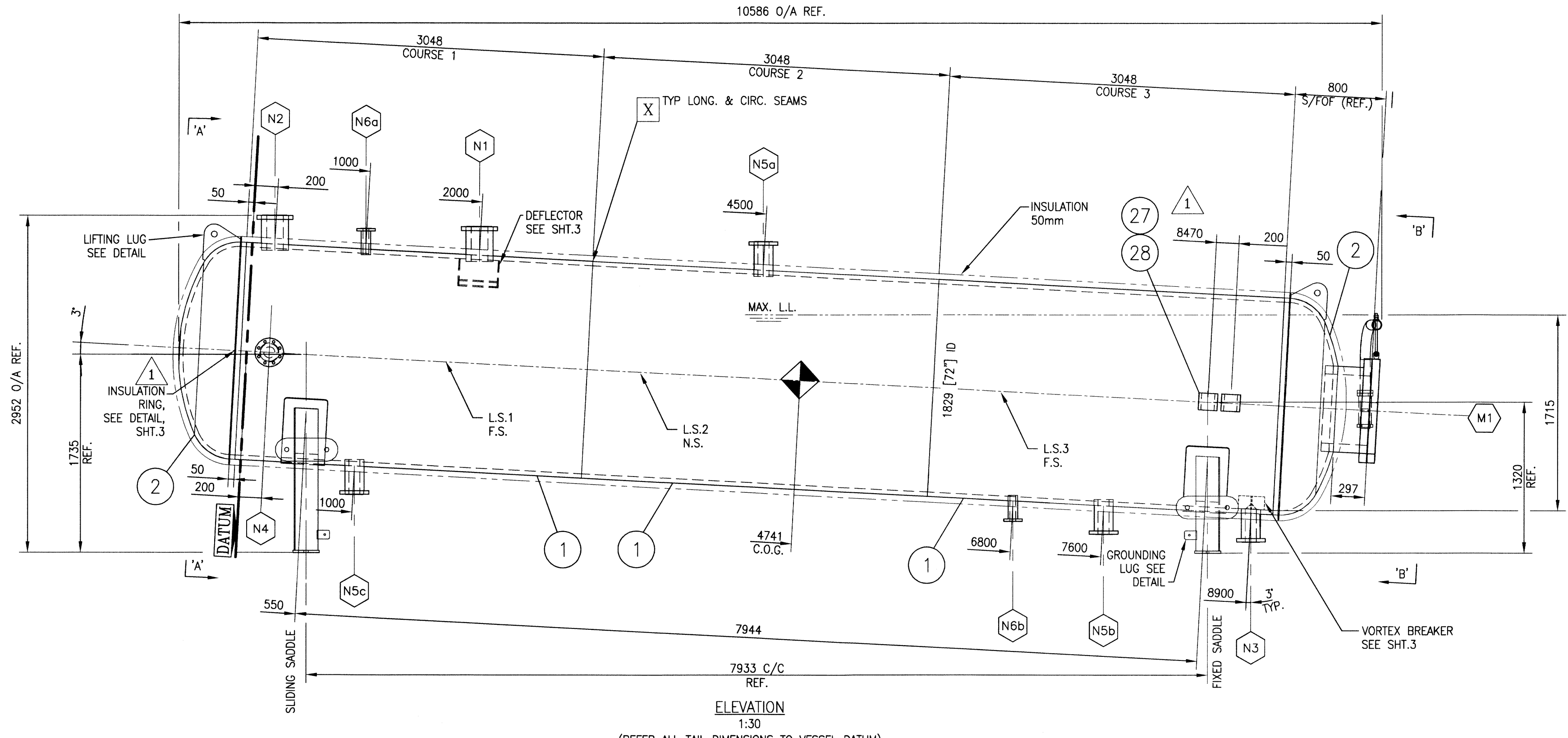
repad
for saddle
MS build
drawing

Foremost Universal LP INSPECTION AND TEST PLAN

MI Document Number: 13-030789-101 ITP	Revision: 0	Date: October 23, 2013
Customer: Suncor Energy c/o Equinox Engineering Ltd	Code of Fabrication	
Customer P.O. Number: P383121-KN-001	ASME Section VIII, Div. 1	
Equipment and Tag No.: Slug Catcher	Inspection Codes	
Client Document Number:	H = Hold W = Witness I = Inspect	
	O = Observe C = Check R = Review	

Description	Acceptance Criteria	Code	FULP	Date	Code	Suncor	Date
4.2 Verify overall dimensions	As-built drawing	I	RS	12/16/13	R-I		JAN 10 2014
5.0 Painting							
5.1 Visual blast inspection to verify surface preparation and random measurement of blast profile	SSPC-SP6/NACE Standards	I	CS	1/3/14	I		
5.2 Prime one coat and paint one coat.	Cloverdale epoxy 83150	R	CS	1/9/14	R		JAN 23 2014
5.3 Random measure dry film thickness of coating	SSPC Standards	I	CS	1/10/14	I		JAN 23 2014
5.4 Visual inspection of dry coating	SSPC Standards	I	CS	1/10/14	I		JAN 10 2014
6.0 Documentation Requirements							
6.1 Manufacturers data books per specified documentation requirements	SDDR	H-I	NM	1/21/14	W-I		JAN 23 2014
6.2 Obtain the shipping release		H	PC	1/27/14	H		JAN 27/14

DRAWINGS



NO.	DATE (d/m/y)	REVISIONS	BY	APPD
10-1-14		ADDED MAMP EXT INFORMATION IN DESIGN NOTES		
06/01/14		REVISED DRAWING NAME, AS BUILT	CY	EC
02/12/13		REVISED MAMP METRIC EQUIVALENT TO MATCH CRN	CY	JM
14/11/13		ADDED THE DOWN LUGS	CY	JM
16/10/13		ADDED INSULATION RINGS & NAME PLATES, ADDED 'C' TO ITEM 1 & 2	IC	EC
		MOVED IN GROUNDING LUGS BY 10mm, ADDED FILLET WELD TO SADDLES		
02/10/13		ISSUED FOR CONSTRUCTION	PC	EC

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FOREMOST

CLIENT
SUNCOR ENERGY c/o EQUINOX ENGINEERING LTD.
BOX 2844, 150 - 6th Ave. SW CALGARY AB T2P 3E3
KOBES C-97-G/94-B-9 WATER HANDLING

DWG TITLE
SLUG FINGER V-120
1829mm [72] ID x 9144mm [30'-0"] S/S
GENERAL ARRANGEMENT

NO. REQ'D
1

SCALE
1:30 UNO

DATE (d/m/y)
20/09/13

PERMIT TO PRACTICE
ALBERTA NO. P-12145

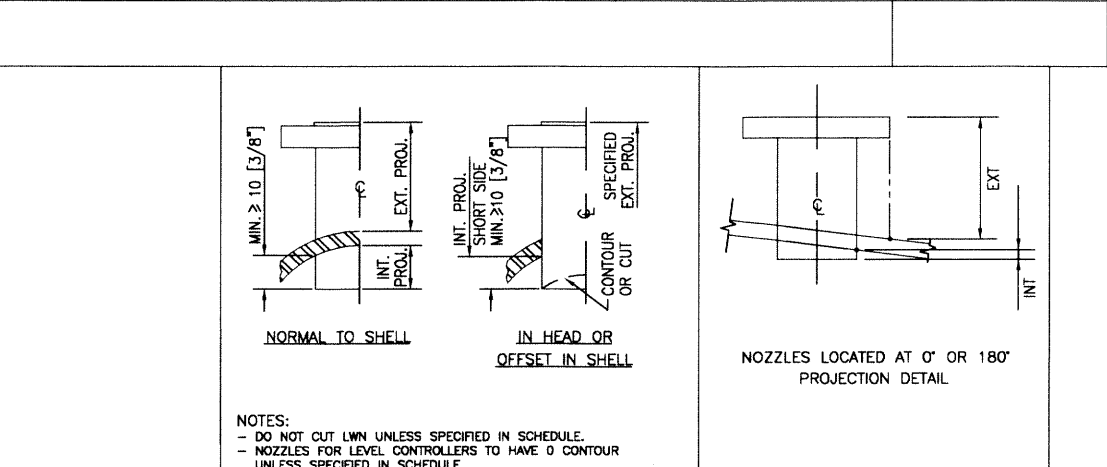
NO. NO.
030789

LEG. NO.
01,2,3,8

SHEET NO. REV. NO.
1 of 3

N6 (g/b)	2	HOT WATER	DN50 [2"]	-	300	RFLWN	x 229 LG	W	180	MIN.			10		5				8
N5c	1	EQUALIZATION	DN100 [4"]	-	300	RFHB	x 305 LG	W	250	MIN.			10		5				6
N5b	1	EQUALIZATION	DN100 [4"]	-	300	RFHB	x 305 LG	W	250	MIN.			10		5				6
N5g	1	EQUALIZATION	DN100 [4"]	-	300	RFHB	x 305 LG	W	250	MIN.			10		5				6
N4	1	SPARE	DN100 [4"]	-	300	RFHB	x 305 LG	W	250	MIN.			10		5	c/w BLIND		6,7,12,13,14	
N3	1	LIQUID OUTLET	DN100 [4"]	-	300	RFHB	x 305 LG	Y	250	FLUSH			10		-				6
N2	1	VAPOUR OUTLET	DN150 [6"]	-	300	RFHB	x 305 LG	W	250	MIN.			10		5				5
N1	1	INLET	DN150 [6"]	-	300	RFHB	x 305 LG	W	250	MIN.			10		5				5
M1	1	MANWAY	DN600 [24"]	-	300	RFHB	x 406 LG	W	SPEC.	60			10		5	c/w BLIND & DAVIT		3,4,9,10,11	

ASME B16.5 FLANGES		NOZZLE SCHEDULE	
I	SEAMS	W	X
WPS MI-GSS-4	WPS MI-GSS-4	WPS MI-GSS-4	WPS MI-GSS-4
BEVEL -	BEVEL 60° ± 10°	BEVEL 30° ± 5°	BEVEL 60° ± 10°
GAP -	GAP 5 ± 3	GAP 5 ± 3	GAP 5 ± 3
LAND NONE	LAND NONE	LAND NONE	LAND NONE



DESIGN NOTES

DESIGN CODE - ASME SECTION VIII, DIVISION 1 2010 ADDENDA 2011a

DESIGN PRESSURE OR MAMP (HOT & CORRODED) 5068 kPag [735 Psig] DESIGN TEMPERATURE 38 °C [100 °F]

MAMP (HOT & CORRODED) LIMITED BY HEAD MIN. SPEC. THK.

MAMP EXT 104 kPa [15 psi] @ 66/-40°C [150/-40°F]

RADIOGRAPHY RT 1, UW-11(g) 100% ON BUTT-WELDED JOINTS JOINT EFFICIENCY SHELL 1.00, HEAD 1.00

POST WELD HEAT TREATMENT YES, SEE SHT.2 ADDITIONAL CODES CSA B51/09

CORROSION ALLOWANCE 3.2mm [1/8"]

HYDRO-TEST PRESSURE 6591 kPag (956 psig) (1.3 x MAMP)

SERVICE SOUR CAPACITY 25,889 cu.m [915 cu.ft]

WEIGHT:dry 22,500 kg [49,604 lbs] hydro 47,800 kg [105,381 lbs] design

OVERALL LENGTH 10,586 [34' 8 3/4"] OAL (REF) OVERALL HEIGHT 2,952 [9' 8 1/4"] OAL (REF)

MINIMUM DESIGN METAL TEMPERATURE -40 °C [-40 °F] @ MAMP

SEE SHT.2 FOR IMPACT TEST

SURFACE PREPARATION AND PAINTING REQUIREMENTS

ITEM	BLAST	PRIMER	D.F.T.	FINISH	D.F.T.
INSULATED VESSEL EXTERIOR	SSPC-SP6	LIGHT GREY	4.0-6.0	WARM GREY	4.0-6.0
UNINSULATED VESSEL EXTERIOR	SSPC-SP6	LIGHT GREY	4.0-6.0	WARM GREY	4.0-6.0
VESSEL INTERIOR	N/A	N/A	N/A	N/A	N/A
APPURTENANCES	-	-	-	-	-
PROTUSIONS	-	-	-	-	-
SADDLE	SSPC-SP6	LIGHT GREY	4.0-6.0	WARM GREY	4.0-6.0
LADDERS	N/A	N/A	N/A	N/A	N/A
PLATFORMS	N/A	N/A	N/A	N/A	N/A
INTERNAL PIPING	-	-	-	-	-
EXTERNAL PIPING	N/A	N/A	N/A	N/A	N/A
UNINSULATED PIPING	N/A	N/A	N/A	N/A	N/A
SKID	N/A	N/A	N/A	N/A	N/A

NOTES:
 1. PRIME GREY OVER CLEAN MILL SCALE (NO BLAST).
 2. REFER TO PAINTING SCHEDULE

HEAT TREATMENT

GOVERNING COMPONENT: HEAD
 GOVERNING WELD THICKNESS: 44.45 [1 3/4"]
 TYPE OF HEAT TREATMENT REQUIRED: POST WELD

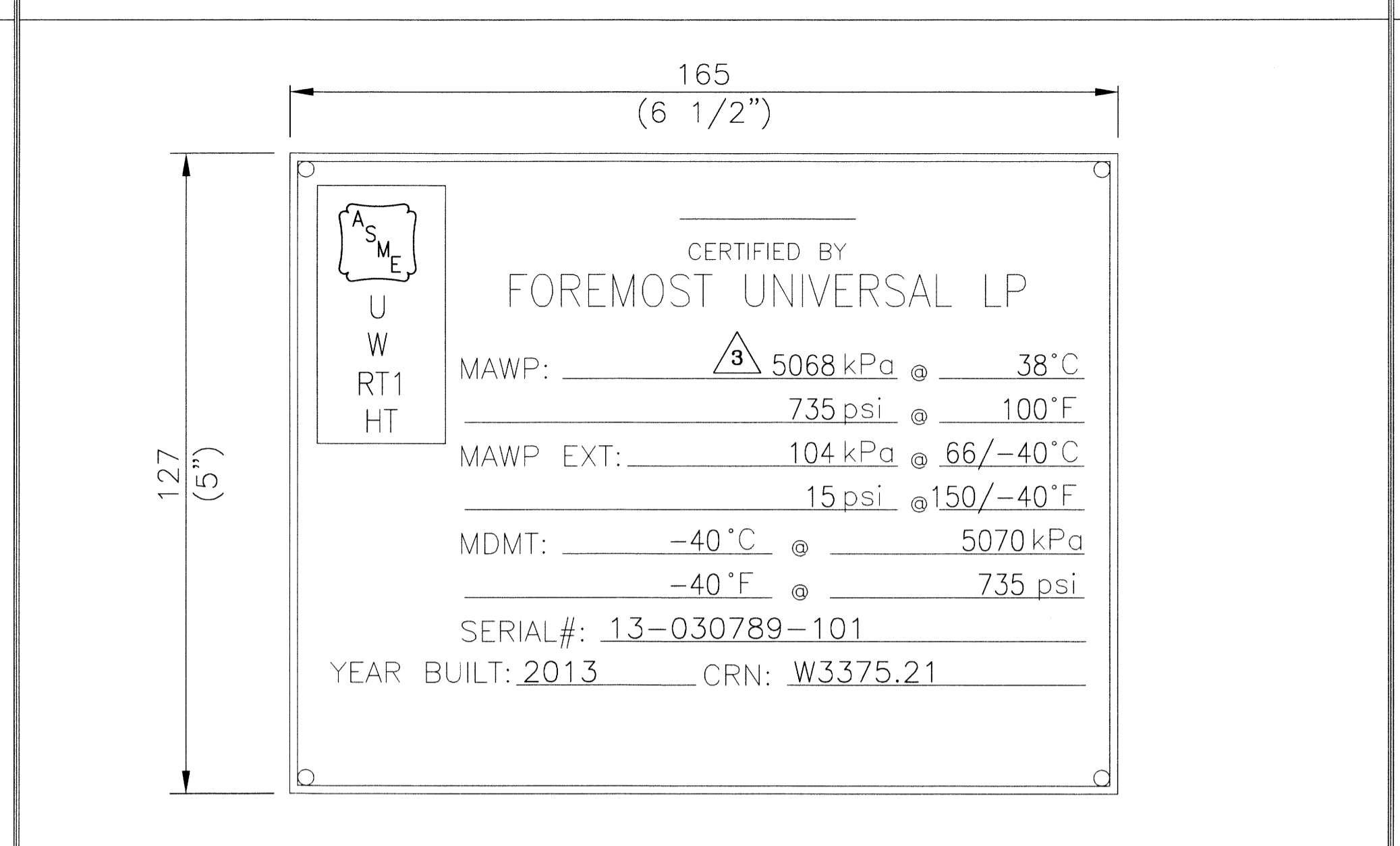
INSTRUCTIONS

- TEMPERATURE TO BE RAISED FROM 800°F TO 1150±50°F AT A MAXIMUM RATE OF 225°F PER HOUR.
- TEMPERATURE TO BE HELD AT 1150±50°F FOR 1 HOUR 45 MINUTES.
- TEMPERATURE TO BE LOWERED FROM 1150±50°F TO 800°F AT A MAXIMUM RATE OF 285°F PER HOUR.
- PLACEMENTS AND LOCATIONS OF THERMOCOUPLES: AS PER ASME VIII, DIV. 1, UW-40(c).
- ADDITIONAL REQUIREMENTS: N/A

FABRICATION NOTES

- ALL FLANGE RATINGS TO BE ASME B16.5 - 2009.
- FLANGE AND BOLT HOLES TO STRADDLE PRINCIPAL CENTRELINES OF VESSEL.
- ALL DIMENSIONS ARE IN S.I. (mm). UNITS OF MEASUREMENT IN [BRACKETS] ARE IMPERIAL HARD CONVERSIONS FOR SHOP REFERENCE ONLY AND PURCHASING REFERENCE ONLY.
- NO WELDING OR HEATING TO CORRECT MISALIGNMENT SHALL BE PERMITTED AFTER PWHT.
- TACK WELDS TO BE REMOVED DURING ROOT PASS.
- L.S. = LONGITUDINAL SEAM
F.S. = FAR SIDE
- HEAD TO SHELL JOINT TO BE TRANSITIONED AS PER UW-9(c).
- RADIUS EXPOSED INSIDE EDGES AS PER UG-76(c).
- ALL MATERIAL AND WELDER IDENTIFICATION SHALL BE WITH LOW STRESS STAMPS.
- FABRICATION TOLERANCES SHALL BE IN ACCORDANCE WITH TOLERANCE DRAWINGS (EDS-6070 LATEST REV., EDS-6071 LATEST REV. & MI-PVTOL-01 REV.).
- PERMANENT BACKING RINGS ARE NOT PERMITTED.
- ITEMS FORMED BY OTHERS MUST COMPLY WITH UG-79 & REFERENCED PARAGRAPHS, I.E. HEADS & SHELLS.
- WELD CAPS TO BE 0 TO 5 [0 TO 3/16"] MAXIMUM
- MI-GSS-2 REV.1, MI-GSS-4 REV.1, CA-TIG-6 REV.3 CA-PIPB-1 REV.5, CSA-W47.1, CSA-W59 WELD PROCESURES INCLUDE PREHEAT TO 200°F
- NO DIFFERENT 'P' NUMBER WELDED TO PRESSURE ENVELOPE PER SOUR SPEC. 4.1.6

NAMEPLATE DETAIL



REGISTRATION

REGISTERED IN THE PROVINCE(S) AB AND BC
 CRN NUMBER W3375.21
 MFR SERIAL NUMBER 13-030789-101

INSULATION REQUIREMENTS

ITEM	INSULATION TYPE	THK.	CLAD TYP.	THK.
VESSEL	FIBREGLASS	51 [2"]	STRUCTURED EMBOSSED SMOOTH ALUMINUM CLADDING	0.020

NOTES:

HYDROTEST REQUIREMENTS

- VESSEL SHOULD BE HYDROTESTED IN THE HORIZONTAL POSITION AND SHALL BE ADEQUATELY SUPPORTED TO PREVENT WEIGHT DEFORMATION.
- HYDROTEST PRESSURE SHALL BE MAINTAINED FOR A MINIMUM OF ONE(1) HOUR.
- UPON COMPLETION OF HYDROTEST, VESSEL SHALL BE COMPLETELY DRAINED OF ALL WATER.
- HYDROTESTING SHALL BE CARRIED OUT ON THE VESSEL BEFORE IT IS EXTERNALLY PAINTED.

MATERIAL REQUIREMENTS

SHELL
 MATERIAL SA-516-70N

HEADS
 1. MATERIAL SA-516-70N TYPE 2:1 SE
 2. MATERIAL SA-516-70N TYPE 2:1 SE
 3. MATERIAL TYPE

FLANGE SA-350-LF2 CL1 PIPE SA-333-GR.6
 WELD FITTINGS SA-420-WPL6 FIRETUBE N/A
 NONPRESSURE SA-420.21/300W/SA-516-70N FIRETUBE N/A
 WELDOLET N/A THREDOLET N/A
 STUD BOLTS SA-193-B7M HEX NUTS SA-194-2HM
 GASKETS 316SS SPWND GRAPHITE FILLER

NOTES:

- ITEMS IDENTIFIED WITH AN 'M' ARE ATTACHED TO PRESSURE ENVELOPE AND REQUIRE IDENTIFICATION IN ACCORDANCE WITH Q.C. MANUAL
- ITEMS IDENTIFIED WITH AN 'I' ARE IMPACT TESTED, SEE INSPECTION AND TESTING NOTE E
- ITEMS IDENTIFIED WITH 'C' WILL MEET NACE MR0175/ISO 15156 OR CSA Z245 COMPLIANT FOR SOUR SERVICE
- PLATE: FINE GRAIN PRACTICE, FULL KILLED, NORMALIZED, SA-516-70 S = 0.003 % MAX.

FIREPROOFING REQUIREMENTS

ITEM	INSULATION TYPE	THK.

OTHER NOTES

MARKING AND PREPARATION FOR SHIPMENT

- ALL FLANGED OPENINGS SHALL BE PROTECTED WITH WOODEN OR STEEL BLINDS TO PREVENT THE ACCUMULATION OF DIRT AND OTHER DEBRIS DURING SHIPPING.
- VESSEL SHALL HAVE THE WORDS "DO NOT WELD ON VESSEL - PWHT" STENCIL PAINTED ON IT IN LARGE (6") WHITE LETTERS IN 2 PLACES PRIOR TO SHIPPING.
- ALL REMOVABLE PIECES TO BE MARKED WITH EQUIPMENT TAG NUMBER.
- VESSEL MUST BE COMPLETELY CLEAN AND DRY BEFORE BEING SEALED FOR SHIPMENT. (NO HYDROCARBON FILM, MILL SCALE, HEAVY RUST, DIRT & SPLATTER.)

INSPECTION AND TESTING

A. QUALIFICATIONS

- ALL NON-DESTRUCTIVE EXAMINATIONS SHALL BE CONDUCTED AND/OR INTERPRETED BY PERSONNEL CERTIFIED IN ACCORDANCE WITH CGSB AND SNT-TC-1A LEVEL II.

B. VISUAL EXAMINATION

- EXAMINATION AND ACCEPTANCE CRITERIA SHALL BE IN ACCORDANCE WITH ASME SECTION V (ARTICLE 9) AND ASME VIII DIV.1 RESPECTIVELY.
- 100% VISUAL EXAMINATION IS REQUIRED FOR ALL WELDING.

C. RT INSPECTION

- RADIOGRAPHIC EXAMINATION AND ACCEPTANCE CRITERIA SHALL BE IN ACCORDANCE WITH ASME SECTION V (ARTICLE 2) AND ASME SECTION VIII, DIV.1 PARA UW-11(a) 100%, INCLUDING ALL CAT. B & C BUTTWELDS.
- 100% RADIOGRAPHY - BEFORE AND AFTER PWHT
 - ALL CATEGORY A AND B WELDS

D. MPI:

- HEAD KNUCKLE CONVEX SIDE AFTER FORMING
- BEFORE AND AFTER PWHT
 - ALL FILLET WELDING, LIFTING LUGS, INTERNAL AND EXTERNAL ATTACHMENTS
 - ALL TEMPORARY ATTACHMENT REMOVAL

E. IMPACT TESTING:
 L.C.V.N. TEST HEAD/SHELL PLATES & PRODUCTION WELDS TO 15/10 ft-lb @ -40 °F PER UG-84.

F. UT:
 -HEAD/SHELL PLATE ON 100mm GRID TO SA-587 LEVEL 'B' ACCEPTANCE
 - CATEGORY D WELDS

G. HYDROTEST x 1.3 MAWP

NO.	DATE (d/m/y)	REVISIONS	BY	APPD
1	01/14	REVISED DRAWING NAME & INSULATION TYPE, AS BUILT		
2	02/12/13	REVISED MAWP METRIC EQUIVALENT TO MATCH CRN	CY	EC
3	23/10/13	DELETED UT PRIOR TO ALL NOZZLE CUT OUTS	LZ	EC
4	10/10/13	REMOVED STANDARD PROCESS DATA FIELD AS PER CUSTOMER REQUEST	IC	EC
5	02/10/13	ISSUED FOR CONSTRUCTION	PC	EC

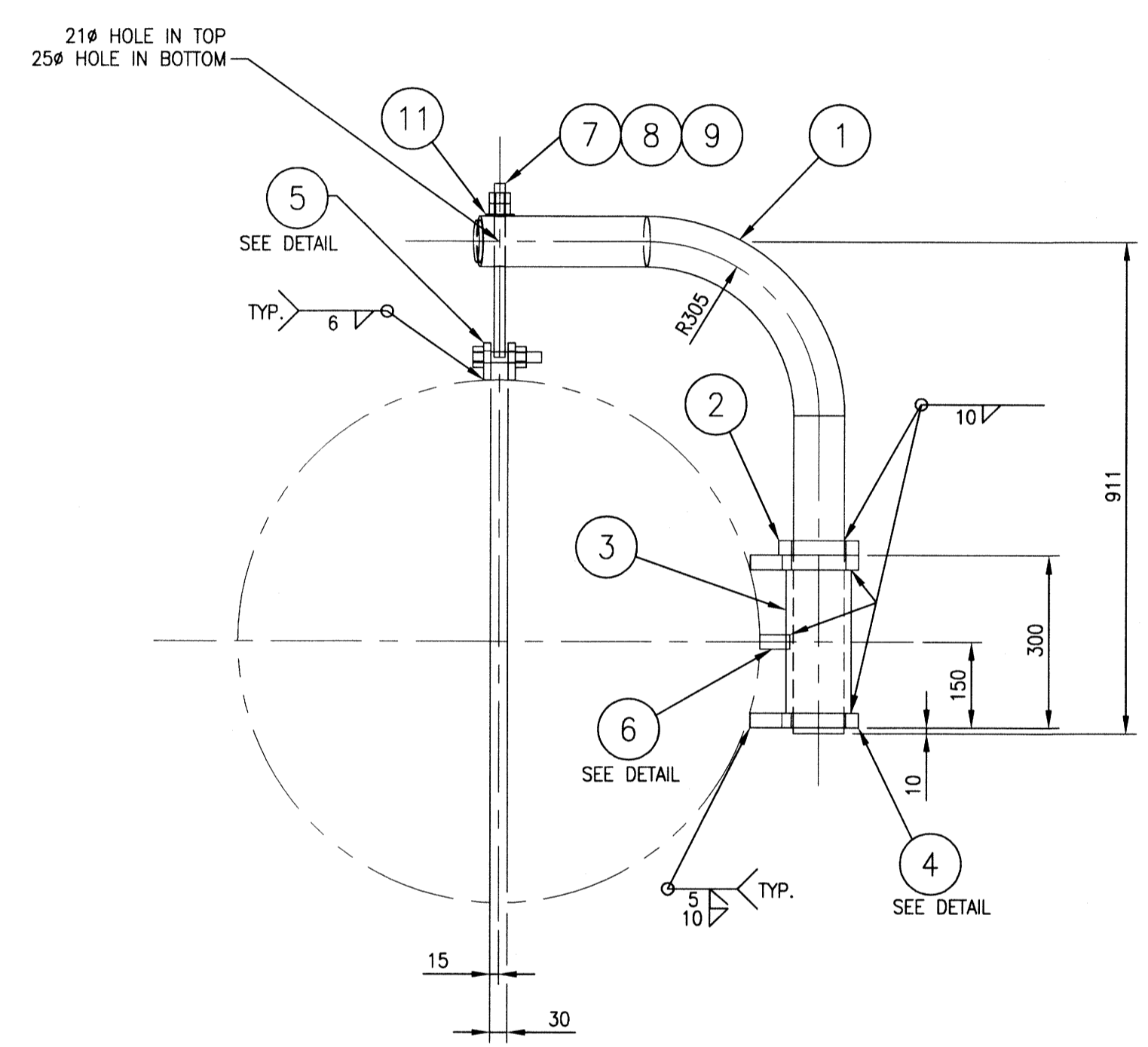
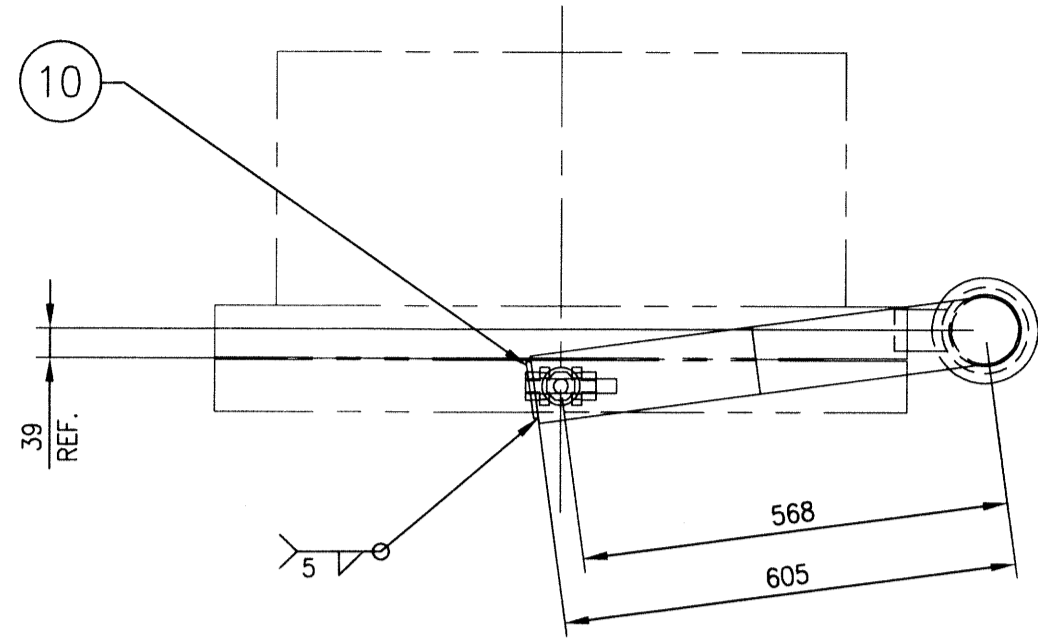
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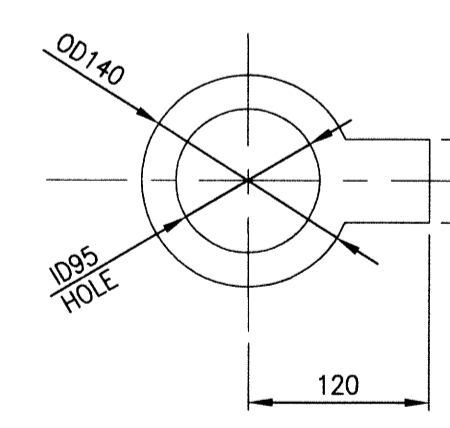
CLIENT
 SUNCOR ENERGY c/o EQUINOX ENGINEERING LTD.
 BOX 2844, 150 - 6th Ave. SW CALGARY AB T2P 3E3
 KOBES C-97-B WATER HANDLING

DWG TITLE
 SLUG FINGER V-120
 1829mm [72"] I.D. X 9144mm [30'-0"] S/S
 DATA SHEET

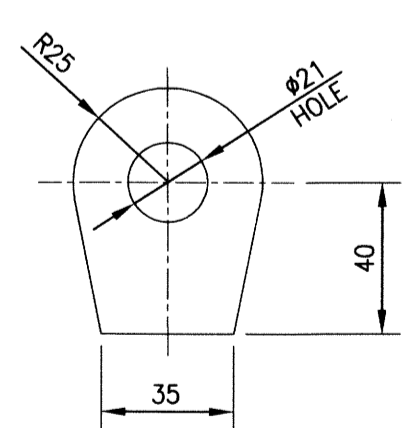
NO. REQ'D	OWN BY	WD. NO.	LEG. NO.
	P.CHANG	030789	
SCALE	CHKD	DWG. NO.	SHEET NO. REV. NO.
		030789-D101	2 of 3
DATE (d/m/y)	CHKD	APPD	
20/09/13			



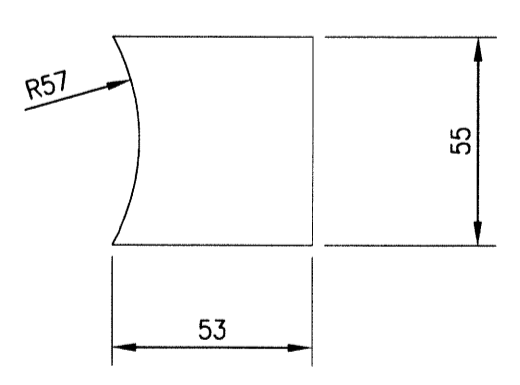
DAVIT DETAIL
1:10
(DAVIT ASSEMBLY WITHOUT TILT)



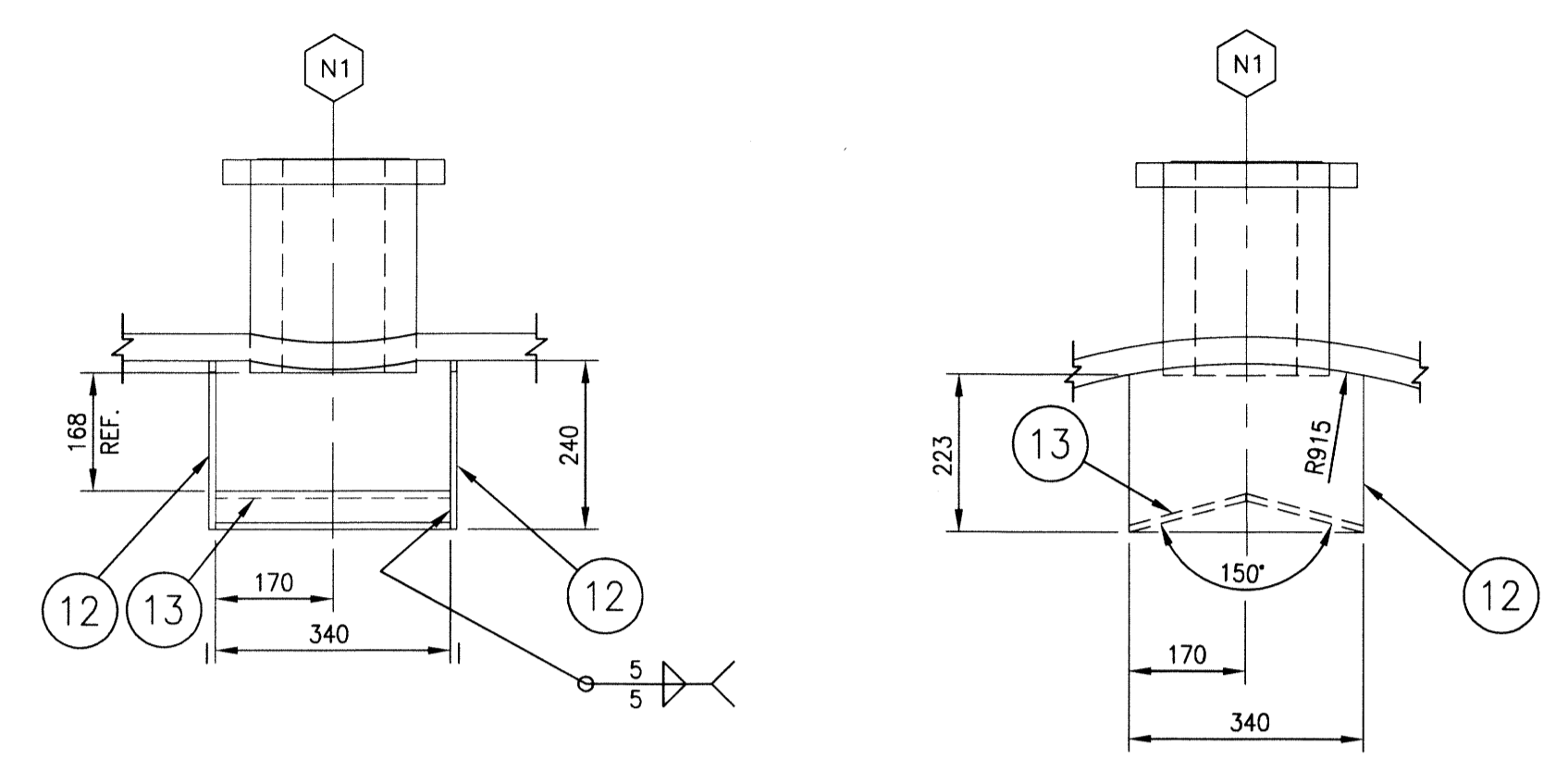
ITEM #4 DETAIL
1:5
(2 REQ'D)



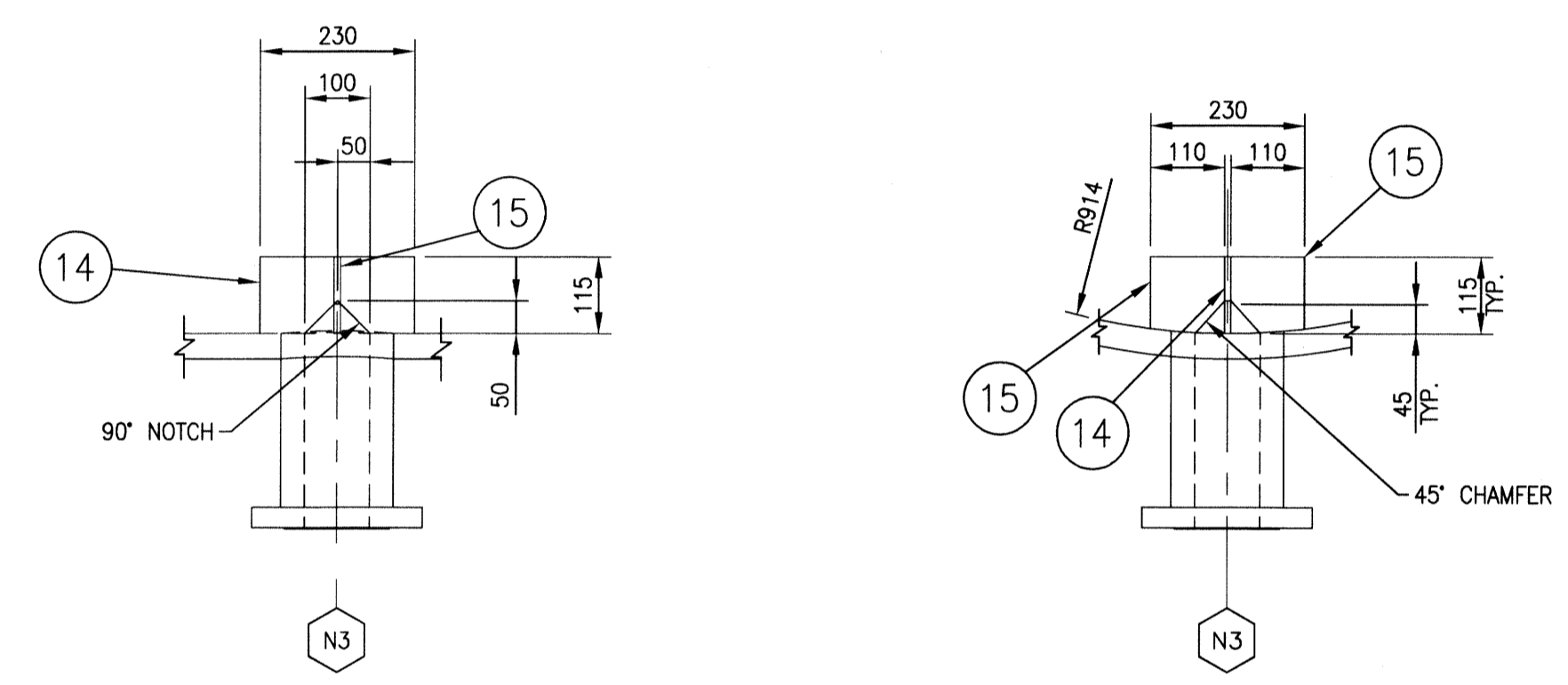
ITEM #5 DETAIL
1:2
(2 REQ'D)



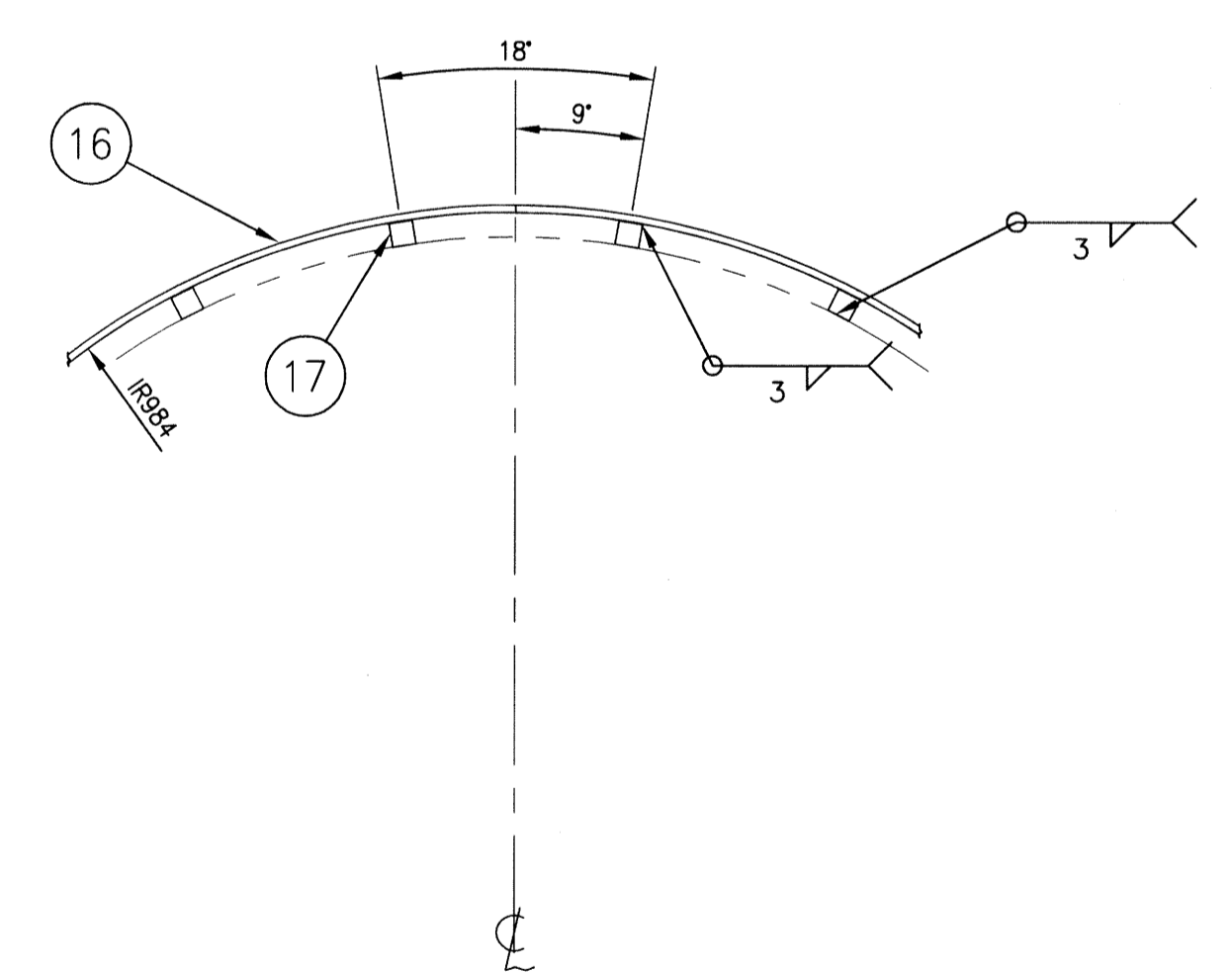
ITEM #6 DETAIL
1:2



INLET DEFLECTOR DETAIL
1:10



VORTEX BREAKER DETAIL
1:10



INSULATION RING DETAIL
SCALE 1:10
(2 REQUIRED)

MATERIAL LIST

MATERIAL REQUIREMENTS						
MK	QTY	PART NO.	DESCRIPTION	LENGTH	MATERIAL	WT
1	1	2237	PIPE, DN80 [3"] SCH XH SMLS	1380	SA-106-B	21
2	1	10632	PLATE, 25.4 [1"] THK x 95 ID x 140 OD	-	G40.21/300W	1.7
3	1	3529	PIPE, DN100 [4"] SCH 120 SMLS	250	SA-106-B	7.0
4	2	10632	PLATE, 25.4 [1"] THK x 140 WD	190	G40.21/300W	2.2
5	2	3125	PLATE, 12.7 [1/2"] THK x 50 WD	65	SA-516-70N	0.2
6	1	6565	PLATE, 25.4 [1"] THK x 53 WD	55	SA-516-70N	0.5
7	1		SPACE-NAUT, 19 [3/4"] x 356 [14"] LG EYE BOLT	-	CAD PLATED	
8	3	10936	HEX NUT, 19 [3/4"] x CAD PLATED	-	GR.5	
9	1	10932	BOLT, 19 [3/4"] x CAD PLATED	3 1/2"	GR.5	
10	1	2490	PLATE, 6.35 [1/4"] THK x 75 x OD	-	G40.21/300W	0.2
11	1	10940	WASHER, 19 [3/4"] x CAD PLATED	-	GR.5	
12	2	6566	PLATE, 9.53 [3/8"] THK x 240 WD (CUT TO SUIT)	340	SA-516-70N	5.8
13	1	6566	PLATE, 9.53 [3/8"] THK x 340 WD (BEND AS SHOWN)	350	SA-516-70N	8.7
14	1	6566	PLATE, 9.53 [3/8"] THK x 115 WD (CUT AS SHOWN)	230	SA-516-70N	1.8
15	2	6566	PLATE, 9.53 [3/8"] THK x 110 WD (CUT AS SHOWN)	115	SA-516-70N	0.9
16	2	2142	ROUND BAR, 9.53 [3/8"] x, ROLL TO 984 IR	6250	SA-36	7.0
17	40	4349	PLATE, 6.35 [1/4"] THK x 32 SQUARE		SA-516-70N	2.0

NO.	DATE (d/m/y)	REVISIONS	BY	APPD
6.1.14		REVISED DRAWING NAME, AS BUILT		
16/10/13		ADDED INSULATION RING DETAIL, REVISED ITEM 3 FROM SCH XH	IC	EC
02/10/13		ISSUED FOR CONSTRUCTION	PC	EC

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CLIENT
SUNCOR ENERGY c/o EQUINOX ENGINEERING LTD.
BOX 2844, 150 - 6th Ave. SW CALGARY AB T2P 3E3
KOBES C-97-G/94-B-9 WATER HANDLING

DWG TITLE
SLUG FINGER V-120/2
1829mm [72"] ID x 9144mm [30'-0"] S/S
INTERNAL DETAILS

NO. REQ'D 1	DWN BY P.CHANG	WO. NO. 030789	LEG. NO. 4,5,6
SCALE 1 : 30 UNO	CHKD P.CHANG	DWG NO. 030789-D101	SHEET NO. REV. NO. 3 of 3 2
DATE (d/m/y) 18/09/13	APPD P.CHANG		

WELD PROCEDURES

April 05, 2013

Philip Correia
FOREMOST UNIVERSAL LP
8825 SHEPARD ROAD SE
CALGARY, AB

EQUINOX ENGINEERING DOCUMENT CONTROL	PO #: 214-06-08-0001
	SEQ #: 0004
	SUB #: 0002
	DATE: 2013-09-16

<input type="checkbox"/> V1 - Correct & Resubmit <i>Manufacturing may NOT proceed</i>
<input type="checkbox"/> V2 - Correct & Resubmit <i>Manufacturing MAY proceed subject to incorporated changes</i>
<input type="checkbox"/> V3 - Review Not Required <i>Accepted for information purposes only</i>
<input type="checkbox"/> V4 - Submit Final Documentation
<input checked="" type="checkbox"/> V5 - Manufacturing May Proceed <i>No further submissions are required</i>
<input type="checkbox"/> V6 - Rejected <i>See e-mail for comments</i>

SIGNATURE: *[Signature]*
DATE: Sept 16 2013

Dear Philip Correia,

The welding procedure, tracking number 2013-01846, originally received on March 13, 2013 was surveyed and accepted for registration as follows:

Reg. No. : WP-3299.2

Accepted on: March 28, 2013

Reg Type : Revision To Acc. Design

Spec. No. : MI-GSS-4 REV 1

Design registered in the name of : FOREMOST UNIVERSAL LP

Please note the acceptance of the registration does not allow the use of this welding procedure in the construction, modification, or repair of any boiler, pressure vessel, pressure piping system or fitting in Alberta unless the contractor/manufacturer has registered a Quality Control system for such work with ABSA.

Welding procedures, which specify impact testing, have been accepted in accordance with A.S.M.E. Section IX only. Other A.S.M.E. Code Sections may have additional requirements respecting impact testing.

An invoice covering survey and registration fees will be forwarded from our Revenue Accounts.

Enclosed is stamped welding procedures for your reference.

Sincerely,

[Signature]

ROSEBERG, BOB, P. Eng.
Design Survey Engineer

WELDING PROCEDURE SPECIFICATION NO.: MI-GSS-4 (Rev. 1)

WELDING PROCEDURE QUALIFICATION RECORD NO.(S): MI-GSS-4-1, MI-GSS-4-2

QUALIFIED FOR

Base Metal (Typical): Std. Appl.: P1 to P1
(SA 106 Gr. B, SA 105, SA 234 WPB, SA 516 Gr. 70, etc.)
Notch Appl.: P1 Groups 1 & 2 to P1 Groups 1 & 2
(SA 333 Gr. 6, SA 350 Gr. LF2, SA 420 WPL6, SA 516 Gr. 70, etc.)

Process(es): GMAW / SMAW / SAW Weld Types: GROOVE & FILLET

Position: GMAW & SMAW: ALL POSITIONS SAW: FLAT & HORIZONTAL

Diameter: ALL DIAMETERS

Filler Metal: Std. Appl.: GMAW: ER70S-2 SMAW: E7018, E7018-1 SAW: F7PX-EM14K
Notch Appl.: GMAW: ER70S-2 SMAW: E7018-1 SAW: F7P6-EM14K

BASE METAL CONDITIONS & GROOVE THICKNESS RANGE QUALIFIED:

BASE METAL THICKNESS RANGE - ASME Section IX

STANDARD APPLICATIONS WITH P.W.H.T. 1.6 to 203 mm (0.062 to 8.00 in.) inclusive

NOTCH TOUGHNESS APPLICATIONS TO -46°C (-50°F) WITH P.W.H.T.

9.52 to 203 mm (0.375 to 8.00 in.) inclusive

COMBINED DEPOSITED WELD METAL THICKNESS

ASME B31.1	<u>203 mm (8.00 in.) maximum</u>
ASME B31.3	<u>203 mm (8.00 in.) maximum</u>
ASME SECT. VIII, DIV.1	<u>203 mm (8.00 in.) maximum</u>

ASXO

SAFETY CODES ACT - PROVINCE OF ALBERTA
WELDING PROCEDURE

Reg. No. WP 3299.2

Spec. No. MI-GSS-4 (REV 1)

Weld Process GMAW / SMAW / SAW

Matt. Gr. P No. 1 Gr 1+2 to P No. 1 Gr 1+2

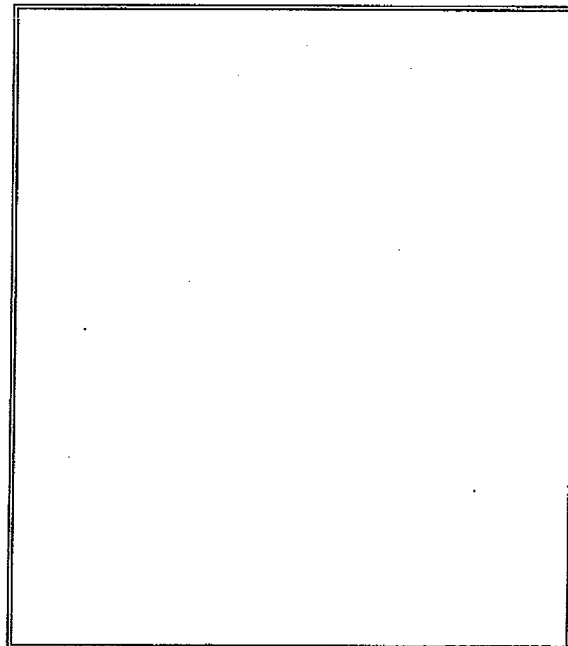
Elec. Gr. F No. 6+4+6 A No. 1

Th. Qual. For 203 mm P.W.H.T. YES

MIN Th. Qual. 9.5 mm, CVN -46°C

Yr. 13 No. 3 Day 28 Signed [Signature]
P. ROSEBERG, P.ENG.
WELDING SPECIALIST

PROVINCIAL REGISTRATION



QW-482 WELDING PROCEDURE SPECIFICATION (WPS)

Foremost Universal LP

Welding Procedure Specification No. MI-GSS-4 (Rev. 1) Date February 26, 2013
 Revision(s): Rev. 1 (Non-essential change) - company name change, formerly
Maloney Industries.
 Signed: *[Signature]* QCM
 Supporting PQR (s) MI-GSS-4-1, MI-GSS-4-2
 Process(es): GMAW / SMAW / SAW Type(s) Semi-auto / Manual / Machine

JOINTS (QW-402)

Joint Design All ASME groove & fillet, reference construction drawing for joint details,
where joint details are not specified, refer to figures 1 to 15 attached.
 Root Opening As per attached typical groove designs, see figures 1 to 15 attached.
 Backing With or without Retainers Not required

BASE METALS (QW-403)

P-Number Std. Appl.: P1 To P-Number P1
 P-Number Notch Appl.: P1 Groups 1 & 2 To P-Number P1 Groups 1 & 2
 Thickness Range: Groove See cover page for thickness qualified by governing code
 Fillet All base metal thicknesses
 Base Metal See cover page
 Pipe Diameter Ranges: Groove All diameters Fillet All diameters
 Deposited Weld Metal (Per pass) GMAW: 3.50 mm (0.138 in.) maximum
SMAW & SAW: 12.7 mm (0.500 in.) maximum

FILLER METALS (QW-404)

	GMAW	SMAW
Specification No. (SFA)	SFA 5.18	SFA 5.1
AWS No. (Class)	ER70S-2	E7018 (Std. Appl. only), E7018-1
F-No.	F6	F4
A-No.	A1	A1
Size	See Table #1	See Table #1
Filler Metal Product Form	Solid wire	N/A
Supplementary Fillers	Without	N/A
Deposited Weld Metal Thickness Range:		
Groove	3.50 mm (0.138 in.) max.*	203 mm (8.00 in.) max.*
Fillet	---	All fillet sizes

FILLER METALS (QW-404)

	SAW
Specification No. (SFA)	SFA 5.17
AWS No. (Class)	EM14K
F-No.	F6
A-No.	A1
Size	See Table #1
Filler Metal Product Form	Solid wire
Supplementary Fillers	Without
Electrode - Flux Classification	Std. Appl.: F7PX-EM14K Notch Appl.: F7P6-EM14K
Flux Type	Neutral
Recrushed slag	<u>Must be tested and meet ASME Section II, Part C SFA 5.17 requirements</u>
Deposited Weld Metal Thickness Range:	
Groove	203 mm (8.00 in.) max.*
Fillet	All fillet sizes
Other	<u>* Combined deposited weld metal thickness shall not exceed 203 mm (8.00 in.)</u>

POSITION (QW-405)

Position of Groove GMAW & SMAW: All positions SAW: Flat & Horizontal
 Position of Fillet GMAW & SMAW: All positions SAW: Flat & Horizontal
 Weld Progression Std Appl.: GMAW: Vertical up or down SMAW: Vertical up SAW: N/A
Notch Appl.: GMAW: Vertical down SMAW: Vertical up SAW: N/A

PREHEAT (QW-406)

Preheat Temperature (Minimum) See attached preheat sheet
 Interpass Temperature (Maximum) Std Appl.: 315°C (600°F) Notch Appl.: 232°C (450°F)
 Preheat Maintenance See attached preheat sheet prior to welding. Preheat maintenance is not required if welding is interrupted or after the completion of welding unless required by the code of construction.

POST WELD HEAT TREATMENT (QW-407)

Temperature Range See P.W.H.T. sheet Time Range See P.W.H.T. sheet
 Other Notch Appl.: Maximum P.W.H.T. time at temperature shall not exceed 7.5 hours

GAS (QW-408)

Specification No. (SFA) SFA 5.32 AWS No. (Class) SG-AC-25
 Shielding GMAW: 75% Argon, 25% CO₂, 10 - 25 liters per minute (20 - 50 cfph)
 Backing None Trailing Without

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
 Amps See Table #1 Volts See Table #1
 Electrode Wire Feed Speed GMAW & SAW: Amperage controlled, see Table #1
 Maximum Heat Input For Notch Toughness Applications Only

Base Metal Thickness Range mm (in.)	GMAW kJ/mm (J/in.)	SMAW kJ/mm (J/in.)	SAW kJ/mm (J/in.)
9.52 (0.375) ≤ T < 15.9 (0.625)	1.33 (33,783)	1.59 (40,500)	1.80 (45,675)
15.9 (0.625) ≤ T ≤ 203 (8.00)	1.39 (35,318)	3.16 (80,357)	2.47 (62,734)

Mode of Metal Transfer GMAW: Short circuiting arc
 Other Heat Input J/mm (J/in.) = Amps x Volts x 60 / Travel speed mm/min. (ipm)

TECHNIQUE (QW-410)

String or Weave GMAW & SMAW: Either SAW: String
 Travel Speed See Table #1
 Orifice or Gas Cup Size GMAW: 9.52 to 19.1 mm (0.375 to 0.750 in.) inclusive
 Initial & Interpass Cleaning Brushing, chipping or grinding as required
 Method of Back Gouging Air carbon arc, back-grind as required
 Oscillation GMAW & SMAW: N/A SAW: Without
 Contact Tube to Work Distance GMAW: 6.35 to 19.1 mm (0.250 to 0.750 in.) inclusive
SAW: 12.7 to 44.5 mm (0.500 to 1.75 in.) inclusive
 Multiple or Single Pass Per Side Std Appl.: Either Notch Appl.: Multiple
 Multiple or Single Electrodes Single
 Electrode Spacing N/A
 Peening Not permitted
 Use of Thermal Processes N/A

TABLE 1 - WELDING PARAMETERS

Standard Applications

Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (i.p.m.)
GMAW	ER70S-2	0.8 (0.030)	DCRP	70 - 130	14 - 21	41 - 250 (1.6 - 10)
GMAW	ER70S-2	0.9 (0.035)	DCRP	80 - 200	15 - 22	51 - 600 (2.0 - 25)
GMAW	ER70S-2	1.1 (0.045)	DCRP	115 - 250	16 - 25	76 - 900 (3.0 - 35)
SMAW	E7018, E7018-1	2.4 (3/32)	DCRP	60 - 110	18 - 26	18 - 300 (0.7 - 12)
SMAW	E7018, E7018-1	3.2 (1/8)	DCRP	90 - 150	19 - 28	28 - 350 (1.1 - 14)
SMAW	E7018, E7018-1	4.0 (5/32)	DCRP	110 - 220	20 - 28	36 - 400 (1.4 - 16)
SMAW	E7018, E7018-1	5.0 (3/16)	DCRP	160 - 320	21 - 30	56 - 500 (2.2 - 20)
SMAW	E7018, E7018-1	5.5 (7/32)	DCRP	240 - 350	22 - 32	86 - 550 (3.4 - 22)
SMAW	E7018, E7018-1	6.4 (1/4)	DCRP	300 - 400	22 - 32	107 - 550 (4.2 - 22)
SAW	F7PX-EM14K	2.0 (5/64)	DCRP	200 - 500	25 - 32	79 - 750 (3.1 - 30)
SAW	F7PX-EM14K	2.4 (3/32)	DCRP	250 - 600	25 - 33	97 - 812 (3.8 - 32)
SAW	F7PX-EM14K	3.2 (1/8)	DCRP	250 - 700	26 - 33	122 - 890 (4.8 - 35)
SAW	F7PX-EM14K	4.0 (5/32)	DCRP	370 - 800	26 - 34	150 - 1015 (5.9 - 40)
SAW	F7PX-EM14K	5.0 (3/16)	DCRP	500 - 1000	28 - 36	216 - 1270 (8.5 - 50)

Note: Size of filler metal, number of passes, voltage, amperage, and travel speed will vary with position, joint thickness, joint type etc.

Notch Toughness Applications

Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (i.p.m.)
GMAW	ER70S-2	0.8 (0.030)	DCRP	70 - 130	14 - 21	43 - 250 (1.7 - 10)
GMAW	ER70S-2	0.9 (0.035)	DCRP	80 - 200	15 - 22	51 - 600 (2.0 - 25)
GMAW	ER70S-2	1.1 (0.045)	DCRP	115 - 250	16 - 25	79 - 900 (3.1 - 35)
SMAW	E7018-1	2.4 (3/32)	DCRP	60 - 110	18 - 24	20 - 300 (0.8 - 12)
SMAW	E7018-1	3.2 (1/8)	DCRP	90 - 150	19 - 26	33 - 350 (1.3 - 14)
SMAW	E7018-1	4.0 (5/32)	DCRP	110 - 220	21 - 28	43 - 400 (1.7 - 16)
SMAW	E7018-1	5.0 (3/16)	DCRP	160 - 320	22 - 30	66 - 500 (2.6 - 20)
SMAW	E7018-1	5.5 (7/32)	DCRP	240 - 340	23 - 32	104 - 550 (4.1 - 22)
SMAW	E7018-1	6.4 (1/4)	DCRP	300 - 400	22 - 32	124 - 550 (4.9 - 22)
SAW	F7P6-EM14K	2.0 (5/64)	DCRP	200 - 500	25 - 32	122 - 750 (4.8 - 30)
SAW	F7P6-EM14K	2.4 (3/32)	DCRP	250 - 600	25 - 33	152 - 812 (6.0 - 32)
SAW	F7P6-EM14K	3.2 (1/8)	DCRP	300 - 700	26 - 33	191 - 890 (7.5 - 35)
SAW	F7P6-EM14K	4.0 (5/32)	DCRP	370 - 800	26 - 34	234 - 1015 (9.2 - 40)
SAW	F7P6-EM14K	5.0 (3/16)	DCRP	500 - 1000	28 - 36	340 - 1270 (13.4 - 50)

Note: Welding parameters shall be adjusted to insure that the maximum heat input value specified in QW-409 above is not exceeded.

TYPICAL JOINT DESIGNS

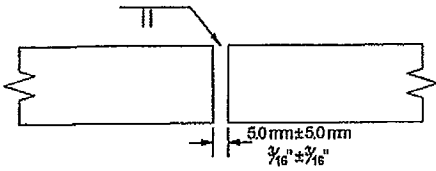


Fig. 1 Single Square Butt

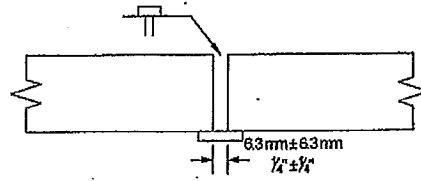


Fig. 2 Single Square Butt with Backing Strip

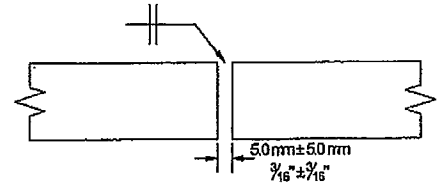


Fig. 3 Double Square Butt

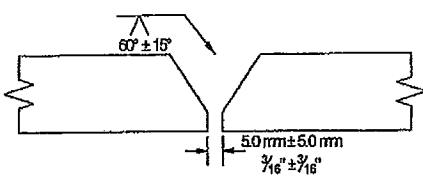


Fig. 4 Single Vee Butt

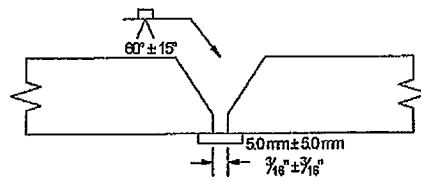


Fig. 5 Single Vee Butt with Backing Strip

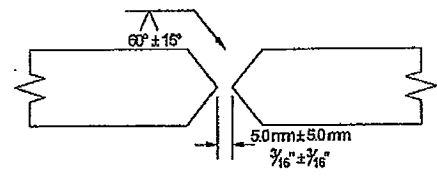


Fig. 6 Double Vee Butt

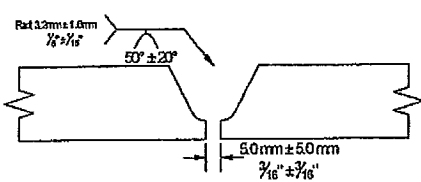


Fig. 7 Single U Butt

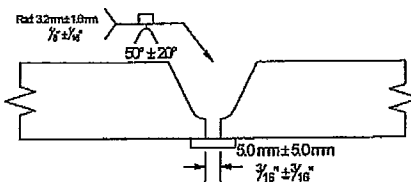


Fig. 8 Single U Butt with Backing Strip

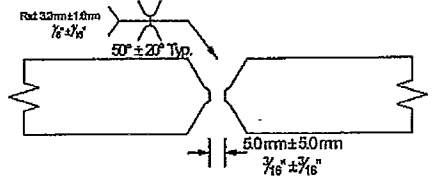


Fig. 9 Double U Butt

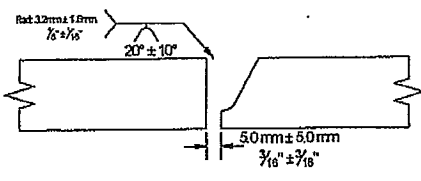


Fig. 10 Single J Butt

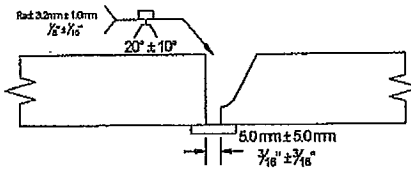


Fig. 11 Single J Butt with Backing Strip

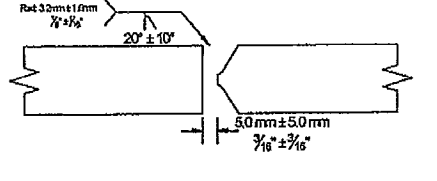


Fig. 12 Double J Butt

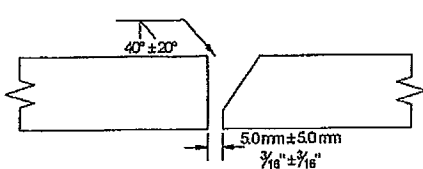


Fig. 13 Single Bevel Butt

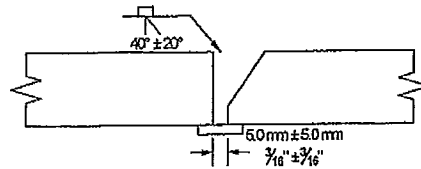


Fig. 14 Single Bevel Butt with Backing Strip

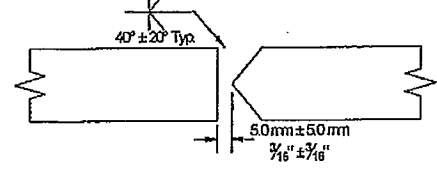


Fig. 15 Double Bevel Butt

Additional joint designs and internal misalignment on circumferential welds shall be within the dimensional limits stated on the approved construction drawing and / or the engineering design.

PREHEAT

P-No. 1

1. Welds joining pressure parts or attachments shall be preheated to not less than the minimum preheat temperatures stated in paragraph 5.
2. The preheat temperature shall be maintained during welding.
3. If welding is interrupted, the weld joint and adjacent areas shall be reheated to the minimum preheat temperature stated in paragraph 5, prior to the start of welding.
4. Preheat temperatures shall be checked by the welder or inspector, using temperature indicating crayons or other reputable methods.
5. Minimum preheating temperatures shall be as follows:

PRESSURE VESSELS IN ACCORDANCE WITH ASME SECTION VIII, DIV. 1

NOMINAL WALL THICKNESS	MINIMUM PREHEAT TEMPERATURE
0 to 31.8 mm (0 to 1.25 in)	10°C (50°F)
Over 31.8 mm (Over 1.25 in.)	93°C (200°F)
Over 25.4 mm (1.0 in.) & specified maximum carbon content in excess of 0.30%.	80°C (175°F)

- The conditions of UW-30 shall apply for base metal temperatures below 0°C (32°F).
- The preheat zone shall extend at least 50.8 mm (2.0 in.) beyond each edge of the weld.

PROCESS PIPING IN ACCORDANCE WITH ASME B31.3

NOMINAL WALL THICKNESS	MINIMUM SPECIFIED BASE METAL TENSILE STRENGTH	MINIMUM PREHEAT TEMPERATURE
< 25.4 mm (1.0 in.)	≤ 490 MPa (71 ksi)	10°C (50°F)
≥ 25.4 mm (1.0 in.)	All	80°C (175°F)
All	> 490 MPa (71 ksi)	80°C (175°F)

- The preheat zone shall extend at least 25.4 mm (1.0 in.) beyond each edge of the weld.
- The interruption of welding shall be subject to the requirements of paragraph 330.2.4.

POWER PIPING IN ACCORDANCE WITH ASME B31.1

NOMINAL WALL THICKNESS	MINIMUM PREHEAT TEMPERATURE
Over 25.4 mm (1.0 in.) & specified maximum carbon content in excess of 0.30%.	80°C (175°F)
All others	10°C (50°F)

- The preheat zone shall extend beyond each edge of the weld for at least 76.2 mm (3.0 in.) or 1.5 times the base metal thickness (as defined in paragraph 131.4.1), whichever is greater.

POSTWELD HEAT TREATMENT

P-No. 1

PRESSURE VESSELS IN ACCORDANCE WITH ASME SECTION VIII, DIV. 1

1. All postweld heat treatment shall be in accordance with ASME Section VIII, Division I, UW-40 & UCS-56 latest edition and addenda.
2. Post weld heat treatment temperatures and minimum holding times are as follows:

NOMINAL WALL THICKNESS	HEAT TREAT TEMPERATURE	HOLDING TIME
Up to 50.8 mm (2.0 in.)	595°C (1100°F) minimum	1 Hour / 25.4 mm (inch), 15 minutes minimum
Over 50.8 mm (2.0 in.)	595°C (1100°F) minimum	2 Hours plus 15 minutes for each additional 25.4 mm (inch) over 50.8 mm (2.0 in.)

PROCESS PIPING IN ACCORDANCE WITH ASME B31.3

1. All postweld heat treatment shall be in accordance with Table 331.1.1 of ASME B31.3 latest edition and addenda.
2. Post weld heat treatment temperatures and minimum holding times are as follows:

NOMINAL WALL THICKNESS	MINIMUM SPECIFIED TENSILE STRENGTH	HEAT TREAT TEMPERATURE	HOLDING TIME
All	All	595 - 650°C (1100 - 1200°F)	1 Hour / 25.4 mm (inch), 1 Hour minimum

POWER PIPING IN ACCORDANCE WITH ASME B31.1

1. All postweld heat treatment shall be in accordance with Table 132 of ASME B31.1 latest edition and addenda.
2. Post weld heat treatment temperatures and minimum holding times are as follows:

NOMINAL WALL THICKNESS	HEAT TREAT TEMPERATURE	HOLDING TIME
Up to 50.8 mm (2.0 in.)	595 - 650°C (1100 - 1200°F)	1 Hour / 25.4 mm (inch), 15 minutes minimum
Over 50.8 mm (2.0 in.)	595 - 650°C (1100 - 1200°F)	2 Hours plus 15 minutes for each additional 25.4 mm (inch) over 50.8 mm (2.0 in.)

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

Maloney Industries

Procedure Qualification Record No. MI-GSS-4-1 Date November 28, 2012
Welding Procedure Specification No. MI-GSS-4
Welding Process(es) GMAW / SMAW / SAW Types Semi-auto/Manual/Machine

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 516 to SA 516 Type or Grade Gr. 60 to Gr. 70
P-No. P1 Grp. 1 To P-No. P1 Grp. 2 Thickness 44.4 mm (1.75 in.)
Diameter N/A - Plate Heat No. 350925 - 23443
Deposited Weld Metal (Per pass) Did not exceed 12.7 mm (0.500 in.)

FILLER METALS (QW-404)

	GMAW	SMAW	SAW
SFA Specification	<u>SFA 5.18</u>	<u>SFA 5.1</u>	<u>SFA 5.17</u>
AWS Classification	<u>ER70S-2</u>	<u>E7018-1</u>	<u>EM14K</u>
Filler Metal F-No.	<u>F6</u>	<u>F4</u>	<u>F6</u>
Weld Metal A-No.	<u>*A1</u>	<u>A1</u>	<u>*A1</u>
Filler Metal Product Form	<u>Solid wire</u>	<u>N/A</u>	<u>Solid wire</u>
Supplementary Fillers	<u>Without</u>	<u>Without</u>	<u>Without</u>
Electrode - Flux Classification	<u>N/A</u>	<u>N/A</u>	<u>F7P6-EM14K</u>
Flux Type	<u>N/A</u>	<u>N/A</u>	<u>Neutral</u>
Recrushed slag	<u>N/A</u>	<u>N/A</u>	<u>None</u>
Size of Electrode	<u>See attached sketch</u>		
Weld Metal Thickness mm (in.)	<u>3.2 (0.125)</u>	<u>19.1 (0.750)</u>	<u>22.2 (0.875)</u>
Trade Name (s)	<u>GMAW: Bonarc ER70S-2</u>		
	<u>SMAW: Blueshield LA 18 Plus</u>		
	<u>SAW: Lincoln Electric, Lincolnweld LA-71 wire / 882 flux</u>		

Other *See attached weld deposit chemical analysis - Laboratory test report # C12-1790.3

POSITION (QW-405)

Position of Groove GMAW: Plate @ 45° off flat SMAW: 3G SAW: 1G
Weld Progression GMAW: Vertical down SMAW: Vertical up SAW: N/A

PREHEAT (QW-406)

Preheat Temperature 66°C (150°F) Interpass Temp. (Max.) 232°C (450°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature Range 621°C (1150°F) Time Range 6 Hours

GAS (QW-408)

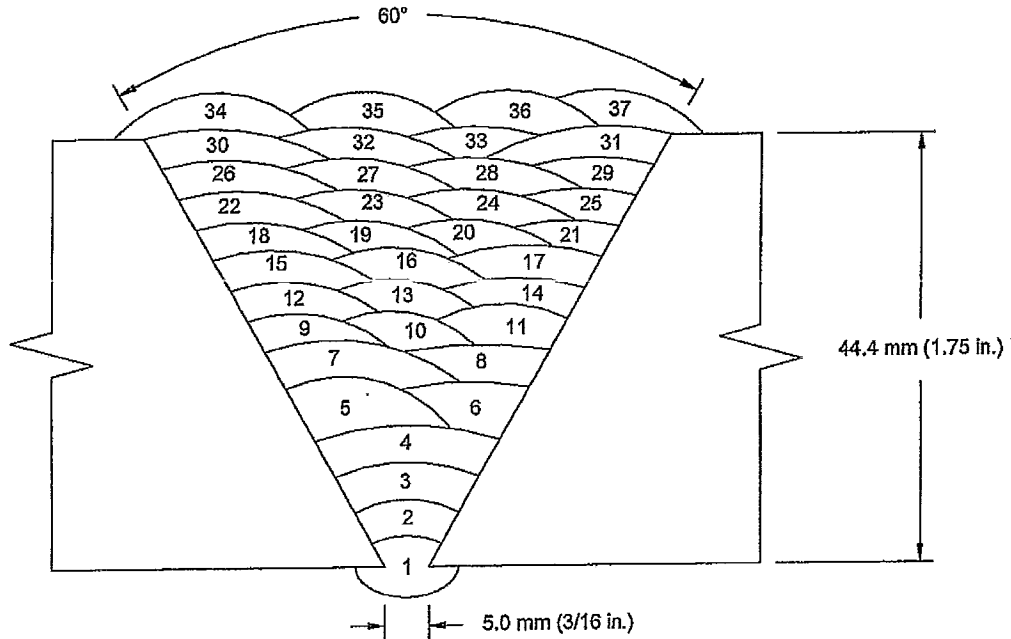
Specification No. (SFA) SFA 5.32 AWS No. SG-AC-25
Shielding GMAW: 75% Argon, 25% CO₂, 12.5 liters per minute (25 cfph)
Backing None Trailing Without

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
 Amps See next page Volts See next page
 Electrode Wire Feed Speed GMAW: 735 cm/min (290 in./min) SAW: Amperage controlled
 Maximum Heat Input GMAW: 1.39 kJ/mm (35,318 J/in.) SMAW: 3.16 kJ/mm (80,357 J/in.)
SAW: 2.47 kJ/mm (62,734 J/in.)
 Mode of Metal Transfer GMAW: Short circuiting arc
 Other Heat Input kJ/mm (J/in.) = Amps x Volts x 60 / Travel speed mm/min. (ipm)

TECHNIQUE (QW-410)

String or Weave GMAW & SMAW: Weave SAW: String Travel Speed See below
 Orifice or Gas Cup Size GMAW: 9.52 mm (0.375 in.) Peening None
 Initial & Interpass Cleaning Brushing, chipping & grinding to remove slag
 Oscillation GMAW & SMAW: N/A SAW: Without
 Contact Tube to Work Distance GMAW: 9.52 to 12.7 mm (0.375 to 0.500 in.)
SAW: 25.4 to 38.1 mm (1.00 to 1.50 in.)
 Method of Back Gouging Not used Multiple or Single Pass Per Side Multiple
 Multiple or Single Electrodes Single Electrode Spacing N/A
 Use of Thermal Processes N/A



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (i.p.m.)
1	GMAW	ER70S-2	0.9 (0.035)	DCRP	135 - 145	18 - 19	112 (4.4)
2 - 3	SMAW	E7018-1	2.4 (3/32)	DCRP	80 - 95	21 - 23	48 - 61 (1.9 - 2.4)
4 - 8	SMAW	E7018-1	3.2 (1/8)	DCRP	120 - 130	22 - 23	53 - 58 (2.1 - 2.3)
9	SAW	F7P6-EM14K	4.0 (5/32)	DCRP	515 - 535	29 - 30	480 (18.9)
10 - 32	SAW	F7P6-EM14K	4.0 (5/32)	DCRP	550 - 570	29 - 30	439 - 495 (17.3 - 19.5)
33 - 37	SAW	F7P6-EM14K	4.0 (5/32)	DCRP	550 - 570	29 - 30	401 - 417 (15.8 - 16.4)

TENSILE TEST (QW-150)

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbf.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	19.0 (0.748)	44.0 (1.73)	836 (1.30)	422 048 (94,900)	505 (73,200)	Partial cup & cone Parent Metal (Gr. 60)
T2	19.2 (0.756)	44.0 (1.73)	845 (1.31)	421 299 (94,700)	499 (72,300)	Partial cup & cone Parent Metal (Gr. 60)

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.2, TSB - S1	Pass	QW-462.2, TSB - S3	Pass
QW-462.2, TSB - S2	Pass	QW-462.2, TSB - S4	Pass

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V-Notch Orientation Transverse
 Test Temperature -46°C (-50°F) Specimen Size 10 X 10 mm (0.394 X 0.394 in.)

Specimen No.	Notch Location	Impact Values J (ft. lbf)
K2.1	Weld Metal	88.1 (65.0)
K2.2	within 1/16 in.	35.8 (26.4)
K2.3	of root	84.1 (62.0)
D2.1	Weld Metal	32.0 (23.6)
D2.2	@ 1/4 T	31.7 (23.4)
D2.3	opposite side	20.6 (15.2)
C3.1	Gr. 60 - HAZ	130 (95.8)
C3.2	Gr. 60 - HAZ	63.2 (46.6)
C3.3	Gr. 60 - HAZ	>141 (>104)
D3.1	Gr. 70 - HAZ	16.3 (12.0)
D3.2	Gr. 70 - HAZ	>141 (>104)
D3.3	Gr. 70 - HAZ	>141 (>104)

OTHER TESTS

Vickers Hardness - see attached laboratory test report # C12-1790.3
Deposited weld metal chemical analysis - see attached laboratory test report # C12-1790.3

Welders Name James Krancan / Kevin Stenger Certificate File No. W-22865 / W-16699
 Tests Conducted By SGS Ludwig Associates Ltd.
 Laboratory Test No. C12-1790.3

We certify the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer MALONEY INDUSTRIES

Date JAN 02 2013 Certified by 



LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.3
Date: December 4, 2012

Attention: Philip Correia

PQR Number: MI-GSS-4-1
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 350925 - 23443)
Thickness: 44.4 mm (1.75 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes

TENSILE TEST QW-150

SAMPLE NUMBER	T1 QW-462.1(a)	T2 QW-462.1(a)
WIDTH mm (in)	19.0 (0.748)	19.2 (0.756)
THICKNESS mm (in)	44.0 (1.73)	44.0 (1.73)
AREA sq mm (sq in)	836 (1.30)	845 (1.31)
ULT. LOAD N (lbf)	422 048 (94,900)	421 299 (94,700)
UTS MPa (psi)	505 (73,200)	499 (72,300)
FRACTURE TYPE	Partial Cup & Cone	Partial Cup & Cone
FRACTURE LOCATION	Parent Metal (SA 516 Gr. 60)	Parent Metal (SA 516 Gr. 60)

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	9.52 mm (0.375 in.)	SAMPLE THICKNESS:	44.4 mm (1.75 in.)
PLUNGER SIZE:	38.1 mm (1.50 in.)	YOKE SIZE:	60.3 mm (2.375 in.)
QW-462.2	Side Bend	Side Bend	Side Bend
SAMPLE NUMBER(S)	S1	S2	S3
RESULTS	Pass	Pass	Pass

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASME Section IX, 2010 edition and latest addenda. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. Samples associated with this report will be discarded in 45 days.

Laboratory Test Conducted By: _____

Xin (Vincent) Su, T.T./Dan-Nguyen, C.E.T.





LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.3
Date: December 3, 2012

Attention: Philip Correia

PQR Number: MI-GSS-4-1
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 350925 - 23443)
Thickness: 44.4 mm (1.75 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes

CHARPY V-NOTCH IMPACT TEST

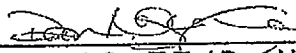
Machine: Satec, SI-1C SN:1363
Capacity: 325 J (240 ft-lbf)
Verified Range: 1.7 - 141.3 J (1.3 - 104.2 ft-lbf)

Specimen Size: 10 x 10 mm (0.394 x 0.394 in.)
Orientation: Transverse
Test Temp.: -46°C (-50°F)

Specimen Number	Notch Location	Impact Values	
		Joules	(ft-lbf)
K2.1	Weld Metal	88.1	(65.0)
K2.2	within 1/16 in.	35.8	(26.4)
K2.3	of root	84.1	(62.0)
D2.1	Weld Metal	32.0	(23.6)
D2.2	@ 1/4T	31.7	(23.4)
D2.3	opposite side	20.6	(15.2)
C3.1	Gr. 60 - HAZ	130	(95.8)
C3.2	Gr. 60 - HAZ	63.2	(46.6)
C3.3	Gr. 60 - HAZ	>141	(>104)
D3.1	Gr. 70 - HAZ	16.3	(12.0)
D3.2	Gr. 70 - HAZ	>141	(>104)
D3.3	Gr. 70 - HAZ	>141	(>104)

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASME Section VIII, Div. 1, UG-84 – 2010 edition and latest addenda. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. Samples associated with this report will be discarded in 45 days.

Laboratory Test Conducted By: _____


Xin (Vincent) Su, T.T. - Dan Nguyen, C.E.T.





LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.3
Date: December 4, 2012

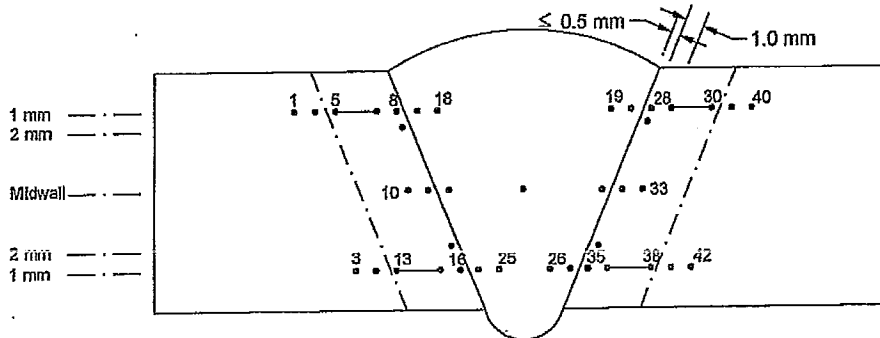
Attention: Philip Correia

PQR Number: MI-GSS-4-1
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 350925 - 23443)
Thickness: 44.4 mm (1.75 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes

HARDNESS TEST

Type of Test: Vickers 10 kg (HV10)

Instrument: Mitutoyo AVK-C1



SA 516 Gr. 60				Weld Metal				SA 516 Gr. 70							
Parent Metal		HAZ		Weld Metal		HAZ		Parent Metal							
1	143	5	145	11	168	17	184	23	148	28	181	34	155	39	138
2	141	6	153	12	173	18	213	24	170	29	152	35	170	40	137
3	147	7	162	13	148	19	212	25	166	30	149	36	161	41	148
4	149	8	210	14	155	20	211	26	167	31	183	37	170	42	142
		9	189	15	158	21	222	27	169	32	139	38	150		
		10	152	16	168	22	202			33	140				

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E384-11^{e1}, ANSI/NACE MR0175/ISO 15156-2:2009(E) and NACE SP0472-2010. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. Samples associated with this report will be discarded in 45 days.

Laboratory Test Conducted By: Oksana Shevchenko / Dan Nguyen, C.E.T.





LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.3
Date: December 5, 2012

Attention: Philip Correia

PQR Number: MI-GSS-4-1
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 350925 - 23443)
Thickness: 44.4 mm (1.75 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes
Test Location: Weld metal - GMAW root

CHEMICAL ANALYSIS


(% by weight)

Instrument Type: Shimadzu PDA-7000 Optical Emission Spectrometer

Carbon	0.09
Manganese	0.97
Silicon	0.39
Chromium	0.03
Nickel	0.02
Molybdenum	<0.01

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E415-08. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. Samples associated with this report will be discarded in 45 days.

Laboratory Test Conducted By: _____


Michelle Marien, T.T. / Steve Rieberger, C.E.T.





LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.3
Date: December 5, 2012

Attention: Philip Correia

PQR Number: MI-GSS-4-1
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 350925 - 23443)
Thickness: 44.4 mm (1.75 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes
Test Location: Weld metal - SAW Cap

CHEMICAL ANALYSIS


(% by weight)

Instrument Type: Shimadzu PDA-7000 Optical Emission Spectrometer

Carbon	0.07
Manganese	1.28
Silicon	0.69
Chromium	0.02
Nickel	0.03
Molybdenum	<0.01

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E415-08. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. Samples associated with this report will be discarded in 45 days.

Laboratory Test Conducted By: _____


Michelle Marien, T.T. / Steve Rieberger, C.E.T.



The Lincoln Electric Company
 22801 St. Clair Avenue
 Cleveland, Ohio 44117-1199

CERTIFICATE OF CONFORMANCE
 (APPLIES ONLY TO U.S. PRODUCTS)



Product: Lincolnweld® 882 Flux /LA-71 Electrode
 Classification: F7P6-EM14K-H8
 Specification: AWS A5.17-97, ASME SFA-5.17
 Test Completed: March 15, 2010

[3 year]

This is to certify that the product named above and supplied on the referenced order number is of the same classification, manufacturing process, and material requirements as the material which was used for the test that was concluded on the date shown, the results of which are shown below. All tests required by the specifications shown for classification were performed at that time and the material tested met all requirements. It was manufactured and supplied according to the Quality System Program of the Lincoln Electric Company, Cleveland, Ohio, U.S.A., which meets the requirements of ISO9001, NCA3800, ANSI/AWS A5.01, and other specification and Military requirements, as applicable. The Quality System Program has been approved by ASME, ABS, and VdTUV.

Operating Settings	AWS/ASME Requirements	Deposit Results
Electrode Size	5/32 inch	5/32 inch
Polarity		DC+
Voltage, V	27 - 30	28
Wire Feed Speed, cm/min (in/min)		109 (43)
Current, amps	475 - 575	525
Contact Tip to Work Distance, mm (in.)	(1 - 1 1/2)	32 (1 1/4)
Travel Speed, cm/min (in/min)	(15 - 17)	41 (16)
Passes/Layers		15/7
Preheat Temp, °C (°F)	(60 - 325)	20 (66)
Interpass Temp, °C (°F)	(275 - 325)	150 (300)

Chemical composition of the weld deposit and electrode

Analysis (weight %)	Deposit		EM14K Electrode	
	Requirements	Results	Requirements	Results
C		0.07	0.06 - 0.19	0.11
Mn		1.19	0.90 - 1.40	1.10
Si	Not Required	0.59	0.35 - 0.75	0.50
S		0.006	0.025 max.	0.006
P		0.011	0.025 max.	0.006
Ti		0.02	0.03 - 0.17	0.09
Cu (total)		0.08	0.35 max.	0.10

Mechanical properties of the weld deposit (stress-relieved 1 hour @ 621°C (1150°F))

Tensile Strength, MPa (ksi)	(70 - 95)	540 (78)
Yield Strength, 0.2% offset MPa (ksi)	(58 min.)	420 (61)
Elongation, %	22 min.	32
Average Hardness Rockwell B	Not Required	85
Charpy V-notch Impact Properties Avg. Joules @ -51 °C (ft-lbf @ -50 °F)	(20 min.)	149 (110) 145, 149, 153 (107, 110, 113)
Diffusible Hydrogen (mL/100g) per AWS A4.3	8.0 max	4.5
Absolute Humidity (grains moisture/lb dry air)		60

Radiographic Test: Met requirements.
 Test assembly constructed of ASTM A36.

Results below the detection limits of the instrument or lower than the precision required by specification are reported as zero.

Strength values in SI units are reported to the nearest 10 MPa converted from actual data. Preheat and interpass temperature values in SI units are reported to the nearest 5 degrees.

This certificate complies to the requirements of EN 10204, 2.2.


Richard J. Bolas For R.B.
 Richard J. Bolas, Certification Supervisor Date March 19, 2010
David A. Fink
 David A. Fink, Manager, Compliance Engineering, Date 19 March 2010
 Consumable R&D Department

Cert. No. 55715



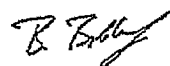


DILLINGER HÜTTE

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

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+AI:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A08 Manufacturer's order/ A03 Certificate No. 357365-001	Sheet 1/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER	A07.2 No.	B01 Product HOT ROLLED PLATES
B02/ Steel design. SA516-70	SA20-S5			 15715
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HOE-3:R29-2010-01-31			

B01-B99 Description of the product

B14 Item No.	B08 Number of places	B09 Thickness	B10 Width	B11 Length	B12 Theoretical mass	B04 Product delivery condition	B07.2 Heat No.	B07.1 Rolled plate No./ Test No.	A09 Purchaser article number
.01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23519-01	<p>CPL-96 SA 516 Gr. 70 1.750 in Heat #: 350925-23443 rec. Sept. 19, 2012 <i>[Signature]</i></p>
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23519-02	
.01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23543-01	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23543-02	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23547-01	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23547-02	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23742-01	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23742-02	
**	8				89656				
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350924	23542-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350924	23546-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350924	23589-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23239-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23401-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23413-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23437-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23443-01	
**	8				104500				
***	16				194256				

A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001			AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A01
		B. BALDAUF Test House Manager	Inspector's stamp	Date 17.09.10	BM 1



DILLINGER HÜTTE

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

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A08/ Manufacturer's order/ A09 Certificate No. 357365-001	Sheet 2/...
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A05 Established inspecting body DE	A06 Purchaser EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER	A07.2 No.	B01 Product HOT ROLLED PLATES
	Final receiver EDMONTON STEEL, EDMON			
B02/ Steel design. SAS16-70			SA20-SS	
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-3;R29-2010-01-31			

B04-Product delivery condition

ITEM NO.: 01-03
 N: HT: 1670 GR.F +36 -27 GR.F
 SOAKING TIME TO ATTAIN THE TARGET TEMPERATURE OVER THE WHOLE SECTION: 1-1,75 MIN/MM (25-45 MIN/INCH)
 COOLING IN STILL AIR

B06 Marking of the product


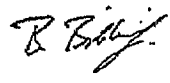

ITEM NO.: 01-03
 STEEL DESIGNATION SAS16 70 MELTY SA516 60 MELTY
 HEAT NO.: / TRADEMARK / ROLLED PLATE NO.-TEST NO. / INSPECTOR'S STAMP

B07-B99 Further information about the product

ITEM NO.: 01-03
 THICKNESS REDUCTION RATIO $\geq 3,0$ IS FULFILLED (CF. A/SA20 PAR. 5.3)

C10-C29 Tensile test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/ C01	C03 Temp. GR.F	C10 KSI RP02	C11	C12 RM	C13	A % L0=2IN	C14-C15
01	350924	23519		K1	QV	RT	50,6		76,9		34	
01	350924	23543		K1	QV	RT	45,1		74,8		35	
01	350924	23547		K1	QV	RT	48,4		76,1		34	
01	350924	23742		K1	QV	RT	51,9		76,6		34	
02	350924	23542		K1	QV	RT	48,0		75,1		36	
02	350924	23546		K1	QV	RT	47,0		75,5		33	
02	350924	23589		K1	QV	RT	47,3		75,5		35	
02	350925	23239		K1	QV	RT	49,6		75,7		34	
02	350925	23401		K1	QV	RT	48,1		75,4		36	

A04  Manufacturer's mark	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.	 B. BALDAUF Test House Manager		AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A01
	QM-System: Certification as per ISO 9001			Inspector's stamp	Date 17.09.10	BM 1



DILLINGER HÜTTE

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

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A08/ Manufacturer's order/ A03 Certificate No. 357365-001	Sheet 3/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER	B01 Product HOT ROLLED PLATES	
B02 Steel design. SA516-70		SA20-S5		
B03 Any suppl. ASME-II-A:07+A09				
requirements DIL-HUE-3:R29-2010-01-31				

C10-C29 Tensile test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01 Temp. GR.F	C02/ C03 C01	C10 KSI .FP02	C11 RT	C12 RM	C13	A % LG=2MM	C14-C15
02	350925	23413			K1.QV	RT	48,3	75,5		34	
02	350925	23437			K1.QV	RT	46,3	74,8		35	
02	350925	23443			K1.QV	RT	47,3	75,7		35	

C30-C39 Hardness test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/C04	C03 Temp. GR.F	C30 Method of test	C35	C31 Individual values	C32 Mean value
01	350924	23519		K1	O	RT	HBW 10/3000	HB 145	145	145
01	350924	23543		K1	O	RT	HBW 10/3000	HB 140	140	140
01	350924	23547		K1	O	RT	HBW 10/3000	HB 145	144	144
01	350924	23742		K1	O	RT	HBW 10/3000	HB 146	147	147
02	350924	23542		K1	O	RT	HBW 10/3000	HB 141	141	140
02	350924	23546		K1	O	RT	HBW 10/3000	HB 142	143	140
02	350924	23589		K1	O	RT	HBW 10/3000	HB 145	146	145
02	350925	23239		K1	O	RT	HBW 10/3000	HB 140	140	139
02	350925	23401		K1	O	RT	HBW 10/3000	HB 142	142	142
02	350925	23413		K1	O	RT	HBW 10/3000	HB 142	141	142
02	350925	23437		K1	O	RT	HBW 10/3000	HB 144	143	143
02	350925	23443		K1	O	RT	HBW 10/3000	HB 141	141	141

A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001			AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A01
		B. BALDAUF Test House Manager	Inspector's stamp	Date 17.09.10	BM 1



DILLINGER HÜTTE

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

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A08/ Manufacturer's order/ A03 Certificate No. 357365-001	Sheet 4/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER A07.2 No.	B01 Product HOT ROLLED PLATES	
B02/ Steel design. SA516-70	SA20-S5			
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-3:R29-2010-01-31			

C40-C49 Impact test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/ C01	C03 Temp. GR.F	C41 Width of test piece	C40 Type of test piece	C44 Testing method	C46 Energy	C45 AV	C42 Individual values AV=FLBF		C43 Mean value	
01	350924	23519		K1	LV	-51		CHP-V			AV	59	97	86	81
01	350924	23543		K1	LV	-51		CHP-V			AV	56	86	42	61
01	350924	23547		K1	LV	-51		CHP-V			AV	91	83	108	94
01	350924	23742		K1	LV	-51		CHP-V			AV	99	125	104	109
02	350924	23542		K1	LV	-51		CHP-V			AV	90	80	73	81
02	350924	23546		K1	LV	-51		CHP-V			AV	44	64	82	63
02	350924	23589		K1	LV	-51		CHP-V			AV	69	71	93	78
02	350925	23239		K1	LV	-51		CHP-V			AV	86	25	83	65
02	350925	23401		K1	LV	-51		CHP-V			AV	101	96	81	93
02	350925	23413		K1	LV	-51		CHP-V			AV	94	97	93	95
02	350925	23437		K1	LV	-51		CHP-V			AV	69	83	89	80
02	350925	23443		K1	LV	-51		CHP-V			AV	80	86	84	83

C70-C99 Chemical composition % - Heat analysis

B07.2 Heat	C70	C	SI	MN	P	S	N	CU	MO	NI	CR	V	NB	SN	TI
350924	Y	0,184	0,390	1,17	0,010	0,0013	0,0078	0,047	0,013	0,061	0,064	0,001	0,000	0,001	0,002
350925	Y	0,188	0,383	1,18	0,009	0,0014	0,0072	0,046	0,018	0,061	0,045	0,002	0,000	0,000	0,002

B07.2 Heat	C70	B	CA	AL-T
350924	Y	0,0001	0,0022	0,038
350925	Y	0,0001	0,0017	0,039

A04 Manufacturer's mark	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001	 B. BALDAUF Test House Manager	 Inspector's stamp	AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A04 Date 17.09.10 BM 1
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DILLINGER HÜTTE

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

A02	INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+RL:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch	A08/ Manufacturer's order/ A03 Certificate No.	Sheet
			369430-17.09.10	357365-001	5/...

A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER	A07.2 No.	B01 Product HOT ROLLED PLATES
	Final receiver EDMONTON STEEL, EDMON			
B02/ Steel design. SA516-70	SA20-SS			
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-3:R29-2010-01-31			

C94 Heat analysis Carbon equivalent / Alloying restrictions

B07.2 Heat	FO-02=	0,40	FO-51=	0,001	FO-55=	0,19	FO-78=	0,08	FO-91=	6,4
350924										
350925										
	FO-02=	0,40	FO-51=	0,002	FO-55=	0,17	FO-78=	0,06	FO-91=	6,3

C95 Ladle treatment

ITEM NO.: 01-03
HEAT OF THE INDICATED ITEM: VACUUM DEGASSED / SULPHIDE SHAPE CONTROL

C95 Further information about ladle treatment

ITEM NO.: 01-03
CALCIUM TREATED

C70-C99 Chemical composition % - Product analysis

B07.2 Heat	B07.1 Test No.	C01	C	SI	MN	P	S	N	CU	MO	NI	CR	V	NS	SN	TI
350924	23543	K1	0,183	0,390	1,16	0,009	0,0011	0,0079	0,046	0,013	0,060	0,042	0,001	0,000	0,001	0,002
350924	23589	K1	0,182	0,381	1,14	0,008	0,0010	0,0083	0,045	0,012	0,059	0,055	0,000	0,000	0,000	0,002
350925	23210	K1	0,184	0,376	1,16	0,009	0,0014	0,0067	0,045	0,018	0,061	0,047	0,002	0,000	0,000	0,002
350925	23401	K1	0,186	0,382	1,14	0,009	0,0013	0,0077	0,045	0,012	0,060	0,036	0,000	0,000	0,000	0,002

B07.2 Heat	B07.1 Test No.	C01	B	CA	AL-T
350924	23543	K1	0,0001	0,0017	0,039
350924	23589	K1	0,0001	0,0015	0,038
350925	23210	K1	0,0001	0,0020	0,041
350925	23401	K1	0,0001	0,0016	0,037

A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.		AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar inspection department		A01
	QM-System: Certification as per ISO 9001			Date 17.09.10	BM 1
Manufacturer's mark		B. BALDAUF Test House Manager	Inspector's stamp		



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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A08/ Manufacturer's order/ A03 Certificate No. 357365-001	Sheet 6
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER A07.2 No.	B01 Product HOT ROLLED PLATES	
B02/ Steel design. SA516-70	SA20-S5			
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-3:R29-2010-01-31			

C94 Product analysis Carbon equivalent / Alloying restrictions

B07.2 Heat	B07.1 Test No.	CM	FO-02=	FO-51=	FO-55=
350924	23543	K1	0,39	0,001	0,16
350924	23589	K1	0,39	0,000	0,17
350925	23210	K1	0,40	0,002	0,17
350925	23401	K1	0,39	0,000	0,15


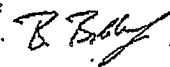

C94 Carbon equivalent formula / Alloying restrictions

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

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

ITEM NO.: 01-03
 RESULT OF MARKING, SURFACE, SHAPE AND DIMENSIONS: NC REMARKS
 SURFACE AS PER ASME-SA20
 THICKNESS AS PER ASME-SA20
 LENGTH AND WIDTH AS PER ASME-SA20
 FLATNESS AS PER 1/2-ASME-SA20



A04,  Manufacturer's mark	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001	 B. BALDAUF Test House Manager	 Inspector's stamp	AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A04 Date 17.09.10 BM 1
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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A40 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A03/ Manufacturer's order A03 Certificate No. 357365-001	Sheet 1/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER	A07.2 No. SA20-S5	B01 Product HOT ROLLED PLATES
B02/ Steel design. SA516-60				
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-3:R29-2010-01-31			



B01-B99 Description of the product

B14 Item No.	B08 Number of pieces	B09 Thickness	B40 Width	B11 Length	B12 Theoretical mass	B04 Product delivery condition	B07.2 Heat No.	B07.1 Rolled plate No./ Test No.	A09 Purchaser article number
INCH									
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23519-01	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23519-02	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23543-01	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23543-02	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23547-01	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23547-02	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23742-01	
01	1	1,5000 x	121,00000 x	480,00000	11207	N	350924	23742-02	
**	8				89656				
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350924	23542-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350924	23546-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350924	23589-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23239-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23401-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23413-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23437-01	
02	1	1,7500 x	121,00000 x	480,00000	13075	N	350925	23443-01	
**	8				104600				
***	16				194256				

CPL-96
SA 516 Gr. 60
1.750 in
Heat #:
350925-23443
rec. Sept. 19, 2012
[Signature]

A04	201/202/203 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001	<i>[Signature]</i> E. BALDAUF Test House Manager	AHB Inspector's stamp	AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A01
				Date 17.09.10	BM 1



DILLINGER HÜTTE

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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A08/ Manufacturer's order/ A03 Certificate No. 357365-001	Sheet 2/...						
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER	A07.2 No. SA20-S5							
B02/ Steel design SA516-60	B03 Any suppl. requirements ASME-III-A:07+A09 DIL-HUE-3:R29-2010-01-31	B01 Product HOT ROLLED PLATES								
B04 Product delivery condition										
ITEM NO.: 01-03 N: HT: 1670 GR.F +36 -27 GR.F SOAKING TIME TO ATTAIN THE TARGET TEMPERATURE OVER THE WHOLE SECTION: 1-1,75 MIN/MM (25-45 MIN/INCH) COOLING IN STILL AIR										
B06 Marking of the product										
ITEM NO.: 01-03 STEEL DESIGNATION SA516 70 MTLTV SA516 60 MTLTV HEAT NO. / TRADEMARK / ROLLED PLATE NO. - TEST NO. / INSPECTOR'S STAMP										
B07-B99 Further information about the product										
ITEM NO.: 01-03 THICKNESS REDUCTION RATIO $\geq 3,0$ IS FULFILLED (CF. A/SA20 PAR. 5.3)										
C10-C29 Tensile test										
B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01 C02/ C01	C03 Temp. GR.F	C10 C11 KSI RF02	C12 RM	C13	A % L0-2IN	C14-C15
01	350924	23519		K1	QV	RT	50,6	76,9	34	
01	350924	23543		K1	QV	RT	45,1	74,8	35	
01	350924	23547		K1	QV	RT	48,4	76,1	34	
01	350924	23742		K1	QV	RT	51,9	76,6	34	
02	350924	23542		K1	QV	RT	49,0	75,1	36	
02	350924	23546		K1	QV	RT	47,0	75,5	33	
02	350924	23589		K1	QV	RT	47,3	75,5	35	
02	350925	23239		K1	QV	RT	49,6	75,7	34	
02	350925	23401		K1	QV	RT	48,1	75,4	36	
A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.				QM-System: Certification as per ISO 9001		 B. BALDAUF Test House Manager		AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department Date 17.09.10	
 Manufacturer's mark						Inspector's stamp		Date 17.09.10		BM 1



DILLINGER HÜTTE

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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A00/ Manufacturer's order/ A03 Certificate No. 357365-001	Sheet 3/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER	A07.2 No. SA20-S5	
B02/ Steel design. SA516-60	B01 Product HOT ROLLED PLATES			
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-3:R29-2010-01-31			

C10-C29 Tensile test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01 C01	C02 C02	C03 C03	C10 C10	C11 C11	C12 C12	C13 C13	A % ED-ZIN	C14-C15 C14-C15
02	350925	23413		K1 QV	RT		48,3	RM	75,5		34	
02	350925	23437		K1 QV	RT		46,3		74,8		35	
02	350925	23443		K1 QV	RT		47,3		75,7		35	

C30-C39 Hardness test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01 C01	C02 C02	C03 C03	C30 C30	C35 C35	C31 C31	C32 C32
01	350924	23519		K1	0	RT	HBW 10/3000	HB 145	145	145
01	350924	23543		K1	0	RT	HBW 10/3000	HB 140	140	140
01	350924	23547		K1	0	RT	HBW 10/3000	HB 145	144	144
01	350924	23742		K1	0	RT	HBW 10/3000	HB 146	147	148
02	350924	23542		K1	0	RT	HBW 10/3000	HB 141	141	140
02	350924	23546		K1	0	RT	HBW 10/3000	HB 142	143	140
02	350924	23589		K1	0	RT	HBW 10/3000	HB 145	146	145
02	350925	23239		K1	0	RT	HBW 10/3000	HB 140	140	139
02	350925	23401		K1	0	RT	HBW 10/3000	HB 142	142	142
02	350925	23413		K1	0	RT	HBW 10/3000	HB 142	141	142
02	350925	23437		K1	0	RT	HBW 10/3000	HB 144	143	143
02	350925	23443		K1	0	RT	HBW 10/3000	HB 141	141	141

A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.		AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	
	QM-System: Certification as per ISO 9001			A01
	B. BALDAUF Test House Manager		Date 17.09.10	BM 1



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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004
INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991
MATERIAL TEST REPORT (MTR)

A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10
A08/ Manufacturer's order/ A03 Certificate No. 357365-001
Sheet 4/...

A05 Established inspecting body DH
A06 Purchaser EDMONTON STEEL, EDMON
A07.1 No. ED10551-J1010-ER
Final receiver EDMONTON STEEL, EDMON
A07.2 No. SA20-S5

B01 Product HOT ROLLED PLATES

B02/ Steel design. SA516-60
B03 Any suppl. requirements ASME-II-A:07+A09
 DIL-HUE-3:R29-2010-01-31

C40-C49 Impact test

B14 Item No.	B07.2 Heat No.	B07.1 Rol. plate/ Test No.	B05 Referenc (heat) treatment	C01	C02 C01	C03 Temp. GR.F	C41 Width of test piece	C40 Type of test piece	C44 Testing method	C46 Energy	C45 C42 Individual values AV=FTLBF	C43 Mean value
01	350924	23519		K1	LV	-51		CHP-V			AV 59 97 86	81
01	350924	23543		K1	LV	-51		CHP-V			AV 56 85 42	61
01	350924	23547		K1	LV	-51		CHP-V			AV 91 83 108	94
01	350924	23742		K1	LV	-51		CHP-V			AV 99 125 104	109
02	350924	23542		K1	LV	-51		CHP-V			AV 90 80 73	81
02	350924	23546		K1	LV	-51		CHP-V			AV 44 64 82	63
02	350924	23589		K1	LV	-51		CHP-V			AV 69 71 93	78
02	350925	23239		K1	LV	-51		CHP-V			AV 86 25 83	65
02	350925	23401		K1	LV	-51		CHP-V			AV 101 96 81	93
02	350925	23413		K1	LV	-51		CHP-V			AV 94 97 93	95
02	350925	23437		K1	LV	-51		CHP-V			AV 69 83 89	80
02	350925	23443		K1	LV	-51		CHP-V			AV 80 86 84	83

C70-C99 Chemical composition % - Heat analysis

B07.2 Heat	C70	C	SI	MN	P	S	N	CU	MO	NI	CR	V	NB	SN	TI
350924	Y	0,184	0,390	1,17	0,010	0,0013	0,0078	0,047	0,013	0,061	0,064	0,001	0,000	0,001	0,002
350925	Y	0,188	0,383	1,18	0,009	0,0014	0,0072	0,046	0,018	0,061	0,045	0,002	0,000	0,000	0,002

B07.2 Heat	C70	B	CA	AL-T
350924	Y	0,0001	0,0022	0,038
350925	Y	0,0001	0,0017	0,039

A04 Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

QM-System: Certification as per ISO 9001

B. BALDAUF
Test House Manager

AHB
Inspector's stamp

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

Date 17.09.10

BM 1





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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A08/ Manufacturer's order/ A03 Certificate No. 357365-001	Sheet 5/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER A07.2 No.	B01 Product HOT ROLLED PLATES	
B02/ Steel design. SAS16-60	SA20-S5			
B03 Any suppl. requirements	ASME-II-A: 07+A09 DIL-HUE-3-R29-2010-01-31			

C94 Heat analysis Carbon equivalent / Alloying restrictions

B07.2 Heat	FO-02=	FO-51=	FO-55=	FO-78=	FO-91=
350924	0,40	0,001	0,19	0,08	6,4
350925	0,40	0,002	0,17	0,06	6,3

C95 Ladle treatment

ITEM NO.: 01-03
HEAT OF THE INDICATED ITEM: VACUUM DEGASSED / SULPHIDE SHAPE CONTROL

C95 Further information about ladle treatment

ITEM NO.: 01-03
CALCIUM TREATED

C70-C99 Chemical composition % - Product analysis

B07.2 Heat	B07.1 Test No.	C01	C	SI	MN	P	S	N	CU	MG	NI	CR	V	NB	SN	TI
350924	23543	K1	0,183	0,390	1,16	0,009	0,0011	0,0079	0,046	0,013	0,060	0,042	0,001	0,000	0,001	0,002
350924	23589	K1	0,182	0,381	1,14	0,008	0,0010	0,0083	0,045	0,012	0,059	0,055	0,000	0,000	0,000	0,002
350925	23210	K1	0,184	0,376	1,16	0,009	0,0014	0,0067	0,045	0,018	0,061	0,047	0,002	0,000	0,000	0,002
350925	23401	K1	0,186	0,382	1,14	0,009	0,0013	0,0077	0,045	0,012	0,060	0,036	0,000	0,000	0,000	0,002

B07.2 Heat	B07.1 Test No.	C01	B	CA	AL-T
350924	23543	K1	0,0001	0,0017	0,039
350924	23589	K1	0,0001	0,0015	0,038
350925	23210	K1	0,0001	0,0020	0,041
350925	23401	K1	0,0001	0,0016	0,037

A04 Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.



QM-System: Certification as per ISO 9001

B. BALDAUF
Test House Manager



Inspector's stamp

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

Date 17.09.10

BM 1



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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 369430-17.09.10	A08/ Manufacturer's order/ A03 Certificate No. 357365-001	Sheet 6
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10551-J1010-ER	B01 Product HOT ROLLED PLATES	
B02/ Steel design. SA516-60	A07.2 No. SA20-S5			
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-3:R29-2010-01-31			

C94 Product analysis Carbon equivalent / Alloying restrictions

B07.2 Heat	B07.1 Test No.	C01						
350924	23543	K1	FO-02=	0,39	FO-51=	0,001	FO-55=	0,16
350924	23589	K1	FO-02=	0,39	FO-51=	0,000	FO-55=	0,17
350925	23210	K1	FO-02=	0,40	FO-51=	0,002	FO-55=	0,17
350925	23401	K1	FO-02=	0,39	FO-51=	0,000	FO-55=	0,15


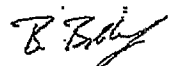

C94 Carbon equivalent formula / Alloying restrictions

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

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

ITEM NO.: 01-03
 RESULT OF MARKING, SURFACE, SHAPE AND DIMENSIONS: NO REMARKS
 SURFACE AS PER ASME-SA20
 THICKNESS AS PER ASME-SA20
 LENGTH AND WIDTH AS PER ASME-SA20
 FLATNESS AS PER 1/2-ASME-SA20



A04  Manufacturer's mark	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001	 B. BALDAUF Test House Manager	 Inspector's stamp	AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A01 Date 17.09.10 BM 1
---	--	---	--	--	------------------------------

QW-483 PROCEDURE QUALIFICATION RECORD (PQR)

Maloney Industries

Procedure Qualification Record No. MI-GSS-4-2 Date November 28, 2012
Welding Procedure Specification No. MI-GSS-4
Welding Process(es) GMAW / SMAW / SAW Types Semi-auto/Manual/Machine

JOINTS (QW-402)

Type Butt joint, single vee groove, see next page

BASE METALS (QW-403)

Material Spec. SA 516 to SA 516 Type or Grade Gr. 60 to Gr. 70
P-No. P1 Grp. 1 To P-No. P1 Grp. 2 Thickness 9.52 mm (0.375 in.)
Diameter N/A - Plate Heat No. 342179 - 68026
Deposited Weld Metal (Per pass) Did not exceed 12.7 mm (0.500 in.)

FILLER METALS (QW-404)

	GMAW	SMAW	SAW
SFA Specification	<u>SFA 5.18</u>	<u>SFA 5.1</u>	<u>SFA 5.17</u>
AWS Classification	<u>ER70S-2</u>	<u>E7018-1</u>	<u>EM14K</u>
Filler Metal F-No.	<u>F6</u>	<u>F4</u>	<u>F6</u>
Weld Metal A-No.	<u>*A1</u>	<u>A1</u>	<u>*A1</u>
Filler Metal Product Form	<u>Solid wire</u>	<u>N/A</u>	<u>Solid wire</u>
Supplementary Fillers	<u>Without</u>	<u>Without</u>	<u>Without</u>
Electrode - Flux Classification	<u>N/A</u>	<u>N/A</u>	<u>F7P6-EM14K</u>
Flux Type	<u>N/A</u>	<u>N/A</u>	<u>Neutral</u>
Recrushed slag	<u>N/A</u>	<u>N/A</u>	<u>None</u>
Size of Electrode	<u>See attached sketch</u>		
Weld Metal Thickness mm (in.)	<u>2.5 (0.100)</u>	<u>3.5 (0.138)</u>	<u>3.5 (0.138)</u>
Trade Name (s)	<u>GMAW: Bonarc ER70S-2</u>		
	<u>SMAW: Blueshield LA 18 Plus</u>		
	<u>SAW: Lincoln Electric, Lincolnweld LA-71 wire / 882 flux</u>		

Other *See attached weld deposit chemical analysis - Laboratory test report # C12-1790.4

POSITION (QW-405)

Position of Groove GMAW: Plate @ 45° off flat SMAW: 3G SAW: 1G
Weld Progression GMAW: Vertical down SMAW: Vertical up SAW: N/A

PREHEAT (QW-406)

Preheat Temperature 10°C (50°F) Interpass Temp. (Max.) 232°C (450°F)

POSTWELD HEAT TREATMENT (QW-407)

Temperature 621°C (1150°F) Time 6 hours
Note Additional Vickers hardness test from 1 hour PWHT time

GAS (QW-408)

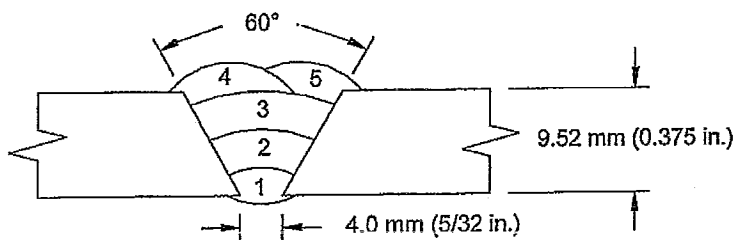
Specification No. (SFA) SFA 5.32 AWS No. SG-AC-25
Shielding GMAW: 75% Argon, 25% CO₂, 12.5 liters per minute (25 cfph)
Backing None Trailing Without

ELECTRICAL CHARACTERISTICS (QW-409)

Current Direct Polarity Reverse, electrode positive
 Amps See next page Volts See next page
 Electrode Wire Feed Speed GMAW: 735 cm/min (290 in./min) SAW: Amperage controlled
 Maximum Heat Input GMAW: 1.33 kJ/mm (33,783 J/in.) SMAW: 1.59 kJ/mm (40,500 J/in.)
SAW: 1.80 kJ/mm (45,675 J/in.)
 Mode of Metal Transfer GMAW: Short circuiting arc
 Other Heat Input kJ/mm (J/in.) = Amps x Volts x 60 / Travel speed mm/min. (ipm)

TECHNIQUE (QW-410)

String or Weave GMAW & SMAW: Weave SAW: String Travel Speed See below
 Orifice or Gas Cup Size GMAW: 9.52 mm (0.375 in.) Peening None
 Initial & Interpass Cleaning Brushing, chipping & grinding to remove slag
 Oscillation GMAW & SMAW: N/A SAW: Without
 Contact Tube to Work Distance GMAW: 9.52 to 12.7 mm (0.375 to 0.500 in.)
SAW: 25.4 to 38.1 mm (1.00 to 1.50 in.)
 Method of Back Gouging Not used Multiple or Single Pass Per Side Multiple
 Multiple or Single Electrodes Single Electrode Spacing N/A
 Use of Thermal Processes N/A



Pass	Process	Filler Metal	Diameter mm (in.)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min. (i.p.m.)
1	GMAW	ER70S-2	0.9 (0.035)	DCRP	135 - 145	18 - 19	117 (4.6)
2	SMAW	E7018-1	2.4 (3/32)	DCRP	85 - 95	22 - 23	76 (3.0)
3	SAW	F7P6-EM14K	3.2 (1/8)	DCRP	410 - 430	28 - 30	470 (18.5)
4	SAW	F7P6-EM14K	3.2 (1/8)	DCRP	410 - 430	28 - 30	457 (18.0)
5	SAW	F7P6-EM14K	3.2 (1/8)	DCRP	410 - 430	28 - 30	406 (16.0)

TENSILE TEST (QW-150)

Specimen No.	Width mm (in.)	Thickness mm (in.)	Area Sq. mm (Sq. in.)	Ultimate Load N (lbf.)	Ultimate Stress MPa (psi)	Character & Fracture Location
T1	19.2 (0.756)	7.92 (0.312)	152 (0.236)	74 877 (16,800)	492 (71,400)	Partial cup & cone Parent Metal (Gr. 70)
T2	19.1 (0.752)	7.91 (0.311)	151 (0.234)	73 914 (16,800)	489 (71,000)	Partial cup & cone Parent Metal (Gr. 70)

GUIDED BEND TEST (QW-160)

Type & Figure No.	Result	Type & Figure No.	Result
QW-462.2, TSB - S1	Pass	QW-462.2, TSB - S3	Pass
QW-462.2, TSB - S2	Pass	QW-462.2, TSB - S4	Pass

CHARPY IMPACT TOUGHNESS

Type of Test Charpy V-Notch Orientation Transverse
 Test Temperature -46°C (-50°F) Specimen Size 10 X 8 mm (0.394 X 0.315 in.)

Specimen No.	Notch Location	Impact Values J (ft. lbf)
Z2.1	Weld Metal	>141 (>104)
Z2.2	within 1/16 in.	16.3 (12.0)
Z2.3	of root	68.3 (50.4)
Z3.1	Gr. 60 - HAZ	>141 (>104)
Z3.2	Gr. 60 - HAZ	>141 (>104)
Z3.3	Gr. 60 - HAZ	>141 (>104)
A3.1	Gr. 70 - HAZ	>141 (>104)
A3.2	Gr. 70 - HAZ	>141 (>104)
A3.3	Gr. 70 - HAZ	>141 (>104)

OTHER TESTS

Vickers Hardness (6 hour PWHT) - see attached laboratory test report # C12-1790.4
Vickers Hardness (1 hour PWHT) - see attached laboratory test report # C12-1790.5
Deposited weld metal chemical analysis - see attached laboratory test report # C12-1790.4

Welders Name James Krancan / Kevin Stenger Certificate File No. W-22865 / W-16699
 Tests Conducted By SGS Ludwig Associates Ltd.
 Laboratory Test No. C12-1790.4 & C12-1790.5

We certify the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer MALONEY INDUSTRIES

Date JAN 02 2013 Certified by 



LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta.
T2C 4N9

Laboratory Test No.: C12-1790.4
Date: December 3, 2012

Attention: Philip Correia

PQR Number: MI-GSS-4-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 342179 - 68026)
Thickness: 9.52 mm (0.375 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes

TENSILE TEST QW-150

SAMPLE NUMBER	T1 QW-462.1(a)	T2 QW-462.1(a)
WIDTH mm (in)	19.2 (0.756)	19.1 (0.752)
THICKNESS mm (in)	7.92 (0.312)	7.91 (0.311)
AREA sq mm (sq in)	152 (0.236)	151 (0.234)
ULT. LOAD N (lbf)	74 877 (16,800)	73 914 (16,600)
UTS MPa (psi)	492 (71,400)	489 (71,000)
FRACTURE TYPE	Partial Cup & Cone	Partial Cup & Cone
FRACTURE LOCATION	Parent Metal (SA 516 Gr. 70)	Parent Metal (SA 516 Gr. 70)

GUIDED-BEND TEST QW-160

SAMPLE WIDTH:	9.52 mm (0.375 in.)	SAMPLE THICKNESS:	9.52 mm (0.375 in.)
PLUNGER SIZE:	38.1 mm (1.50 in.)	YOKE SIZE:	60.3 mm (2.375 in.)
QW-462.2	Side Bend	Side Bend	Side Bend
SAMPLE NUMBER(S)	S1	S2	S3
RESULTS	Pass	Pass	Pass

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASME Section IX, 2010 edition and latest addenda. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. Samples associated with this report will be discarded in 45 days.

Laboratory Test Conducted By: Xin (Vincent) Su, T.T./Dan Nguyen, C.E.T.





LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.4
Date: December 3, 2012

Attention: Philip Correia

PQR Number: MI-GSS-4-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 342179 - 68026)
Thickness: 9.52 mm (0.375 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes


CHARPY V-NOTCH IMPACT TEST

Machine: Satec, SI-1C SN:1363
Capacity: 325 J (240 ft-lbf)
Verified Range: 1.7 - 141.3 J (1.3 - 104.2 ft-lbf)

Specimen Size: 10 x 8 mm (0.394 x 0.315 in.)
Orientation: Transverse
Test Temp.: -46°C (-50°F)

Specimen Number	Notch Location	Impact Values	
		Joules	(ft-lbf)
Z2.1	Weld Metal within 1/16 in. of root	>141	(>104)
Z2.2		16.3	(12.0)
Z2.3		68.3	(50.4)
Z3.1	Gr. 60 - HAZ	>141	(>104)
Z3.2		>141	(>104)
Z3.3		>141	(>104)
A3.1	Gr. 70 - HAZ	>141	(>104)
A3.2		>141	(>104)
A3.3		>141	(>104)

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASME Section VIII, Div. 1, UG-84 – 2010 edition and latest addenda. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. Samples associated with this report will be discarded in 45 days.

Laboratory Test Conducted By: 
Xin (Vincent) Su, T.T./Dan Nguyen, C.E.T.





LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.4
Date: December 4, 2012

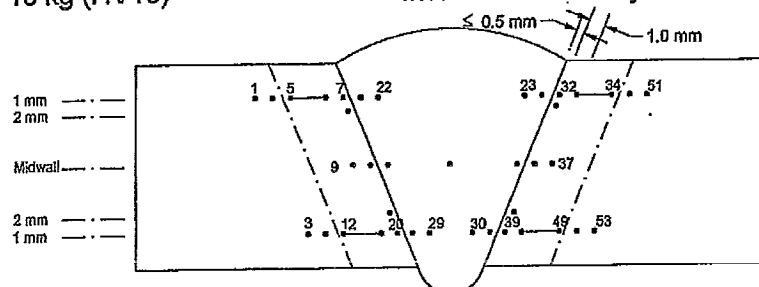
Attention: Philip Correia

PQR Number: MI-GSS-4-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 342179 - 68026)
Thickness: 9.52 mm (0.375 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes

HARDNESS TEST

Type of Test: Vickers 10 kg (HV10)

Instrument: Mitutoyo AVK-C1



SA 516 Gr. 70				Weld Metal				SA 516 Gr. 60							
Parent Metal		HAZ		Weld Metal		Weld Metal		HAZ		Parent Metal					
1	138	5	143	14	144	21	182	30	142	32	170	41	151	50	143
2	142	6	150	15	147	22	180	31	150	33	147	42	150	51	143
3	146	7	181	16	150	23	183			34	142	43	151	52	144
4	144	8	184	17	155	24	172			35	167	44	141	53	144
		9	148	18	155	25	158			36	160	45	149		
		10	156	19	154	26	155			37	151	46	147		
		11	166	20	157	27	155			38	154	47	146		
		12	142			28	140			39	171	48	143		
		13	144			29	138			40	150	49	144		

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E384-11^{e1}, ANSI/NACE MR0175/ISO 15156-2:2009(E) and NACE SP0472-2010. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. **Samples associated with this report will be discarded in 45 days.**

Laboratory Test Conducted By: _____

Oksana Shevchenko / Dan Nguyen, C.E.T.





LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.5
Date: December 5, 2012

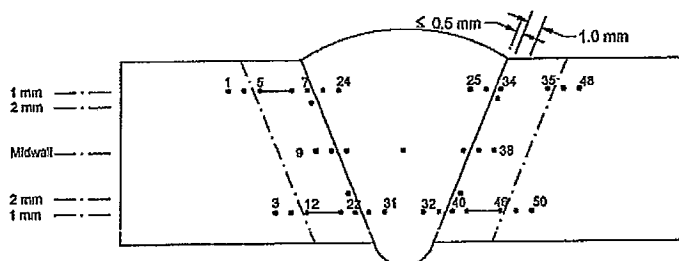
Attention: Philip Correia

PQR Number: MI-GSS-4-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 342179 – 68026)
Thickness: 9.52 mm (0.375 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 60 minutes

HARDNESS TEST

Type of Test: Vickers 10 kg (HV10)

Instrument: Mitutoyo AVK-C1



SA 516 Gr 60					Weld Metal				SA 516 Gr 70						
Parent Metal		HAZ							HAZ			Parent Metal			
1	149	5	149	14	151	23	176	32	139	34	175	43	156	47	148
2	147	6	156	15	152	24	176	33	141	35	156	44	150	48	149
3	149	7	179	16	155	25	185			36	176	45	149	49	147
4	148	8	171	17	157	26	187			37	161	46	147	50	149
		9	153	18	154	27	164			38	156				
		10	161	19	159	28	157			39	159				
		11	165	20	159	29	155			40	162				
		12	148	21	161	30	144			41	158				
		13	149	22	155	31	145			42	157				

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E384-11^{e1}, ANSI/NACE MR0175/ISO 15156-2:2009(E) and NACE SP0472-2010. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. **Samples associated with this report will be discarded in 45 days.**

Laboratory Test Conducted By: 
Oksana Shevchenko / Dan Nguyen, C.E.T.





LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.4
Date: December 5, 2012

Attention: Phillip Correia

PQR Number: MI-GSS-4-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 342179 - 68026)
Thickness: 9.52 mm (0.375 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes
Test Location: Weld metal - GMAW root

CHEMICAL ANALYSIS


(% by weight)

Instrument Type: Shimadzu PDA-7000 Optical Emission Spectrometer

Carbon	0.09
Manganese	0.96
Silicon	0.35
Chromium	0.03
Nickel	0.02
Molybdenum	<0.01

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E415-08. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. **Samples associated with this report will be discarded in 45 days.**

Laboratory Test Conducted By: _____


Michelle Marien, T.T. / Steve Rieberger, C.E.T.



LABORATORY
ACCREDITATION
BUREAU

ACCREDITED ISO/IEC 17025

Certificate # L2057-1 Testing

4027 - 14 Street, S.E., CALGARY, ALBERTA T2G 3K6 PHONE: (403) 262-7072 FAX: (403) 266-3169
7925 Davies Road, EDMONTON, ALBERTA T6E 4N1 PHONE: (780) 468-3030 FAX: (780) 468-3032

Page 1 of 1



LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: Maloney Industries
8825 Shepard Road S.E.
Calgary, Alberta
T2C 4N9

Laboratory Test No.: C12-1790.4
Date: December 5, 2012

Attention: Philip Correia

PQR Number: MI-GSS-4-2
Material: SA 516 Gr. 60 to SA 516 Gr. 70 (Heat No.: 342179 - 68026)
Thickness: 9.52 mm (0.375 in.)
Thermal Condition: PWHT @ 621°C (1150°F) for 360 minutes
Test Location: Weld metal - SAW Cap

CHEMICAL ANALYSIS

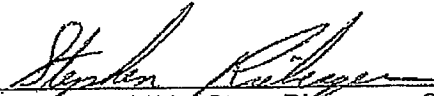
(% by weight)

Instrument Type: Shimadzu PDA-7000 Optical Emission Spectrometer

Carbon	0.09
Manganese	1.22
Silicon	0.57
Chromium	0.03
Nickel	0.03
Molybdenum	<0.01

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E415-08. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report. Samples associated with this report will be discarded in 45 days.

Laboratory Test Conducted By: _____


Michelle Marien, T.T. / Steve Rieberger, C.E.T.



The Lincoln Electric Company
 22801 St. Clair Avenue
 Cleveland, Ohio 44117-1199

CERTIFICATE OF CONFORMANCE
 (APPLIES ONLY TO U.S. PRODUCTS)



Product: Lincolnweld® 882 Flux /LA-71 Electrode
 Classification: F7P6-EM14K-H8
 Specification: AWS A5.17-97, ASME SFA-5.17
 Test Completed: March 15, 2010

[3 year]

This is to certify that the product named above and supplied on the referenced order number is of the same classification, manufacturing process, and material requirements as the material which was used for the test that was concluded on the date shown, the results of which are shown below. All tests required by the specifications shown for classification were performed at that time and the material tested met all requirements. It was manufactured and supplied according to the Quality System Program of the Lincoln Electric Company, Cleveland, Ohio, U.S.A., which meets the requirements of ISO9001, NCA3800, ANSI/AWS A5.01, and other specification and Military requirements, as applicable. The Quality System Program has been approved by ASME, ABS, and VdTUV.

Operating Settings	AWS/ASME Requirements	Deposit Results
Electrode Size	5/32 inch	5/32 inch
Polarity		DC+
Voltage, V	27 - 30	28
Wire Feed Speed, cm/min (in/min)		109 (43)
Current, amps	475 - 575	525
Contact Tip to Work Distance, mm (in.)	(1 - 1 1/2)	32 (1 1/4)
Travel Speed, cm/min (in/min)	(15 - 17)	41 (16)
Passes/Layers		15/7
Preheat Temp, °C (°F)	(60 - 325)	20 (66)
Interpass Temp, °C (°F)	(275 - 325)	150 (300)

Chemical composition of the weld deposit and electrode

Analysis- (weight %)	Deposit		EM14K Electrode	
	Requirements	Results	Requirements	Results
C		0.07	0.06 - 0.19	0.11
Mn		1.19	0.90 - 1.40	1.10
Si	Not	0.59	0.35 - 0.75	0.50
S	Required	0.006	0.025 max.	0.006
P		0.011	0.025 max.	0.006
Ti		0.02	0.03 - 0.17	0.09
Cu (total)		0.08	0.35 max.	0.10

Mechanical properties of the weld deposit (stress-relieved 1 hour @ 621°C (1150°F))

Tensile Strength, MPa (ksi)	(70 - 95)	540 (78)
Yield Strength, 0.2% offset MPa (ksi)	(58 min.)	420 (51)
Elongation, %	22 min.	32
Average Hardness Rockwell B	Not Required	85
Charpy V-notch Impact Properties Avg. Joules @ -51 °C (ft-lbf @ -60 °F)	(20 min.)	149 (110)
Diffusible Hydrogen (mL/100g) per AWS A4.3		145,149,153 (107,110,113)
Absolute Humidity (grains moisture/lb dry air)	8.0 max	4.5
		60

Radiographic Test: Met requirements.
 Test assembly constructed of ASTM A36.

Results below the detection limits of the instrument or lower than the precision required by specification are reported as zero.
 Strength values in SI units are reported to the nearest 10 MPa converted from actual data. Preheat and interpass temperature values in SI units are reported to the nearest 5 degrees.
 This certificate complies to the requirements of EN 10204, 2.2.

For R.B.
 March 19, 2010
 Richard J. Bofas, Certification Supervisor Date
 David A. Fink, Manager, Compliance Engineering, Date
 Consumable R&D Department

Cert. No. 55715



DILLINGER HÜTTE

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

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B.AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10.	A08 Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 2/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER	A07.2 No.	B01 Product: HOT ROLLED PLATES
B02 Steel design SA516-70	SA20-SS			
B03 Any suppl. requirements	ASME-II-A-07+A09 DIL-HUE-1-R25-2009-12-04			

B01-B99 Description of the product

B14 Item No.	B08 Number of pieces	B05 Thickness	B10 Width	B11 Length	B12 Theoretical mass	B04 Product/delivery condition	B07.2 Heat No.	B07.1 Rolled plate No./ Test No.	A09 Purchaser article number
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68018-03	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68020-01	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68020-02	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68020-03	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68024-01	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68024-02	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68024-03	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68026-01	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68026-02	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68026-03	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68055-01	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68055-02	
.01	1	0,3750	96,50000	480,00000	2234	N	342179	68055-03	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55555-01	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55555-02	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55555-03	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55556-01	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55556-02	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55556-03	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55559-01	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55559-02	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55559-03	
.01	1	0,3750	96,50000	480,00000	2234	N	342181	55560-01	

CPL-100
 0,375 in.
 SA 516 CL 70
 HT# 342179-68026
 Rec'd Nov. 26, 2012
 P.O. # C0422



Z01Z02Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.
 QM-System: Certification as per ISO 9001

B. Mueller
 B. MUELLER
 Test House Manager



Inspector's stamp

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

Date 04.02.10

PP 1



DILLINGER HÜTTE

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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 9/...
A05 Established inspecting body DE	A06 Purchaser Final receiver	EDMONTON STEEL, EDMON EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER A07.2 No.	B01 Product HOT ROLLED PLATES
B02/ Steel design.	SA516-70	SA20-S5		
B03 Any suppl. requirements	ASME-II-A:07-A09 DLL-HUE-1:R25-2009-12-04			

B01-B99 Description of the product




B14 Item No.	B08 Number of pieces	B09 Thickness	B10 Width	B11 Length	B12 Theoretical mass KG	B04 Product delivery condition	B07.2 Heat No.	B07.1 Rolled plate No./ Test No.	A08 Purchaser/article number
			INCH						
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65686-01	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65686-02	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65686-03	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65695-01	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65695-02	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65695-03	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65696-01	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65696-02	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65696-03	
**	41				152520				
***	184				524132				

B04 Product delivery condition

ITEM NO.: 01-03
 N: RT: 1670 GR.F #36 -27 GR.F
 SOAKING TIME TO ATTAIN THE TARGET TEMPERATURE OVER THE WHOLE SECTION: 1-1,75 MIN/MM (25-45 MIN/INCH)
 COOLING IN STILL AIR

B06 Marking of the product

ITEM NO.: 01-03
 STEEL DESIGNATION SA516 70 MLTY SA516 60 MLTY
 HEAT NO. / TRADEMARK / ROLLED PLATE NO.-TEST NO. / INSPECTOR'S STAMP

A04  Manufacturer's mark	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001	 B. MUELLER Test House Manager	 Inspector's stamp	AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A04 Date 04.02.10 PP 1
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DILLINGER HÜTTE

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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004. INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 10/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-RR	A09 SA20-S5	
B02 Steel design. SA516-70	B03 Any suppl. requirements ASME-II-A:07+A09 DIL-HUE-1:R25-2009-12-04		B01 Product HOT ROLLED PLATES	

B07-B99 Further information about the product

ITEM NO.: 01-03
THICKNESS REDUCTION RATIO >= 3.0 IS FULFILLED (CF. A/SA20 PAR. 5.3)

C10-C29 Tensile test

B14 Item No.	B07Z Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02	C03	C10	C11	C12	C13	C14-C15
				C01 Temp. GRF		KSI RP02		RM	A % L0-gin		
01	342179	67986		KL	Q	RT	50,8		73,8		26
01	342179	67998		KL	Q	RT	51,0		74,0		25
01	342179	68004		KL	Q	RT	51,3		74,2		26
01	342179	68005		KL	Q	RT	51,0		74,0		27
01	342179	68014		KL	Q	RT	50,2		73,8		23
01	342179	68018		KL	Q	RT	51,3		74,1		26
01	342179	68020		KL	Q	RT	49,9		73,5		28
01	342179	68024		KL	Q	RT	51,0		74,2		26
01	342179	68026		KL	Q	RT	50,5		74,2		26
01	342179	68055		KL	Q	RT	50,0		73,7		25
01	342181	55555		KL	Q	RT	52,3		75,0		24
01	342181	55556		KL	Q	RT	51,5		75,5		25
01	342181	55559		KL	Q	RT	51,2		74,5		26
01	342181	55560		KL	Q	RT	51,2		74,4		24
01	342181	55578		KL	Q	RT	50,9		74,5		22
01	342181	55589		KL	Q	RT	51,2		74,8		26
01	342181	55592		KL	Q	RT	51,0		75,1		23
01	342181	55618		KL	Q	RT	51,0		74,5		28
01	342183	50326		KL	Q	RT	50,2		72,9		25
01	342183	51466		KL	Q	RT	50,8		73,8		27

A04	201/202/203 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.		A01
	QM-System: Certification as per ISO 9001		AG der Dillinger Hüttenwerke. Postfach 1580, D-66748 Dillingen/Saar Inspection department
Manufacturer's mark		B. MUELLER Test House Manager	Inspector's stamp Date 04.02.10 PP 1



DILLINGER HÜTTE

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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1:B AS PER EN 10204:1991+AL:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A09 Certificate No. 352257-001	Street 13/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER	A07.2 No.	
B02/ Steel design SA516-70	SA20-SS		B01 Product HOT ROLLED PLATES	
B03 App. suppl. requirements	ASME-II-A:07+A09 DIL-HUE-1:R25-2009-12-04			

C30-C39 Hardness test

B14 Item No.	B07.2 Heat No.	B07.1 Roll date/ Test No.	B05 Reference (heat) treatment	C01	C02/C01	C03 Temp. GRF	C30 Testing method	C35-C39 Individual values			C32 Mean value
01	342179	67986		K1	0	RT	HBW 5/750	HB 143	145	143	144
01	342179	67998		K1	0	RT	HBW 5/750	HB 144	145	147	145
01	342179	68004		K1	0	RT	HBW 5/750	HB 146	147	146	146
01	342179	68005		K1	0	RT	HBW 5/750	HB 143	145	145	144
01	342179	68014		K1	0	RT	HBW 5/750	HB 147	150	150	149
01	342179	68018		K1	0	RT	HBW 5/750	HB 143	141	143	142
01	342179	68020		K1	0	RT	HBW 5/750	HB 145	149	143	146
01	342179	68024		K1	0	RT	HBW 5/750	HB 148	150	149	149
01	342179	68026		K1	0	RT	HBW 5/750	HB 148	149	150	149
01	342179	68055		K1	0	RT	HBW 5/750	HB 147	149	148	148
01	342181	55555		K1	0	RT	HBW 5/750	HB 146	149	146	147
01	342181	55556		K1	0	RT	HBW 5/750	HB 151	149	144	148
01	342181	55559		K1	0	RT	HBW 5/750	HB 146	149	148	148
01	342181	55560		K1	0	RT	HBW 5/750	HB 144	147	149	147
01	342181	55578		K1	0	RT	HBW 5/750	HB 146	145	150	147
01	342181	55589		K1	0	RT	HBW 5/750	HB 149	153	150	151
01	342181	55592		K1	0	RT	HBW 5/750	HB 147	150	148	148
01	342181	55618		K1	0	RT	HBW 5/750	HB 150	149	146	148
01	342183	50326		K1	0	RT	HBW 5/750	HB 150	150	150	150
01	342183	51466		K1	0	RT	HBW 5/750	HB 148	147	148	148
01	342183	55516		K1	0	RT	HBW 5/750	HB 147	147	146	147
01	342183	55518		K1	0	RT	HBW 5/750	HB 144	146	147	146
01	342183	55520		K1	0	RT	HBW 5/750	HB 143	145	147	145
01	342183	55521		K1	0	RT	HBW 5/750	HB 146	151	149	149

A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.		A01
	QM-System: Certification as per ISO 9001		AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department
Manufacturer's mark	B. MUELLER Test House Manager		Inspector's stamp Date 04.02.10 PP 1




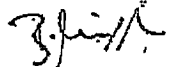

DILLINGER HÜTTE

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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 16/...
A05 Established inspecting body. DE	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER A07.2 No.	A09 Product HOT ROLLED PLATES	
B02/ Steel design. SA516-70	SA20-S5			
B03 Any suppl. requirements	ASME-II-A:07+A99 DIL-HUE-1:R25-2009-12-04			

C40-C49 Impact test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01 C01	C02 C02	C03 Temp. GR.F	C41 Width of test piece	C40 Type of test piece	C44 Testing method	C46 Energy	C45 C42 Individual values AV=FTLBF	C43 Mean value
01	342179	67986		KL	LV	-51	3/4	CHP-V		AV 139	140	134
01	342179	67998		KL	LV	-51	3/4	CHP-V		AV 149	139	126
01	342179	68004		KL	LV	-51	3/4	CHP-V		AV 129	126	131
01	342179	68005		KL	LV	-51	3/4	CHP-V		AV 168	130	135
01	342179	68014		KL	LV	-51	3/4	CHP-V		AV 127	91	148
01	342179	68018		KL	LV	-51	3/4	CHP-V		AV 92	154	131
01	342179	68020		KL	LV	-51	3/4	CHP-V		AV 134	147	94
01	342179	68024		KL	LV	-51	3/4	CHP-V		AV 142	141	156
01	342179	68026		KL	LV	-51	3/4	CHP-V		AV 87	144	91
01	342179	68055		KL	LV	-51	3/4	CHP-V		AV 119	89	111
01	342181	55555		KL	LV	-51	3/4	CHP-V		AV 145	142	139
01	342181	55556		KL	LV	-51	3/4	CHP-V		AV 129	142	99
01	342181	55559		KL	LV	-51	3/4	CHP-V		AV 134	105	147
01	342181	55560		KL	LV	-51	3/4	CHP-V		AV 109	150	130
01	342181	55578		KL	LV	-51	3/4	CHP-V		AV 145	136	141
01	342181	55589		KL	LV	-51	3/4	CHP-V		AV 101	153	134
01	342181	55592		KL	LV	-51	3/4	CHP-V		AV 138	91	153
01	342181	55618		KL	LV	-51	3/4	CHP-V		AV 158	140	151
01	342183	50326		KL	LV	-51	3/4	CHP-V		AV 149	170	137
01	342183	51466		KL	LV	-51	3/4	CHP-V		AV 136	128	128
01	342183	55516		KL	LV	-51	3/4	CHP-V		AV 134	131	164
01	342183	55518		KL	LV	-51	3/4	CHP-V		AV 128	139	141
01	342183	55520		KL	LV	-51	3/4	CHP-V		AV 148	134	131
01	342183	55521		KL	LV	-51	3/4	CHP-V		AV 88	143	135

A04  Manufacturer's mark	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001	 B. MUELLER Test House Manager	 Inspector's stamp	AG der Dillinger Hüttenwerke Postfach 1580; D-66748 Dillingen/Saar Inspection department	A07 Date 04.02.10 PP 1
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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 - Certificate No. 352257-001	Sheet 19/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER	A01 Product HOT ROLLED PLATES	
B02 Steel design SA516-70	SA20-S5			
B03 Any special requirements	ASME-II-A:07+A09 DIL-HUE-1:R25-2009-12-04			

C70-C99. Chemical composition % - Heat analysis

B07.2 Heat	C70	C	SI	MN	P	S	N	CU	MO	NI	CR	V	NB	SN	Bi
342179	Y	0,175	0,316	1,16	0,012	0,0012	0,0060	0,030	0,008	0,043	0,031	0,001	0,000	0,001	0,002
342181	Y	0,174	0,329	1,17	0,011	0,0008	0,0055	0,022	0,007	0,031	0,032	0,000	0,000	0,001	0,003
342183	Y	0,173	0,325	1,17	0,011	0,0007	0,0064	0,028	0,007	0,042	0,035	0,000	0,000	0,000	0,003
342669	Y	0,166	0,367	1,17	0,009	0,0012	0,0063	0,030	0,009	0,037	0,037	0,000	0,000	0,001	0,003
342670	Y	0,164	0,369	1,18	0,009	0,0011	0,0060	0,018	0,006	0,026	0,028	0,000	0,000	0,001	0,003
342671	Y	0,168	0,387	1,19	0,009	0,0012	0,0062	0,026	0,007	0,032	0,032	0,001	0,000	0,002	0,003

B07.2 Heat	C70	B	CA	AL-T
342179	Y	0,0001	0,0024	0,032
342181	Y	0,0001	0,0017	0,030
342183	Y	0,0001	0,0015	0,031
342669	Y	0,0002	0,0017	0,037
342670	Y	0,0001	0,0017	0,038
342671	Y	0,0002	0,0023	0,037

C94 Heat analysis: Carbon equivalent / Alloying restrictions

B07.2 Heat	FO-02=	FO-55=	FO-78=	FO-91=
342179	0,38	0,11	0,04	6,6
342181	0,38	0,09	0,04	6,7
342183	0,38	0,11	0,04	6,8
342669	0,37	0,11	0,05	7,0
342670	0,37	0,08	0,03	7,2
342671	0,38	0,10	0,04	7,1

A04 201/202/203 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

QM-System: Certification as per ISO 9001



B. MUELLER
Test House Manager



Inspector's stamp

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

Date 04.02.10

A01

PP 1



DILLINGER HÜTTE

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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 22.
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER A07.2 No.	B01 Product HOT ROLLED PLATES	
B02 Steel design. B03 Any suppl. requirements	SA516-70 ASME-II-A:07+A09 DIL-HUE-1-R25-2009-12-04	SA20-S5		

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

ITEM NO.: 01-03
 RESULT OF MARKING, SURFACE, SHAPE AND DIMENSIONS: NO REMARKS
 SURFACE AS PER ASME-SA20
 THICKNESS AS PER ASME-SA20
 LENGTH AND WIDTH AS PER ASME-SA20
 FLATNESS AS PER 1/2-ASME-SA20



A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001			AG der Dillinger Hüttenwerke Postfach 1580; D-66748 Dillingen/Saar Inspection department	A01
		B. MUELLER Test House Manager	Inspector's stamp	Date 04.02.10	PP 1



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A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 2/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER	A07.2 No.	B01 Product HOT ROLLED PLATES
B02/ Steel design. SA516-60	SA20-SS			
B03 Any suppl. requirements	ASME-IX-A:07+A09 DIL-HUE-1:R25+2009-12-04			

B01-B99 Description of the product

B14 Item No.	B08 Number of pieces	B09 Thickness	B10 Width	B11 Length	B12 Theoretical mass KG	B04 Product delivery condition	B07.2 Heat No.	B07.1 Rolled plate No./ Test No.	A09 Purchaser article number
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68019-03	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68020-01	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68020-02	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68020-03	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68024-01	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68024-02	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68024-03	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68026-01	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68026-02	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68026-03	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68055-01	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68055-02	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342179	68055-03	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55555-01	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55555-02	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55555-03	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55556-01	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55556-02	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55556-03	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55559-01	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55559-02	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55559-03	
01	1	0,3750 x	96,50000 x	480,00000	2234	N	342181	55560-01	

CPL-100
0.375 in.
SA 516 CL.60
HT# 342179-68026
Recd. Nov. 26, 2012
P.O. # C0122
MC

A04	201202/203 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001			AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A01
	Manufacturer's mark	B. MUELLER Test House Manager	Inspector's stamp	Date 04.02.10	PP 1



DILLINGER HÜTTE

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

A02	INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)	A10	Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 9/...
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A05	Established inspecting body DH	A06	Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1	No. ED10S46-J1010-ER	A07.2	No.	B01	Product HOT ROLLED PLATES
B02	Steel design	SA516-60							SA20-S5
B03	Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-1:R25-2009-12-04							

B01-B99 Description of the product

B14	B08	B09	B10	B11	B12	B04	B07.2	B07.1	A09
Item No.	Number of pieces	Thickness	Width	Length	Theoretical mass KG	Product delivery condition	Heat No.	Rolled plate No./ Test No.	Purchaser article number
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65686-01	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65686-02	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65686-03	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65695-01	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65695-02	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65695-03	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65696-01	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65696-02	
03	1	0,5000 x	120,50000 x	480,00000	3720	N	342671	65696-03	
**	41				152520				
***	194				524132				

B04 Product delivery condition

ITEM NO.: 01-03

N: HT: 1670 GR.F +36 -27 GR.F


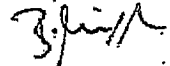

SOAKING TIME TO ATTAIN THE TARGET TEMPERATURE OVER THE WHOLE SECTION: 1-1,75 MIN/MM (25-45 MIN/INCH)
COOLING IN STILL AIR

B06 Marking of the product

ITEM NO.: 01-03

STEEL DESIGNATION SA516 70 MELTV SA516 60 MELTV

HEAT NO. / TRADEMARK / ROLLED PLATE NO.-TEST NO. / INSPECTOR'S STAMP

A04	 Manufacturers mark	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001	 B. MUELLER Test House Manager	 Inspector's stamp	AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar inspection department	A01
					Date 04.02.10	PP 1



DILLINGER HÜTTE

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

A02	INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)	A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 10/...
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A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON	A07.1 No. RD10546-J1010-ER	B01 Product HOT ROLLED PLATES
	Final receiver EDMONTON STEEL, EDMON	A07.2 No.	
B02 Steel design SA516-60	SA20-SS		
B03 Any suppl. requirements	ASME-II-A; 07+A09 DIL-HUE-1; R25-2009-12-04		

B07-B99 Further information about the product

ITEM NO.: 01-03

THICKNESS REDUCTION RATIO: >= 3.0 IS FULFILLED (CF. A/SA20 PAR. 5.3)

C10-C29 Tensile test

B14	B07.2	B07.1	B03	C01	C02	C03	C10	C11	C12	C13	A	C14-C15
Item No.	Heat No.	Roll plate Test No.	Reference (heat) treatment	C01	Temp. GRF	KSI RP02			RM		% LO=8IN	
01	342179	67986		K1	Q	RT	50,8		73,8		26	
01	342179	67998		K1	Q	RT	51,0		74,0		25	
01	342179	68004		K1	Q	RT	51,3		74,2		26	
01	342179	68005		K1	Q	RT	51,0		74,0		27	
01	342179	68014		K1	Q	RT	50,2		73,8		23	
01	342179	68018		K1	Q	RT	51,3		74,1		26	
01	342179	68020		K1	Q	RT	49,9		73,5		28	
01	342179	68024		K1	Q	RT	51,0		74,2		26	
01	342179	68026		K1	Q	RT	50,5		74,2		26	
01	342179	68055		K1	Q	RT	50,0		73,7		25	
01	342181	55555		K1	Q	RT	52,3		75,0		24	
01	342181	55556		K1	Q	RT	51,5		75,5		25	
01	342181	55559		K1	Q	RT	51,2		74,5		26	
01	342181	55560		K1	Q	RT	51,2		74,4		24	
01	342181	55578		K1	Q	RT	50,9		74,5		22	
01	342181	55589		K1	Q	RT	51,2		74,8		26	
01	342181	55592		K1	Q	RT	51,0		75,1		23	
01	342181	55618		K1	Q	RT	51,0		74,5		28	
01	342183	50326		K1	Q	RT	50,2		72,9		25	
01	342183	51466		K1	Q	RT	50,8		73,8		27	

A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001			A01
		B. MUELLER Test House Manager	AG der Dillinger Hüttenwerke Postfach 4580, D-66748 Dillingen/Saar Inspection department	
		Inspector's stamp	Date 04.02.10	PP 1



DILLINGER HÜTTE

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

A02: INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 13/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER A07.2 No.	B07 Product HOT ROLLED PLATES	
B02 Steel design. SA516-60	SA20-S5			
B03 Any suppl. requirements	ASME-III-A:07+A09 DIL-HUE-1:R25-2009-12-04			

C30-C39 Hardness test

B14 Item No.	B07.2 Heat No.	B07.1 Rol.plate/ Test No.	B05 Reference (heat) treatment	C01	C02/C01	C03 Temp. GRF	C03 Testing method	C35 C31 Individual values	C32 Mean value
01	342179	67986		KL	0	RT	HBW 5/750	HB 143 145 143	144
01	342179	67998		KL	0	RT	HBW 5/750	HB 144 145 147	145
01	342179	68004		KL	0	RT	HBW 5/750	HB 146 147 146	146
01	342179	68005		KL	0	RT	HBW 5/750	HB 143 145 145	144
01	342179	68014		KL	0	RT	HBW 5/750	HB 147 150 150	149
01	342179	68018		KL	0	RT	HBW 5/750	HB 143 141 143	142
01	342179	68020		KL	0	RT	HBW 5/750	HB 145 149 143	146
01	342179	68024		KL	0	RT	HBW 5/750	HB 148 150 149	149
01	342179	68026		KL	0	RT	HBW 5/750	HB 148 149 150	149
01	342179	68055		KL	0	RT	HBW 5/750	HB 147 149 148	148
01	342181	55555		KL	0	RT	HBW 5/750	HB 146 149 146	147
01	342181	55556		KL	0	RT	HBW 5/750	HB 151 149 144	148
01	342181	55559		KL	0	RT	HBW 5/750	HB 146 149 148	148
01	342181	55560		KL	0	RT	HBW 5/750	HB 144 147 149	147
01	342181	55578		KL	0	RT	HBW 5/750	HB 146 145 150	147
01	342181	55589		KL	0	RT	HBW 5/750	HB 149 153 150	151
01	342181	55592		KL	0	RT	HBW 5/750	HB 147 150 148	148
01	342181	55618		KL	0	RT	HBW 5/750	HB 150 149 146	148
01	342183	50326		KL	0	RT	HBW 5/750	HB 150 150 150	150
01	342183	51466		KL	0	RT	HBW 5/750	HB 148 147 148	148
01	342183	55516		KL	0	RT	HBW 5/750	HB 147 147 146	147
01	342183	55518		KL	0	RT	HBW 5/750	HB 144 146 147	146
01	342183	55520		KL	0	RT	HBW 5/750	HB 143 145 147	145
01	342183	55521		KL	0	RT	HBW 5/750	HB 146 151 149	149

A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001			AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar Inspection department	A01
	B. MUELLER Test House Manager	Inspector's stamp	Date 04.02.10	PP 1	



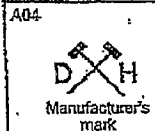
DILLINGER HÜTTE

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

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004. INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate-No. 352257-001	Sheet 16/...
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER A07.2 No.	B01 Product HOT ROLLED PLATES	
B02/ Steel design. SA516-60	SA20-S5			
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-1:R25-2009-12-04			

C40-C49 Impact test

B14 Item No.	B07.2 Heat No.	B07.1 Roll plate/ Test No.	B05 Reference (heat) treatment	C01	C02/ C01	C03 Temp. GRF	C41 Width of test piece	C40 Type of test piece	C44 Testing method	C46 Energy	C45 C42 Individual values AV=FTLEF	C43 Mean value
01	342179	67986		KL	LV	-51	3/4	CHP-V		AV 139	140	134
01	342179	67998		KL	LV	-51	3/4	CHP-V		AV 149	139	90
01	342179	68004		KL	LV	-51	3/4	CHP-V		AV 129	126	136
01	342179	68005		KL	LV	-51	3/4	CHP-V		AV 168	130	135
01	342179	68014		KL	LV	-51	3/4	CHP-V		AV 127	91	148
01	342179	68018		KL	LV	-51	3/4	CHP-V		AV 92	154	131
01	342179	68020		KL	LV	-51	3/4	CHP-V		AV 134	147	94
01	342179	68024		KL	LV	-51	3/4	CHP-V		AV 142	141	156
01	342179	68026		KL	LV	-51	3/4	CHP-V		AV 67	144	91
01	342179	68055		KL	LV	-51	3/4	CHP-V		AV 119	89	111
01	342181	55555		KL	LV	-51	3/4	CHP-V		AV 145	142	139
01	342181	55556		KL	LV	-51	3/4	CHP-V		AV 129	142	99
01	342181	55559		KL	LV	-51	3/4	CHP-V		AV 134	105	147
01	342181	55560		KL	LV	-51	3/4	CHP-V		AV 109	150	130
01	342181	55578		KL	LV	-51	3/4	CHP-V		AV 145	136	141
01	342181	55589		KL	LV	-51	3/4	CHP-V		AV 101	153	134
01	342181	55592		KL	LV	-51	3/4	CHP-V		AV 138	91	153
01	342181	55618		KL	LV	-51	3/4	CHP-V		AV 158	140	151
01	342183	50326		KL	LV	-51	3/4	CHP-V		AV 149	170	137
01	342183	51466		KL	LV	-51	3/4	CHP-V		AV 136	128	128
01	342183	55516		KL	LV	-51	3/4	CHP-V		AV 134	131	164
01	342183	55518		KL	LV	-51	3/4	CHP-V		AV 128	139	141
01	342183	55520		KL	LV	-51	3/4	CHP-V		AV 148	134	131
01	342183	55521		KL	LV	-51	3/4	CHP-V		AV 88	143	135



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

QM-System: Certification as per ISO 9001

B. MUELLER
Test House Manager



Inspector's stamp

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

Date 04.02.10

PP 1



DILLINGER HÜTTE

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

A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A03/Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 19/...
A05 Established inspecting body DH.	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER	B01 Product HOT ROLLED PLATES	
B02 Steel design. SAS16-60	SA20-S5			
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-1:R25-2009-12-04			

C70-C99 Chemical composition % - Heat analysis

B07.2 Heat	C70	C	SI	MN	P	S	N	CU	MO	NI	CR	V	AS	SN	TI
342179	Y	0,175	0,316	1,16	0,012	0,0012	0,0060	0,030	0,008	0,043	0,031	0,001	0,000	0,001	0,002
342181	Y	0,174	0,329	1,17	0,011	0,0008	0,0055	0,022	0,007	0,031	0,032	0,000	0,000	0,001	0,003
342183	Y	0,173	0,325	1,17	0,011	0,0007	0,0064	0,028	0,007	0,042	0,035	0,000	0,000	0,000	0,003
342669	Y	0,166	0,367	1,17	0,009	0,0012	0,0063	0,030	0,009	0,037	0,037	0,000	0,000	0,001	0,003
342670	Y	0,164	0,369	1,18	0,009	0,0011	0,0060	0,018	0,006	0,026	0,028	0,000	0,000	0,001	0,003
342671	Y	0,168	0,387	1,19	0,009	0,0012	0,0062	0,026	0,007	0,032	0,032	0,001	0,000	0,002	0,003

B07.2 Heat	C70	B	CA	AL-T
342179	Y	0,0001	0,0024	0,032
342181	Y	0,0001	0,0017	0,030
342183	Y	0,0001	0,0015	0,031
342669	Y	0,0002	0,0017	0,037
342670	Y	0,0001	0,0017	0,038
342671	Y	0,0002	0,0023	0,037

C94 Heat analysis Carbon equivalent / Alloying restrictions

B07.2 Heat	FO-02=	FO-55=	FO-78=	FO-91=
342179	0,38	0,11	0,04	6,6
342181	0,38	0,09	0,04	6,7
342183	0,38	0,11	0,04	6,8
342669	0,37	0,11	0,05	7,0
342670	0,37	0,08	0,03	7,2
342671	0,38	0,10	0,04	7,1

A04 Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order.

QM-System: Certification as per ISO 9001



B. MUELLER
Test House Manager



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

Inspector's stamp Date 04.02.10

PP 1



DILLINGER HÜTTE

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

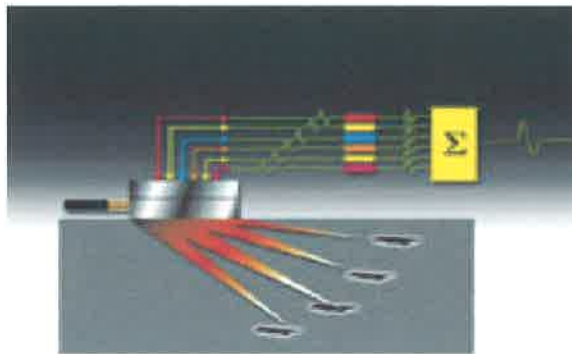
A02 INSPECTION CERTIFICATE 3.1 AS PER EN 10204:2004 INSPECTION CERTIFICATE 3.1.B AS PER EN 10204:1991+A1:1995 + AS PER ISO 10474:1991 MATERIAL TEST REPORT (MTR)		A10 Advice of dispatch No./ Date of dispatch 351793-04.02.10	A08/ Manufacturer's order/ A03 Certificate No. 352257-001	Sheet 22
A05 Established inspecting body DH	A06 Purchaser EDMONTON STEEL, EDMON Final receiver EDMONTON STEEL, EDMON	A07.1 No. ED10546-J1010-ER A07.2 No.	B01 Product HOT ROLLED PLATES	
B02/ Steel design. SA516-60	SA20-SS			
B03 Any suppl. requirements	ASME-II-A:07+A09 DIL-HUE-1:R25-2009-12-04			
D01 Marking and identification, surface appearance, shape and dimensional properties				
ITEM NO.: 01-03 RESULT OF MARKING, SURFACE, SHAPE AND DIMENSIONS: NO REMARKS SURFACE AS PER ASME-SA20 THICKNESS AS PER ASME-SA20 LENGTH AND WIDTH AS PER ASME-SA20 FLATNESS AS PER 1/2-ASME-SA20				
A04	Z01/Z02/Z03 We hereby certify, that the above mentioned materials have been delivered in accordance with the terms of order. QM-System: Certification as per ISO 9001		A01	
				AG der Dillinger Hüttenwerke Postfach 1580, D-66748 Dillingen/Saar inspection department
Manufacturer's mark	B. MUELLER Test House Manager	Inspector's stamp	Date 04.02.10	PP 1



NON-DESTRUCTIVE TEST PROCEDURES



SPECTRUM N.D.T. LTD



NON-DESTRUCTIVE TESTING
PROCEDURES MANUAL NDT.P1



CERTIFYING STATEMENT

FOREMOST UNIVERSAL LP
8825 Shepard Road S.E.
Calgary, Alberta Canada T2C 4N9
(403) 279-5000 Tel.
(403) 279-2088 Fax

I have reviewed the:

Written Practice:	Non Destruction Testing Procedures Manual NDT. P1 Edition 3 Rev. 0
	(Edition Number and or Revision Number of Written Practice)
NDE Procedures:	UP4, UP5, UP6, MET 100, MP2, LP2, HP1, HP2 and PMI 1
	UP4, UP5, UP6, MET 100, MP2, LP2, HP1, HP2 and PMI 1
	Edition 3 Rev. 0
	(Method and Edition Number and or Revision Number of Procedures)
and personnel certification records and eye examination records of all Examiners that will perform NDE at FOREMOST UNIVERSAL LP	

For

Spectrum NDT LTD. Bay 40, 3170, 114 Avenue S.E., Calgary, Alberta, T2Z 3V6
(Name and Address of NDE Company)

Based upon my review of the above referenced procedures, it is my opinion that they are in accordance with ASME Section V requirements as referenced by the applicable construction Code, and that the written practice complies in all respects with the requirements of SNT-TC-1A.

In addition I hereby certify that the demonstration of procedure(s) to the satisfaction of the AI, as required by the ASME Code, Section V, paragraph T-150, has been completed as specified within the (Name Of Company) written quality system.

Therefore:

Spectrum NDT LTD.
(Name of NDE Company)

are hereby appointed to perform:

LPI, UT, CIT/UP, PMI & MPI
(RT, UT, PT, MT, ET, VT, and/or LT)

for:

Foremost Universal LP
(Name of Manufacturer)

APPOINTMENT OF LEVEL III EXAMINER

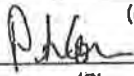
Mark Edwards
(Name of Level III Examiner)

is by this statement appointed to act as the Level III examiner for:

FOREMOST UNIVERSAL LP
(Name of Manufacturer)

in the following methods:

LPI, UT, CIT/UP, PMI & MPI
(RT, UT, PT, MT, ET, VT, and/or LT)


(Signature of QC Supervisor)

FEB 26 2013
(Date)

FEB 26 2014
(Appointment Expiry Date)

LEVEL III EXAMINER ACCEPTANCE OF APPOINTMENT

I hereby accept the appointment as indicated above.


(Signature of Level III Examiner)

NON-DESTRUCTIVE TESTING
PROCEDURES MANUAL

N.D.T. P.1
EDITION 3 REV 0

THIS MANUAL IS COPYRIGHT AND IS THE PROPERTY OF SPECTRUM NDT LTD.
IT IS A CONFIDENTIAL DOCUMENT. IT IS PROPRIETARY INFORMATION TO
OUR CUSTOMERS AND POTENTIAL CUSTOMERS AND SHALL BE RETURNED
TO SPECTRUM NDT LTD WHEN REQUESTED.

THIS PROCEDURES MANUAL HAS BEEN WRITTEN AND IMPLEMENTED IN
ACCORDANCE WITH ASME(2010 EDITION) AND SNT -TC -1A LATEST
ACCEPTED CODE EDITION.

SPECTRUM N.D.T. LTD

2nd Jan 2013

We have reviewed the written NDT procedures and practices of the 2010 Edition 2011 add.
Changes were not necessary regarding "essential variable criteria" of the NDT procedures contained within this manual.

ASME Section VIII Div. 1

ASME Section VIII Div 2.

ASME Section V.

All references to "current mandatory edition" in this manual refer to the 2010 Edition 2011 add.



Mark Edwards,
N.D.T. Level III

THIS MANUAL IS ASSIGNED TO: PHILIP CORREIA

ADDRESS: MALONEY INDUSTRIES
A DIVISION OF FOREMOST UNIVERSAL LP

MANUAL NO: 4

THIS MANUAL IS A CONTROLLED COPY YES

OR

THIS MANUAL IS AN UNCONTROLLED COPY _____

SECTION #00 INDEX AND REVISION STATUS

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SECTION 1

PERSONNEL QUALIFICATION, CERTIFICATION AND TRAINING IN N.D.T. METHODS (U.T, M.T AND P.T).

1.1 Scope

1.1.1 As required by The American Society for Non-Destructive Testing recommended practice No SNT-TC-1A, this documentation is established for the control, administration, certification, examination and training of N.D.T. personnel.

1.1.2 The training, qualification and certification of all N.D.T. personnel shall be performed as described in this document hereafter. The following requirements are sufficiently stringent to meet the requirements of the A.S.M.E. codes.

1.1.3 N.D.T. personnel to become certified under this practice shall have the required knowledge to perform N.D.T. in the particular method to which they are certified.

1.1.4 All reference to SNT-TC-1A in this manual is to the current mandatory edition.

1.2 Definitions

1.2.1 Terms used in this procedure are as follows:

A. Training - The program developed to impart the knowledge and skills necessary for qualification.

B. Qualification - Demonstrated skill, training, knowledge, examinations and experience required for personnel to perform the duties of a specific job.

C. Certification - Written testimony of qualification.

1.3 Non-Destructive Test Methods

1.3.1 Training, qualification and certification of N.D.T. personnel in accordance with this part of procedure is applicable to Ultrasonic Testing (U.T.), Magnetic Particle Testing (M.T.) and Liquid Penetrant Testing (P.T.).

1.4 Levels of Qualification

1.4.1 There are three levels of certification and are described as follows:

A. Level I - An individual qualified as a level I technician shall have the required training and experience to perform calibrations, tests, evaluation and to record results while monitored or supervised by a level II or a level III technician pertaining to that particular method.

B. Level II - An individual qualified as a level II technician shall have the required training and experience to perform the setting up and calibration of equipment and to interpret and evaluate results with reference to the applicable codes and specifications. He or she shall be thoroughly familiar with the scope and limitations of the methods for which he or she is qualified and will also be aware of the responsibilities associated with training and guidance of level I personnel or other lesser qualified personnel. The level II technician will, when specified prepare written instructions, organize and report the results of Non-destructive tests.

C. Level III - An individual qualified as a level III technician shall be capable of and responsible for establishing techniques and procedures; interpreting codes, standards and specifications; and designation of particular inspection methods or techniques. The N.D.T. level III technician will be wholly responsible for the N.D.T. operations for which he or she is qualified and to

which assigned and shall be completely competent in the evaluation of results, in terms of reference codes, standards and specifications. The practical background of the level III technician shall be applicable to the following: basic metallurgical knowledge, materials fabrication, product technology. He or she shall be able to apply this practice knowledge to establish techniques and to assist in establishing acceptance criteria where none are otherwise available. He or she shall have responsibility for the training and examination of level I and level II personnel for qualification.

1.4.2 In accordance with ASNT recommended practice No SNT-TC-1A current mandatory edition, Spectrum NDT Ltd. has duly placed Clint Magdee as their level III representative. Written certification is provided with evidence supporting same and is filed in Certifications.

1.5 Training

1.5.1 Individuals to be considered for training are required to have knowledge of N.D.T. examination procedures and of the products to be examined. He or she shall complete sufficient training to become familiar with the principles and practices of the specified test method related to the level of certification desired. The minimum training required shall be as outlined in Table 6.3.1 of SNT-TC-1A.

1.5.2 Spectrum NDT Ltd, N.D.T. training program includes:

A. The general training program for method as outlined in the applicable supplements of A.S.N.T. recommended practice No SNT-TC-1A.

B. Correspondence courses prepared by The Canadian Welding Bureau, i.e. "Weld Quality Control and Inspection" and "Fundamentals, Principles and Practices of Welding".

C. Non-Destructive Testing courses held by The Canadian Society for Non-Destructive Testing Inc., a university or technical institute course, an N.D.T. equipment manufacturers course.

D. "In house" and "on the job" training. Course text books used for in house training are The Canadian General Standards Board recommended

procedures and the General Dynamics audio visual. Film strips and tapes are also used for classroom training.

1.6 Examination

1.6.1 All N.D.T. personnel performing Non-Destructive Testing shall be subject to an annual eye examination by a qualified person to ascertain that the applicant is capable of reading the equivalent of Jaegers number 2 at a distance of not less than 12" on standard Jaegers test chart in at least one eye, either natural or corrected.

1.6.2 Individuals shall be capable of reading color charts to distinguish and differentiate contrast between colors and shades of gray for the inspection methods used. This test shall be done at time of original certification and every three years thereafter.

1.6.3 Personnel seeking certification to levels I and II shall be subject to examination as follows:

A. General - (Written) This examination shall cover the basic test principles relative to the appropriate method. The level III examiner shall select 40 questions from the appropriate appendix of the applicable S.N.T. supplementary document.

B. Specific - (Written) This examination shall cover the equipment operating procedures, and test techniques that the applicant may encounter in his daily operations. The specific examination shall also cover the specifications or codes and acceptance/rejection criteria used. The level III examiner shall select twenty questions for the specific examination.

C. Practical - The person considered for certification shall demonstrate by practical examination that he or she is familiar with and can operate the necessary equipment, analyze and report the resultant information to the degree required. One specimen shall be selected by the level III examiner for the purpose of this demonstration. The specimen shall be a special test piece with known defects and shall be analyzed by the person considered for

certification. Where deemed necessary the level III person may accompany personnel on normal work assignments to assess their ability in the field.

D. Time Limits - There shall be a two hour time limit on the general exam and a one hour time limit on the specific exam. Both exams shall be administered without access to reference material (closed book). Graphs and tables may be provided.

1.6.4 Personnel seeking certification to level III shall be subject to qualification examination as follows:

A. Basic - (Required only once when more than one method of examination is taken). This examination consists of fifteen questions relating to understanding the SNT-TC-1A document; twenty questions relative to applicable materials, fabrication and product technology; twenty questions which are selected from or are similar to published level II questions for other appropriate methods.

B. Method - (Required for each method). This examination consists of thirty questions relating to fundamentals and principles, which are selected from or are similar to published ASNT level III questions for each method; fifteen questions relating to application and establishment of techniques and procedures which are selected from or are similar to the published ASNT level III questions for each method; twenty questions relating to capability for interpreting codes, standards and specifications relating to the method.

C. Specific - (Required for each method). This examination consists of twenty questions relating to specifications, equipment, techniques and procedures applicable to the employers product(s) and methods employed to the administration of the employers written practice.

On the basis of demonstrated ability, achievement, experience and education, as defined in SNT-TC-1A the employer may waive examination for re-certification for the level III individual. Written certification should be provided and evidence supporting the certification should be held on file and made available when verification is required.

1.6.5 Grading of Examinations - The grading of examinations shall be recommended in the applicable supplements of SNT recommended practice for qualification and

certification of N.D.T. personnel. The percentile weights to be assigned to the percentage grades of the various examinations shall be as follows:

N.D.T. Level I	
General	0.35
Specific	0.3
Practical	0.35
N.D.T. Level II	
General	0.3
Specific	0.3
Practical	0.4
N.D.T. Level III	
Basic	0.3
Method	0.4
Specific	0.3

A composite grade of 80% or greater is required for certification and in addition, each passing grade for the general, specific and practical or the basic, method and specific examinations shall be 70% or greater.

At least 90% of all known indications should be found in test objects used in the practical examination.

1.6.6 Re-Examination - Personnel failing to attain the required grades must wait at least 30 days and they shall have additional training in the area found deficient before attempting re-examination.

1.7 Certification

1.7.1 The certifying authority for Spectrum NDT Ltd is the appointed level III examiner. In the case of certification of the Spectrum certifying authority, the certification will be completed by an officer of the company.

1.7.2 The personnel records of the certified individuals shall be kept on file (See Appendix B) and shall include the following information:

- (i) Name of operator
- (ii) Test method and level of certification
- (iii) Experience and educational background
- (iv) Details of all N.D.T. training and courses attended by the operator

- (v) Details of latest physical examination
- (vi) Results of all examinations.
- (vii) Percentile weights assigned to each examination
- (viii) Dates of certification and/or re-certification
- (ix) Signature of the examiner
- (x) The certification form plus pocket size card (Forms C1 and PC1 respectively)

1.7.3 Re-Certification - Certified personnel to levels I and II shall be re-certified on a periodic basis of not more than three years. Level III shall be not more than 5 years. This re-certification shall be based on evidence of continuing satisfactory performance as observed by the company level III examiner or appointed officer of the company.

1.7.4 The level III individual can at any time, with due justification call for re-examination of any level I or level II personnel.

1.7.5 Technical Performance Evaluation – Annually, an NDT Level III shall evaluate and document the technical performance of level I and II personnel. Random evaluations may be performed at any time by the NDT Level III. The Technical Performance Evaluation Log is located in APPENDIX B. Elements for the evaluation as a minimum include:

- Use of the proper Equipment and associated Calibration documents
- Equipment Condition
- Correct Procedure and Application
- Evaluation of findings
- Consideration of Environmental conditions affecting the inspection
- Correct Interpretation of the code
- Essential variable criteria
- Reporting-all required elements.

1.8 Education and Experience

1.8.1 Personnel considered for certification shall have sufficient education and experience to ensure understanding of the principles and procedures of those areas of testing in which they are being considered for certification.

1.8.2 To be considered for certification, a candidate shall satisfy any one of the following requirements for the applicable N.D.T. method and level:

Ultrasonic Level I

- A. Junior Matriculation or equivalent education plus one years experience in the applicable method.
- B. Elementary school graduation plus two years experience in the applicable method.
- C. Successful completion of a course of instruction (minimum of 40 hours) plus one years experience in the applicable method.
- D. Completion with passing grades of at least two years at a technical institute in associated fields such as welding, metallurgy or other Non-Destructive examinations, plus six months experience in the applicable method.

Ultrasonic Level II

- A. Junior matriculation plus two years experience as a certified level I in the applicable method.
- B. Three years experience as a certified level I in the applicable method.
- C. Five years experience in the applicable method, providing at least two years have been spent in a position that involved responsibilities comparable to those listed for level II personnel.
- D. Completion with passing grades of at least two years at a technical institute in associated fields such as welding, metallurgy or other Non-Destructive examinations, plus one years experience as a certified level I in the applicable method.

Magnetic Particle and Liquid Penetrant Level I

- A. Elementary school education plus three months experience in the applicable method.
- B. At the discretion of the level III examiner through demonstrated ability.

Magnetic Particle and Liquid Penetrant Level II

- A. Elementary school education plus at least six months experience as a level I.
- B. Successful completion of a course of instruction in the applicable method (minimum 20 hours) plus six months experience.
- C. At the discretion of the level III examiner through demonstrated ability.

N.D.T. Level III

- A. Graduate of engineering from college or university with degree plus three years as a level II in the Non-Destructive methods of testing.
- B. Minimum of ten years experience in the Non-Destructive Testing methods at senior levels.

1.9 Certification of Employees holding C.G.S.B. or A.S.N.T Qualifications

1.9.1 Employees of Spectrum NDT Ltd, who are required to maintain certification to C.G.S.B. or A.S.N.T. may be certified to this procedure without examination at the corresponding level.

1.10 Termination

1.10.1 All certification shall be automatically terminated when an employee leaves the employer where he/she has been certified, and where the certified person is not

employed on the method for which he/she is certified for a period of six months or longer.

1.10.2 A level I, II or III may be re-certified to his/her formal level providing:

- A. The employee has proof of prior certification from a previous employer.
- B. The employee was working in the capacity to which he/she was certified within six months of certification.
- C. The employee is being re-certified within six months of termination.

1.10.3 Re-certification by examination is required for interrupted service when personnel are not employed in the method(s) they are certified in for a period of six months or longer.

SECTION 2

PERSONNEL QUALIFICATION, CERTIFICATION AND TRAINING HT AND PMI

2.1 Scope

2.1.1 As required by Spectrum NDT Ltd this documentation is established for the control, administration, certification, examination and training of the Hardness Testing and Positive Material Identification personnel.

2.1.2 The training, qualification and certification of personnel shall be performed as described hereafter.

2.2 Levels of Qualification

2.2.1 Hardness Testing / Ferrite Testing:

H.T.1- F.T.1 is the only level of qualification required. He/she shall have the required training and experience to perform the setting up and calibration of equipment and to interpret and evaluate results with reference to applicable codes and specifications. He/she shall be thoroughly familiar with the scope and limitations of the method and also will be aware of the responsibilities associated with training and guidance of lesser qualified personnel.

2.2.2 Positive material Identification:

P.M.1. is the only level of qualification required. Minimum certified level 1 CGSB radiographer or NRCAN certified operator or equivalent ticket for analytical devices is required. He/she shall have the required training and experience to perform the setting up and calibration of equipment and to interpret and evaluate results with reference to applicable codes and specifications. He/she shall be thoroughly familiar with the scope and limitations of the method and also will be aware of the responsibilities associated with training and guidance of lesser qualified personnel.

2.3 Training

2.3.1 Individuals to be considered for training are required to have knowledge of the procedures and of the products to be examined. He/she shall have sufficient training to become familiar with the principles and practices of the method.

2.3.2 Spectrum NDT Ltd training for H.T.1. and P.M.1 may consist of:

A. "In house" and "on the job" training working to equipment manufacturers procedures and/or customers applicable codes and specifications and/or Spectrum NDT Ltd codes and specifications.

B. A university or technical institute's course or an equipment manufacturer's course.

2.4 Examination

2.4.1 All personnel shall be subjected to an annual eye examination as previously described in 1.6.1.

2.4.2 The formal examinations shall consist of the individual demonstrating by practical examination that he/she is familiar with and can operate the necessary equipment, analyze and report the resultant information to the degree required.

2.4.3 Evaluation of applicant's performance shall be made by the company N.D.T. III examiner.

2.5 Certification

2.5.1 The personnel records of the certified individuals shall be kept on file. Refer to Appendix B.

2.5.2 The file shall include the following:

- (i) Name of operator
- (ii) Test method
- (iii) Experience and educational background
- (iv) Details of all N.D.T. training and courses attended by the operator
- (v) Details of latest physical examinations
- (vi) Dates of certification and/or re-certification
- (ix) Signature of the examiner

- (x) The certification form plus pocket size card (Forms C2 and PC2 Respectively)

2.5.3 Re-Certification:

Qualified personnel shall be re-certified on a periodic basis of not more than three years. This re-certification shall be based on evidence of continuing satisfactory performance as observed by the company level III examiner.

The level III individual can at any time, with due justification call for re-examination of the personnel.

2.5.4 Termination:

All certification shall be automatically terminated when an employee leaves the employer where he/she has been certified, and where the certified person is not employed on the method for which he/she is certified for a period of six months or longer.

2.6 Education and Experience

2.6.1 Personnel considered for certification shall have sufficient education and experience to ensure understanding of the principles and procedures in the areas which they are being considered for certification.

2.6.2 To be considered for certification a candidate shall satisfy any one of the following requirements:

- A. Junior matriculation or equivalent education plus one years experience in HT or PMI
- B. Elementary school graduation plus two years experience in HT or PMI
- C. Successful completion of a course of instruction plus one years experience in HT or PMI
- D. Completion with passing grades of at least two years at a technical institute in associated fields such as welding, metallurgy or other Non-Destructive examinations, plus six months experience in HT or PMI
- E. The discretion of the N.D.T. level III examiner through demonstrated ability.

2.7 Termination

2.7.1 Certification will be revoked upon termination from Spectrum NDT Ltd.

2.7.2 H.T.1. Or P.M.1 personnel may be re-certified to his/her formal level providing:

- A. The employee has proof of prior certification from a previous employer.
- B. The employee was working in the capacity to which he/she was certified within six months of certification.
- C. The employee is being re-certified within six months of termination.

SECTION 3

EQUIPMENT CHECKS AND CALIBRATIONS

3.1 The following is a list of checks to be carried out by certified Spectrum NDT Ltd personnel or certified sub-contractors. Records of these checks are to be kept on file.

3.1.1 Ultrasonic flaw detection units shall be checked after every period of extended use or every 3 months (whichever is less) for vertical and horizontal linearity. (Forms QS3.1 and QS3.2).

3.1.2 Ultrasonic thickness gauges shall be checked against a certified calibration block not less than once in each 8 hour period of use. Usage shall be documented in an equipment time log.

3.1.3 Hand yokes shall be checked to have the required lifting capability not less than once in each 8 hour period of use. Usage shall be documented in an equipment time log. Required lifting capabilities are 10lb for A/C and 40lb for D/C at the maximum prod spacings. 10lb and 40lb weights for checking the lifting capability of the magnetic particle inspection yokes shall be weighed by a reputable manufacturer or agency. A statement of accuracy shall be issued by the agency. Unless weights are damaged this check is only required once.

3.1.4 White light meters shall be used to demonstrate sufficient light intensity from light sources used during inspections. The meters calibration shall be current at the time of the demonstration.

3.1.5 Ultraviolet lamps shall be checked not less than once in each 8 hour period of use. Lamp usage shall be documented in an equipment time log. The light intensity shall be not less than 1000 uW/cm².

3.1.6 UV light meters shall be checked annually by a reputable manufacturer or agency. A statement of accuracy shall be issued by the agency.

3.1.7 Ultrasonic master calibration blocks shall be measured and/or certified by a reputable manufacturer or agency. A statement of accuracy or certificate shall be issued by the agency. Unless blocks are damaged recertification is not required.

3.1.8 Hardness testers to be checked annually against a certified known hardness specimen. Recertification of the specimen is only required if damaged or resurfacing has been performed.

3.1.9 Positive material identification unit calibration piece shall be certified by agency or reputable manufacturer. Unless damaged recertification is not required.

APPENDIX A

NDT TECHNIQUES

1.0 The level of certification required to conduct an inspection will be as outlined in the relevant applicable code or specification. As a minimum requirement the following levels of certification will be required for any inspection conducted by Spectrum NDT Ltd personnel:

U.T. SNT Level II

M.T. SNT Level II

P.T. SNT Level II

H.T. HT 1

P.M.I PM 1

F.T FT 1

2.0 The following procedures are located in this appendix.

UP4 Basic Ultrasonic Examination Procedure for Weld Inspection.

UP5 Ultrasonic Technique for Thickness Measurements

UP6 Ultrasonic Inspection of plate

MP2 Magnetic Particle Inspection and Yoke Technique.

LP2 Liquid Penetrant Examination.

HP1 Hardness Testing using the Portable Telebrineller

HP2 Hardness Testing using the Microdur MIC 10

PMI1 Positive Material Identification using the x-ray fluorescence analyzer.

MET 100 PAUT weld inspection

MET 300 PAUT weld inspection

FT1 Ferrite Testing

- 3.0 Witness and review of N.D.T. procedures (U.T, M.T, P.T, PAUT) by a customers authorized inspection agency representative (C.A.I.A.R.) is a code requirement. Procedure and demonstration records are located in this appendix.
- 4.0 Procedure Revision Record.
- 5.0 Consumable products used in procedures are listed in this appendix.

SPECTRUM

**Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition).
Procedure # U.P.4 Rev 1**

General

This procedure is to be used when examining carbon steel full penetration groove joints by manual scanning in accordance with ASME V art 4.

Welds up to 8" thick in product forms such as plate, pipe and forgings may be inspected using this procedure providing acceptable performance demonstration for the applicable type of groove weld has been conducted.

For coarse grain welds, materials and dissimilar metal welds it is necessary to supplement this procedure with weld mockups containing reference reflectors in the weld deposit and the addition of angle beam longitudinal wave transducers.

1 Personnel

The operator shall be qualified to SNT-TC-1A 2011, ed. UT Level 2 as outlined in Spectrum Manual NDTP1. Personnel may be required to conduct acceptable performance demonstrations for new product forms and/or unusual weld geometries/materials and special procedures.

2 Scanning Surface

The scanning surface shall be selected to enable a scan of the entire volume of weld for each selected search unit.

3 Surface Condition

The contact surface shall be free from spatter or any roughness that would interfere with free movement of search unit or impair the transmission of ultrasonic vibrations. Weld surface shall be finished so they cannot mask or be confused with reflections from defects, and should merge smoothly into the surface of the adjacent base materials.

4 Couplant

Use water based couplant. Separate couplant containers and new brushes shall be used for stainless steel materials to avoid contamination. The requirements for contamination control are not more than 250 ppm of sulfur for nickel base alloys and not more than 250 ppm of halides for austenitic stainless steel or titanium.

5 Techniques

SPECTRUM

Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition). Procedure # U.P.4 Rev 1

The manual techniques described in this procedure are straight beam and angle beam contact methods.

6 Computer Enhanced Data Acquisition

Computerized Imaging Technique utilizing phased array technology shall be conducted in accordance with the requirements of this procedure plus all requirements described in Spectrum procedure **MET 100**.

7 Equipment

Pulse echo ultrasonic instruments with frequency range of at least 1 to 5 MHz with stepped gain control of 2dB or less. Reject or damping controls shall be off for all examinations unless it can be demonstrated not to affect linearity of examination. Either of the following instruments may be used:

Krautkramer USN 50
Krautkramer USN 52
Krautkramer USN 52L
Krautkramer USN 58

8 Search Units

Search units may be of single or dual element type. The nominal frequency shall be from 1 MHz to 5 MHz and shall be rectangular or circular in shape with a maximum element dimension of 1". Straight beam search units shall be normal incident longitudinal wave propagation. Angle beam search units shall be selected from a range of 45 to 70 inclusive whichever beam angle or combination of beam angles pass through weld and interfaces most perpendicularly.

9 Special Search Units

Special search units, wedges shoes, saddles and modifications to existing equipment may be used to aid ultrasonic coupling but must be qualified with an acceptable performance demonstration using the specified calibration block/s described within this procedure.

10 Calibration Blocks

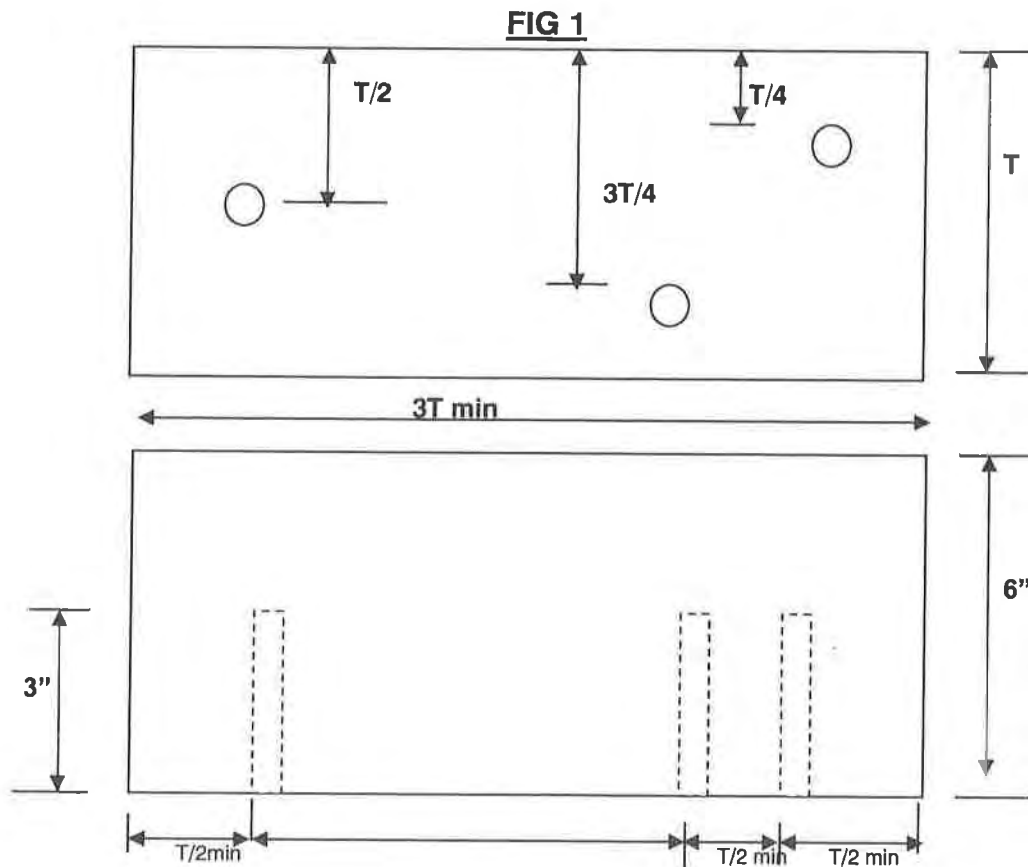
The IIW calibration block-A1 block.

SPECTRUM

Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition).

Procedure # U.P.4 Rev 1

The Primary reference reflector block(s) shall be of the same product form and material specification or equivalent P-number grouping as one of the materials being examined (clad or unclad). Scanning surface finish on the blocks shall be representative to the surface of the component to be examined and fabricated to the dimensions shown and described. See figure 1. Prior to fabrication this block shall be completely examined with a straight beam search unit. Indications exceeding the remaining back wall reflection are not permitted. For materials 20" diameter and less a curved block shall be used in accordance with ratio limits outlined in Art 4 fig T-434.1.7.2



Weld Thickness (t)

1" or less
 Over 1" through 2"
 Over 2" through 4"
 Over 4" through 6"
 Over 6" through 8"

Basic Calibration Block Thickness

3/4" or t
 1.1/2" or t
 3" or t
 5" or t
 7" or t

Hole Dia.

3/32"
 1/8"
 3/16"
 1/4"
 5/16"

SPECTRUM

Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition).

Procedure # U.P.4 Rev 1

- (a) Holes shall be drilled and reamed a minimum of 1 1/2" deep, essentially parallel examination surface.
- (b) For curved surfaces less than 20", two curved blocks, one for each representative curvature or two sets of calibration reflectors orientated 90 deg. from each other shall be used.
- (c) Notches may be provided as required.
- (d) Tolerance for hole diameter shall be plus/minus 1/32". The tolerance on notch depth shall be +10 and -20%. The tolerance on hole location through the thickness shall be plus/minus 1/32"
- (e) Use figure/notes from T-434.3 for piping calibrations.

11 Instrument Linearity Checks

Vertical and horizontal linearity checks shall be performed at intervals not exceeding 3 three months or prior to first use thereafter.

12 Examination Calibration

General: Always place flaw detector unit in an area where no high voltage cables can interfere with equipment performance. Calibrations shall be performed from the surface corresponding to the surface of the component from which the examination will be performed. Calibrations for sensitivity and horizontal sweep (distance) shall be made by the operator just prior to and at the termination of examination for each weld and at intervals of 30 minutes as examination proceeds. Re-calibrations shall be done each time there is a change of personnel, operation, when transducers are changed, when new batteries are installed, when equipment is operating from a 115-V source or connected to a different power outlet and also at the end of weld examination. The following calibrations shall be used in accordance with T463 (non piping) and T464 (piping).

Calibrations for straight beam examination: Adjust the horizontal sweep for distance calibration to present the equivalent of at least two-plate thickness on screen. Adjust sensitivity at a location free from indications so that the first back reflection from the far side of plate will be 50% to 75% of full screen height. For this purpose the reject shall be turned off. This is the primary reference response.

Calibration for angle beam examination: The horizontal sweep shall be adjusted to represent actual sound path distance by using the IIW A1 block. Using the block as described in figure 1, a DAC curve shall be constructed to establish reporting, referencing and scanning sensitivity.

The method for this as follows: Select the hole in the test block that gives the highest peak at a constant gain setting and adjust the peak to 80% of full screen height. This is the primary reference level and shall be electronically stored in dBs. Keeping the same

SPECTRUM

Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition).

Procedure # U.P.4 Rev 1

gain setting, move the search unit to the other holes in the block and maximize the peak each time, storing each peak on the screen at the corresponding material thickness that the sound has traveled on the screen scale. Employ the DAC function on the unit to produce the curve on the screen. Turn down gain 6dB (50%) and make a second curve using the same method. Turn up gain 6dB back to the primary reference.

13 Scanning

General: Each pass of the search unit shall overlap a minimum of 10% of the transducer dimension parallel to the direction of scan indexing. The pulse repetition rate shall be small enough to ensure that a signal from a reflector located at the maximum distance in the examination volume will arrive back at the search unit before the next pulse is placed on the transducer. The rate of search unit movement shall not exceed 6 inches per second. The temperature differential between the calibration block and examination surface shall be within 25 deg F.

Straight Beam Longitudinal Wave Technique: The volume of base material through which sound will travel shall be completely scanned with a straight beam search unit prior to angle beam examination. Any area where back reflection is lost is unsuitable for inspection and the area must be documented. All reflectors in base material which interfere with the scanning of examination volumes shall be documented and require the angle beam technique to be modified such that the maximum feasible volume is examined.

Angle Beam Shear Wave Technique: Scanning shall be carried out in both parallel and transverse directions (4 scans) and the recommended scanning patterns are shown in figure 2. The scanning sensitivity shall be at a gain level of at least two times the primary reference level. To seek longitudinal indications employ the following scanning movements so as to cover the full weld section (fig 2):

- a) Scanning movement "A" Rotation Angle "A" = 10 deg
- b) Scanning movement "B"
- c) Scanning movement "C"

Progression distance "c" shall be approximately one-half the transducer width. (Note-movements "A", "B" and "C" are combined into one scanning pattern).

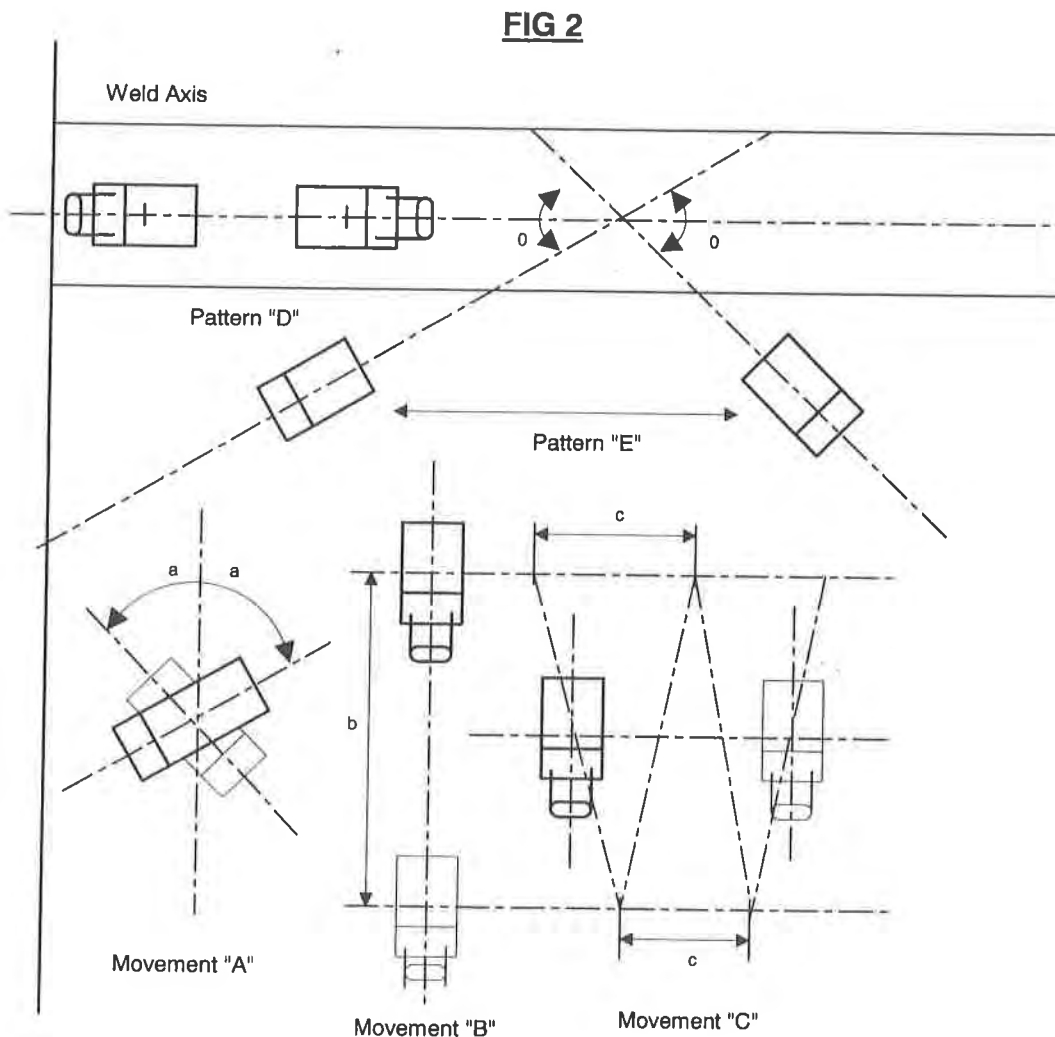
To seek transverse indications employ the following scanning Patterns so as to cover the full weld section (fig.2):

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Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition).

Procedure # U.P.4 Rev 1

- a) Scanning pattern "D" (when welds are ground flush)
- b) Scanning pattern "E" (when weld reinforcement is not ground flush) scanning Angle "e" = 15 deg maximum. In examining electro slag or electro gas welds (additional scanning pattern) employ scanning pattern "E" so as to cover the full weld section. Search unit rotation angle "e" between 45 to 60 deg.



Note:

Testing patterns are symmetrical about the weld axis with the exception of Pattern "D" which is conducted directly over the weld axis. Testing from both Sides of the weld axis are to be done where mechanically possible.

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Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition).

Procedure # U.P.4 Rev 1

Welds that cannot be fully examined from two directions with the angle beam technique are **restricted access welds** and shall be examined, if possible, with a straight beam technique. Areas are to be documented in the examination report. **Inaccessible welds** are welds that cannot be examined from at least one side using the angle beam technique and shall be documented in the examination report. For flange welds, straight beam or low angle longitudinal waves from the flange face may be used provided the examination volume can be covered.

14 Evaluation

The evaluation shall be performed with respect to the primary reference level. Length sizing shall be performed using the **6dB drop method for indication**. Any imperfection which causes an indication in excess of 20% DAC shall be investigated to the extent that it can be evaluated in terms of the referencing codes section (unless specified otherwise).

Geometric Indications are to be evaluated by referring to fabrication drawings, visual and or magnetic particle examination. The location and extent of reflector causing the geometric shall be recorded.

The recommended acceptance/rejection standard for ASME V article 4 is UA 903 and/or **ASME Section VIII Division 1 appendix 12**.

All rejectable indications shall be physically marked on the weld area for repair and all re-examination shall be conducted by the same procedure used for the original detection.

15 Reporting

The report shall contain the following information:

- i) Procedure identification and revision
- ii) Equipment model and serial number
- iii) Personnel identity and qualification
- iv) Calibration data (DAC settings)
- v) Identification and location of weld volume scanned
- vi) Scanning Surface
- vii) Map of indications, rejectable or recordable
- viii) Date and time of test

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Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition).
 Procedure # U.P.4 Rev 1

- ix) Calibration block identification
- x) Couplant brand or type
- xi) Surface condition
- xii) Search Units Frequency, size, angle, type and serial number
- xiii) Special equipment
- xiv) Computer program identification and revision if used
- xv) Simulation block and electronic simulator identification when used
- xvi) Reference level and damping/reject settings if used
- xvii) Areas of restricted access or inaccessible welds
- xviii) Acceptance rejection criteria

The report shall be filed and maintained in accordance with the referencing codes section.

16 Performance Demonstrations

Element	Demonstration #		
	1018	1019	1020
Type	Butt Weld	Pipe	Tee
Test Piece S/N	2250	2242	2243
Temp differential (25 F max)	0	0	0
ABSA rep. Witness of demo	B. Ionel	B. Ionel	B. Ionel
REPORT #	14473	14474	14475

PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards 	10/18/2007	REV1 03/15/2010	NO
ASNT-NDT-III 148347	DATE		
Kundae Han 	12/20/2012		

*****END OF DOCUMENT*****



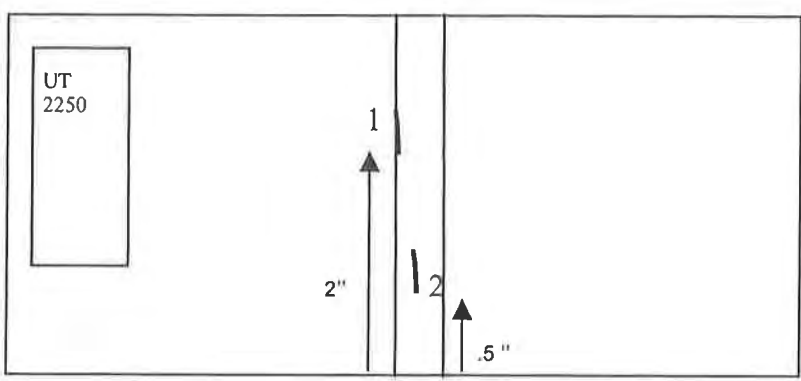
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ULTRASONIC TEST REPORT

Client SPECTRUM DEMO	Job #	UT-2250	Report #	14473
	Inspector	M. EDWARDS	Work Sheet #	
Address CALGARY; ALBERTA	Requested by		Demo #	1018
	NA		Procedure #	UP 4 REV 0

Work Description INSPECTION OF DOUBLE VEE PLATE BUTT WELD SPECIMEN # UT-2250	Code ASME V ART 4	Acceptance Criteria ASME VIII DIV 1 APP 12 PARA 12-3
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Material CARBON STEEL	Surface GOOD	Size 5/8 " THICK	Scanning Surface Top Side
Instrument KRAUTKRAMER	Model USN 52	S/N 620073	Sensitivity 3/32 " DIA HOLE DAC
			Couplant EXOSEN
			Calibration Std IIW BLOCK 99-6262

Search Unit	S/N	Size	Reference Sensitivity	Scanning Sensitivity
45 Deg 2 mHz MWB	56929-10882	8 X 9 mm	48DB	+ 6dB
60 Deg 2 mHz MWB	56928-13272	8 X 9 mm	51DB	+ 6dB
70 Deg 2 mHz MWB	56928-16042	8 X 9 mm	60DB	+ 6dB
0 Deg 2.25 mHz Long	00KBWB	1" Dia	75 % BWE	+ 6dB



Ind #	Depth	Length	Amplitude	Probe(s)	Type	Remarks
1	1/8 "	1"	+ 2DB	45	C	Non fusion
2	3/8 "	1/2 "	+ 2DB	70	C	Incomplete penetration

REFLECTOR CLASSIFICATION:
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication

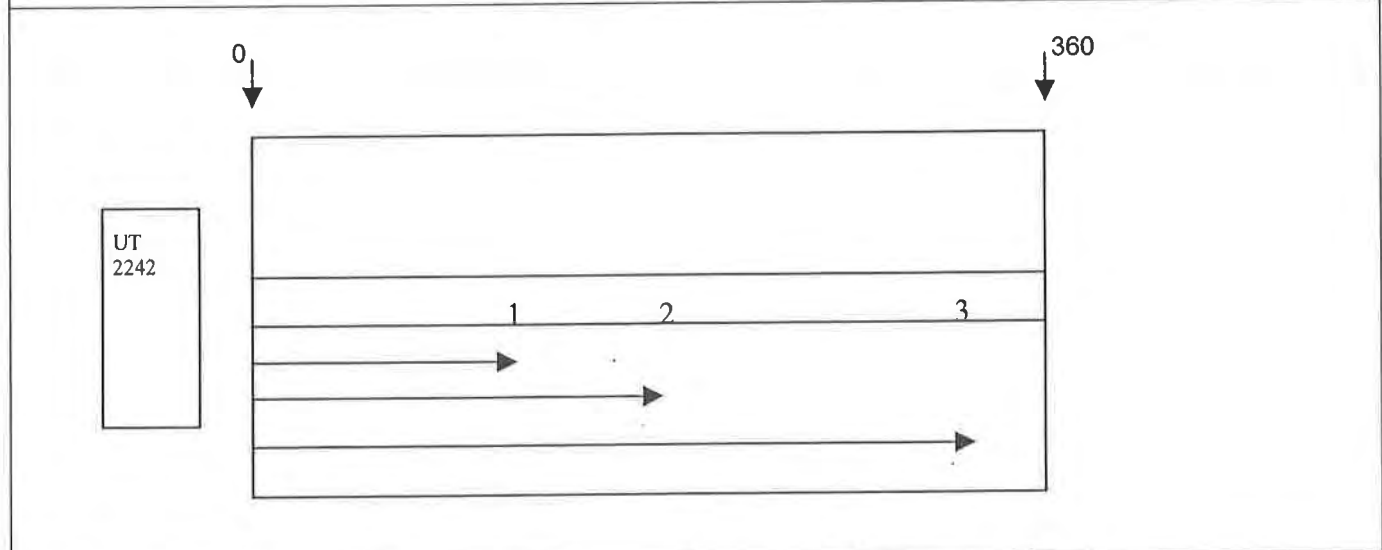
CLIENT	DATE 07/07/2005	LEVEL CGSB II SNT III	INSPECTOR
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ULTRASONIC TEST REPORT

Client SPECTRUM DEMO		Job # UT-2242	Report # 14474
Address CALGARY; ALBERTA		Inspector M. EDWARDS	Work Sheet #
Requested by NA		Demo # 1019	Procedure # UP 4 REV 0
Work Description INSPECTION OF SINGLE VEE PIPE WELD SPECIMEN # UT-2242		Code ASME V ART 4	Acceptance Criteria ASME VIII DIV 1 APP 12 PARA 12-3
Material CARBON STEEL	Surface GOOD	Size 3/8" THICK	Scanning Surface OD
Instrument KRAUTKRAMER	Model USN 52	S/N 620073	Sensitivity 3/32" DIA HOLE DAC
		Couplant EXOSEN	Calibration Std IIW BLOCK 99-6262

Search Unit	S/N	Size	Reference Sensitivity	Scanning Sensitivity
70 Deg 2 mHz MWB	56928-16042	8 X 9 mm	60 dB	+ 6dB
0 Deg 2.25 mHz Long	00KBWB	1" Dia	75 % BWE	+ 6dB



Ind #	Depth Below Surface	Dist from 0	Length	Amplitude	Probe(s)	Type	Remarks
1	1/8"	5"	1/2"	+2DB	70	C	Crack
2	1/8"	8"	1/2"	+4DB	70	C	Slag
3	3/16"	13.5"	7/8"	+4DB	70	C	Non Fusion

REFLECTOR CLASSIFICATION:
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication

CLIENT	DATE 07/07/2005	LEVEL CGSB II SNT III	INSPECTOR
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SPECTRUM N.D.T. LTD
ULTRASONIC TEST REPORT

Client SPECTRUM DEMO		Job # UT-2243	Report # 14475
Address CALGARY; ALBERTA		Inspector M. EDWARDS	Work Sheet #
Requested by NA		Demo # 1020	Procedure # UP 4 REV 0
Work Description INSPECTION OF SINGLE TEE WELD SPECIMEN # UT-2243		Code ASME V ART 4	Acceptance Criteria ASME VIII DIV 1 APP 12 PARA 12-3
Material CARBON STEEL	Surface GOOD	Size 3/8 " THICK	Scanning Surface Top & Btm Faces
Instrument KRAUTKRAMER	Model USN 52	S/N 620073	Sensitivity 3/32 " DIA HOLE DAC
		Couplant EXOSEN	Calibration Std IIW BLOCK 99-6262

Search Unit	S/N	Size	Reference Sensitivity	Scanning Sensitivity
70 Deg 2 mHz MWB	56928-16042	8 X 9 mm	60 dB	+ 6dB
0 Deg 2.25 mHz Long	00KBWB	1" Dia	75 % BWE	+ 6dB

Ind #	Depth Below Surface	Dist from 0	Length	Amplitude	Probe(s)	Type	Remarks
1	1/16"	1.5"	1/2"	+5DB	0 DEG	C	Crack Base Metal
2	Root	3"	1/2"	+2DB	70	C	IP

REFLECTOR CLASSIFICATION:
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication

CLIENT	DATE 07/07/2005	LEVEL CGSB II SNT III	INSPECTOR
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Ultrasonic Technique for Thickness Measurements (*DIGITAL and/or A-Scan*) Procedure # U.P.5 Rev 2

General

This procedure shall be used to determine thru wall thickness of specified materials (metals) up to 8" thick using the manual straight beam contact technique in accordance with ASME BPVC Sec V Article 5, T-574/ SE-797

1 Personnel

The operator shall be qualified to SNT-TC-1A 2011, ed. UT Level 2 as outlined in Spectrum Manual NDTP1. Personnel may be required to conduct acceptable performance demonstrations for new product forms and/or unusual weld geometries/materials and special procedures.

2 Equipment

Pulse echo ultrasonic instruments with frequency range of at least 1 to 5 MHz. Reject or damping controls, if applicable to instrument, shall be off for all examinations unless it can be demonstrated not to affect linearity of examination. The following instruments may be used:

- Krautkramer USN 50
- Krautkramer USN 52
- Krautkramer USN 52L
- Krautkramer USN 58
- Krautkramer DME Thickness Gauge

Probes unless specified otherwise, shall be selected by the equipment operator - such factors as surface condition, area to be inspected, thickness of test material, temperature of test material, transducer resolution, etc. shall be considered when selecting the transducer. Acceptability of transducer for A scan testing will depend upon the ability of the test instrument to amplify a signal to the vertical calibration standard height and to resolve the signal. The recommended minimum transducer size is .012" and the minimum recommended frequency is 2.25 MHz. Dual crystal focused beam transducers are recommended for thicknesses below 1".

3 Couplant

Use water based couplant. Separate couplant containers and new brushes shall be used for stainless steel materials to avoid contamination. The requirements for contamination control are not more than 250 ppm of sulfur for nickel base alloys and not more than 250 ppm of halides for austenitic stainless steel or titanium.

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Ultrasonic Technique for Thickness Measurements (*DIGITAL and/or A-Scan*) Procedure # U.P.5 Rev 2

4 Surface Condition

The contact surface shall be free from spatter or any roughness that would interfere with free movement of search unit or impair the transmission of ultrasonic vibrations.

5 Techniques

The technique described in this procedure is the manual straight beam contact technique.

6 Calibration Blocks

The IIW calibration block-A1 block.

A certified step wedge of similar mechanical structure to the test material to cover the range from minimum to maximum thickness that may be recorded. The material from which the block is fabricated shall be of the same product form, material specification or equivalent P-Number grouping, and heat treatment as the material being examined. P-Numbers 1,2,3,4,5A-C and 15A are considered equivalent. The finish on the scanning surface of the block shall be representative of the surface of the material to be scanned.

7 Instrument Linearity Checks

Vertical and horizontal linearity checks shall be performed at intervals not exceeding 3 three months or prior to first use thereafter. (A scan only).

8 Special Equipment

Special search units, wedges shoes, saddles and modifications to existing equipment may be used to aid ultrasonic coupling but must be qualified with an acceptable performance demonstration using the specified calibration block/s described within this procedure. The same special equipment to be used during the examination shall be used for calibration.

9 Examination Calibration

General: Always place flaw detector unit in an area where no high voltage cables can interfere with equipment performance. Calibrations shall be performed from the surface corresponding to the surface of the component from which the examination will be performed. Calibrations for sensitivity and horizontal sweep (distance) shall be made by the operator just prior to and at the termination of examination and at intervals of 30

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Ultrasonic Technique for Thickness Measurements (*DIGITAL and/or A-Scan*) Procedure # U.P.5 Rev 2

minutes as examination proceeds. Distance range points and sensitivity settings shall be verified in accordance with ASME BPVC Sec V Art 5 T-563.3.1

Re-calibrations shall be done each time there is a change of personnel, operation, when transducers are changed, when new batteries are installed, when equipment is operating from a 115-V source or connected to a different power outlet and also at the end of examination.

Temperature differential between the calibration block and examination surface shall be within 25 deg F.

Sensitivity shall be set by the applicable specifications. Where no such calibration is specified, the reference sensitivity shall be determined in co-operation with the project engineer. The minimum height for a back wall response being 100% FSH (A scan only)

Thickness calibration shall be conducted on the step wedge selected to have the expected material thickness in the center of its range. The calibration will be made using a minimum of three thicknesses on the step wedge - two of the extremities and at least one in between. A reputable manufacturer or agency shall measure blocks or step wedges for accuracy.

10 Scanning

The area and surface to be scanned, grid patterns, band positions etc. shall be determined by the applicable specification or co-operation with the project engineer. These areas shall be physically marked on the test material so that the report will be able to correspond directly by means of a sketch to any given point. All readings will be noted during the inspection and any areas of discontinuities or thinning will be mapped.

11 Reporting

The report shall contain the following information:

- Procedure identification and revision
- Equipment model and serial number
- Search Units Frequency, size, angle, type and serial number
- Personnel identity and qualification
- Calibration block identification
- Special equipment
- Calibration data (reference level and damping/reject settings if used)
- Computer program identification and revision if used

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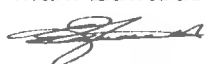

Ultrasonic Technique for Thickness Measurements (*DIGITAL and/or A-Scan*) Procedure # U.P.5 Rev 2

Identification and location of area scanned
 Test material identification
 Surface from which examination is conducted
 Map or sketch to show areas inspected showing grid locations, bands etc.
 Acceptance rejection criteria
 Date and time of test
 Couplant brand or type
 Surface condition
 Notes referring to defective or thinning areas to be correlated with a sketch
 Simulation block and electronic simulator identification when used
 Areas of inaccessible or restricted access

The report shall be filed and maintained in accordance with the referencing codes section.

12 Performance Demonstrations

Element	Demonstration #		
	1023		
Type			
Test Piece S/N	UT2241		
Temp differential (25 F max)	0		
ABSA rep. Witness of demo	B. Ionel		
REPORT #	14476		

PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards 	10/18/2007	REV1 03/15/2010 REV2 03/15/2010	NO NO
ASNT-NDT-III 148347	DATE		
Kundae Han 	12/20/2012		

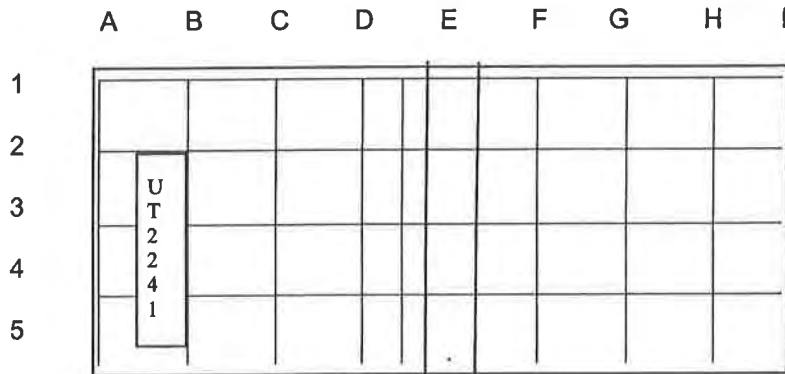
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SPECTRUM N.D.T. LTD
ULTRASONIC TEST REPORT

Client SPECTRUM DEMO		Job # UT-2241	Report # 14476
Address CALGARY; ALBERA		P/O #	Work Sheet #
Requested by NA		Demo # 1023	Procedure # UP 5 REV 0
Work Description THICKNESS INSPECTION OF PLATE SPECIMEN # UT-2241			Code ASME V ART 5
Acceptance Criteria SPECIFIED BY CUSTOMER			Scanning Surface TOP SIDE
Material CARBON STEEL	Surface GOOD	Size 5/8" THICK	STEP WEDGE S/N V 31945 Calibration Std IIW BLOCK
Instrument KRAUTKRAMER	Model DME	S/N 102625	Search Unit 1/2" DIA 5 MHZ FDU 0 DEG S/N KBM560 00M250
Sensitivity NA		Couplant EXOSEN	Inspector M. EDWARDS

1" GRID



	A	B	C	D	E	F	G	H	I
1	.612	.622	.622	.617	.623	.623	.622	.612	.623
2	.623	.617	.612	.612	.625	.618	.615	.622	.612
3	.625	.612	.612	.619	.612	.631	.618	.612	.616
4	.622	.623	.622	.633	.622	.619	.622	.630	.622
5	.625	.612	.623	.612	.623	.612	.619	.630	.618

CLIENT	INSPECTOR 	LEVEL CGSB II SNT III	DATE 07/07/2005
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SPECTRUM

Ultrasonic Technique for Plate Inspection

Procedure # U.P.6 Rev 2

General

This procedure shall be used to examine plate of specified materials (metals) of specified thickness determinations when SA Documents are referenced using the manual straight beam contact technique in accordance with ASME V Article 5. T-571

1 Personnel

The operator shall be qualified to SNT-TC-1A 2011, ed. UT Level 2 as outlined in Spectrum Manual NDTP1. Personnel may be required to conduct acceptable performance demonstrations for new product forms and/or unusual weld geometries/materials and special procedures.

2 Equipment

Pulse echo ultrasonic instruments with frequency range of at least 1 to 5 MHz. Reject or damping controls, if applicable to instrument, shall be off for all examinations unless it can be demonstrated not to affect linearity of examination. The following instruments may be used:

- Krautkramer USN 50
- Krautkramer USN 52
- Krautkramer USN 52L
- Krautkramer USN 58

Probes unless specified otherwise, shall be selected by the equipment operator - such factors as surface condition, area to be inspected, thickness of test material, temperature of test material, transducer resolution, etc. shall be considered when selecting the transducer. Acceptability of transducer for testing will depend upon the ability of the test instrument to amplify a signal to the vertical calibration standard height and to resolve the signal. The recommended normal transducer size is 1" diameter and the minimum recommended frequency is 2.25 MHz. Dual crystal focused beam transducers are recommended for thicknesses below 1".

3 Couplant

Use water based couplant. Separate couplant containers and new brushes shall be used for stainless steel materials to avoid contamination. The requirements for contamination control are not more than 250 ppm of sulfur for nickel base alloys and not more than 250 ppm of halides for austenitic stainless steel or titanium.

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Ultrasonic Technique for Plate Inspection

Procedure # U.P.6 Rev 2

4 Surface Condition

The contact surface shall be free from spatter or any roughness that would interfere with free movement of search unit or impair the transmission of ultrasonic vibrations.

5 Scanning Surface

The scanning surface may be either of the major surfaces of the plate.

6 Technique

The technique described in this procedure is the manual straight beam contact technique utilizing 0 degree longitudinal wave propagation.

7 Special Equipment

Special search units, wedges shoes, saddles and modifications to existing equipment may be used to aid ultrasonic coupling but must be qualified with an acceptable performance demonstration using the specified calibration block/s described within this procedure. The same special equipment to be used during the examination shall be used for calibration.

8 Calibration Blocks

The IIW calibration block-A1 block, and/or fabricated block.

The material from which the block is fabricated shall be of the same product form, material specification or equivalent P-Number grouping, and heat treatment as the material being examined.

P-Numbers 1,2,3,4,5A-C and 15A are considered equivalent. The finish on the scanning surface of the block shall be representative of the surface of the material to be scanned

9 Instrument Linearity Checks

Vertical and horizontal linearity checks shall be performed at intervals not exceeding 3 three months or prior to first use thereafter.

10 Examination Calibration

General: Always place flaw detector unit in an area where no high voltage cables can interfere with equipment performance. Calibrations shall be performed from the surface corresponding to the surface of the component from which the examination will be

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Ultrasonic Technique for Plate Inspection

Procedure # U.P.6 Rev 2

performed. Calibrations for sensitivity and horizontal sweep (distance) shall be made by the operator just prior to and at the termination of examination and at intervals of 30 minutes as examination proceeds. Distance range points and sensitivity settings shall be verified in accordance with ASME V Art 5 T-563.3.1

Re-calibrations shall be done each time there is a change of personnel, operation, when transducers are changed, when new batteries are installed, when equipment is operating from a 115-V source or connected to a different power outlet and also at the end examination.

Temperature differential between the calibration block and examination surface shall be within 25 deg F.

Sensitivity - Adjust the sweep for distance calibration to present the equivalent of at least 2 plate thicknesses on the CRT screen. Adjust sensitivity at a location free from indications so that the first back reflection from the far side of the plate will be 50% to 75% of full screen height. For this purpose the reject shall be turned off. This is the primary reference response.

11 Scanning

The area and surface to be scanned, grid sizes, shall be determined by the applicable SA document or co-operation with the project engineer. In addition to any grid size a 100% scrub within 2" of all edges shall be performed. A 10% probe overlap is required for 100% scanning. Scanning lines shall be measured from the center or corner of the plate. Scanning areas shall be physically marked on the test material so that the report will be able to correspond directly by means of a sketch to any given point. Relevant indications will be noted during the inspection and any areas of discontinuities will be mapped.

12 Acceptance Criteria

Record all areas that cause a complete loss of back wall reflection. Sizing and evaluating indications shall be in accordance with the applicable SA document.

13 Reporting

The report shall contain the following information:

- Procedure identification and revision
- Equipment model and serial number
- Search Units Frequency, size, angle, type and serial number

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Ultrasonic Technique for Plate Inspection



Procedure # U.P.6 Rev 2

- Personnel identity and qualification
- Calibration block identification
- Special equipment
- Calibration data (reference level and damping/reject settings if used)
- Computer program identification and revision if used
- Identification and location of area scanned
- Test material identification
- Surface from which examination is conducted
- Map or sketch to show areas inspected showing grid locations, bands etc.
- Acceptance rejection criteria
- Date and time of test
- Couplant brand or type
- Surface condition
- Notes referring to defective areas to be correlated with a sketch
- Simulation block and electronic simulator identification when used
- Areas of inaccessible or restricted access.

The report shall be filed and maintained in accordance with the referencing codes section.

14 Performance Demonstrations

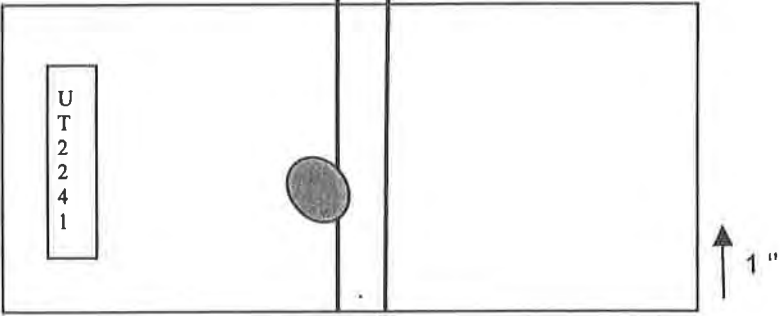

Element	Demonstration #		
	1024		
Type			
Test Piece S/N	UT2241		
Temp differential (25 F max)	0		
ABSA rep. Witness of demo	B. Ionel		
REPORT #	14477		

PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards 	10/18/2007	REV1 03/15/2010 REV2 03/15/2010	NO NO
ASNT-NDT-III 148347	DATE		
Kundae Han 	12/20/2012		

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ULTRASONIC TEST REPORT

Client SPECTRUM DEMO		Job # UT-2241	Report # 14477			
		P/O #	Work Sheet #			
Address CALGARY; ALBERTA		Requested by NA	Demo # 1024			
			Procedure # UP 6 Rev 0			
Work Description INSPECTION OF PLATE SPECIMEN # UT-2241			Code ASME V ART 5 SA 435			
Acceptance Level ASME V SA 435						
Material CARBON STEEL	Surface GOOD	Size 5/8 " THICK	Calibration Std IIW BLOCK			
Instrument KRAUTKRAMER	Model USN 52	S/N 620073	Search Unit 1/2" DIA 5 MHZ FDU S/N 00KBWP			
Sensitivity 75 % FSH BWE		Couplant EXOSEN	Inspector M. EDWARDS			
1" GRID						
						
Ind No	Depth	Max Dim	% Flaw height	% BWE loss	Type	Remarks
1	1/2 "	7/8 "	100 %	100 %	Lamination	Record
CLIENT	INSPECTOR	LEVEL	DATE			
		CGSB II SNT III	07/07/2005			

SPECTRUM

Magnetic Particle Inspection - Yoke Technique. Procedure # M.P.2 Rev 4

General

Materials that may be inspected using this procedure are limited to ferromagnetic Products, either base materials and/or welded surfaces, utilizing continuous magnetization only.

The sequence of operation in magnetic particle examination applies to the relationship to timing and application of particles and magnetizing field.

The size and shape of an item to be examined shall be unrestricted providing the required magnetic flux can be proven adequate and maintained for inspection.

Continuous magnetization is employed utilizing either wet or dry particles. For "Dry" continuous magnetization technique the flow of magnetizing field must be initiated prior to the application of dry magnetic particles and terminated after the application of powder has been completed and any excess has been blown off. "Wet" continuous magnetization technique involves bathing the part with the inspection medium to provide an abundant source of suspended particles on the surface of the part. The particle bath shall be applied to the test surface by spraying or flowing. The magnetic field shall remain on while the particles flow over the surface. Caution shall be used to ensure the application of particle has been stopped prior to removal of magnetic field.

Performance demonstrations for essential elements of this procedure are required. All mediums and consumables will be identified in the demonstrations. A change to any element or type not previously demonstrated a revised procedure and/or performance demonstration is required.

1 Personnel

The operator shall be qualified to, SNT-TC-1A 2011 ed. MT Level 2 as outlined in Spectrum Manual NDTP1.

2 Magnetizing Technique

The yoke shall be the magnetizing technique utilized for this procedure. A y-5 or y-6 hand yoke may be used. The shape of the part will determine the choice of which.

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Magnetic Particle Inspection - Yoke Technique. Procedure # M.P.2 Rev 4

3 Magnetizing Current

Magnetizing current can be supplied from an 110v A/C source or an AC/DC rectifier can be employed.

4 Part Preparation

Satisfactory results may be obtained when the surface of the part is in the as welded, as-rolled, as-cast, or as-forged condition. Prior to all magnetic particle examinations, the surface to be examined and all adjacent areas within at least 25mm shall be dry and free of all dirt, grease, lint, scale, welding flux, weld spatter, oil and other extraneous matter that could obscure surface openings or otherwise interfere with the examination.

Typical cleaning agents, which may be used, are detergents, organic solvents, descaling solutions and paint removers. Degreasing and ultrasonic cleaning methods may also be used.

A time period of 5 minutes shall be allowed to ensure cleaning solutions have completely evaporated.

For non fluorescent methods prior to particle application, white contrast paint may be applied as deemed appropriate by the inspector, and sprayed from a distance of 12" to the test piece in a single layer to enhance viewing.

5 Magnetic Particles (type/application)

Wet or Dry Non Fluorescent Method:

The wet method of inspection will be used for very fine defects and can be used indoors or out doors and is viewed under white light. Concentrations of powder in suspension will be 1.2 - 2.4ml per 100ml of vehicle. Indicating media will be applied by spray and the color shall be of maximum contrast.

The dry method of inspection will be carried out indoors or outdoors and viewed under white light. Color choice shall be to afford maximum contrast. Application of the dry powder shall be with the regular rubber ball (puffer) supplied. Care should be taken when applying dry powder on windy days and will be at the discretion of the technician.

Wet Fluorescent Method:

Concentration of fluorescent powder in suspension will be 0.1 - 0.4ml per 100ml of vehicle. Fluorescent medium will be applied by spray.

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Magnetic Particle Inspection - Yoke Technique. Procedure # M.P.2 Rev 4

Particle Sizes for Dry Methods

Not less than 98% passage through U.S. Standard No 80 mesh sieve (180 μM) as defined in ASTM 3044.

Particle Sizes for Wet Methods

Not less than 98% passage through U.S. Standard No 325 mesh sieve (45 μM) as defined in ASTM 3044.

Contamination

If non aerosol particle types are used, both fluorescent and non fluorescent suspensions shall be checked periodically for contaminants such as dirt, scale, oil, lint, loose fluorescent pigment, water (in case of oil suspensions), and particle agglomerates which can adversely affect the performance of the magnetic particle examination process. The test for contamination shall be performed at least once per week.

- (a) Carrier Contamination: For fluorescent baths, the liquid directly above the precipitate should be examined with black light. The liquid will have a little fluorescence. Its color can be compared with a freshly made up sample using the same materials or with an unused sample from the original bath that was retained for this purpose. If the "used sample" is noticeably more fluorescent than the comparison standard, the bath shall be replaced.
- (b) Particle Contamination: The graduated portion of a centrifuge tube shall be examined under black light or visible light (for both fluorescent and non fluorescent particles) for striations or bands, differences in color or appearance. Bands or striations may indicate contamination. If the total volume of the contaminates, including bands or striations exceeds 30% of the volume of magnetic particles, or if the liquid is noticeably fluorescent, the bath shall be replaced.

6 Excess Particle Removal

Accumulations of excess dry particles in examinations shall be removed with a light air stream from a bulb or syringe or other source of low-pressure dry air. The magnetic field shall be maintained while removing the excess particles.

SPECTRUM

Magnetic Particle Inspection - Yoke Technique. Procedure # M.P.2 Rev 4

7 Minimum Light Intensity

Wet or Dry Non Fluorescent Method:

The minimum lighting requirement for nonfluorescent particles is 1000 Lux (see demonstration #1002).

Wet Fluorescent Method:

With the wet fluorescent method the technician will require a black light. Wet fluorescent inspection will normally be conducted indoors, in a suitable darkened area. A 10-minute period shall be allowed for the black light to warm up, when using a mercury vapor bulb (LED bulbs do not require a warm up time). An extra 5-minute period shall be allowed for the operator's eyes to become accustomed to the darkness. Glasses or lenses worn by examiners shall not be photosensitive. The intensity of the black light shall be 1000 uW/cm² at the surface of the part to be examined. Reflectors and filters should be checked and cleaned prior to use. Cracked or broken filters should be replaced immediately. Intensity checks will be carried out prior to use, whenever light power is interrupted or changed and at the completion of the examination or series of examinations. Light intensity shall be recorded on the report.

8 Coatings

This procedure is limited to ferromagnetic materials with no coatings. Any materials with coatings will require a revised procedure and acceptable performance demonstration.

9 Temperature Limitations

Inspection particle mediums (consumables) used for wet methods shall be within the range as specified by the manufacturer and also within the range of 60 –120 deg F.

Inspection particle mediums (consumables) used for dry methods shall be within the range as specified by the manufacturer and also within the range of 40 –120 deg F.

Inspection contrast paint mediums (consumables) used for shall be within the range as specified by the manufacturer and also within the range of 40 –120 deg F.

Aerosol cans may not be heated to a temperature over 50 deg C. Cans heated above this limit must be discarded.

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**Magnetic Particle Inspection - Yoke Technique.
Procedure # M.P.2 Rev 4**

10 Calibrations

The light meters shall be calibrated at least once every year and whenever the meter is repaired. If meters have not been in use for one year or more, calibrations shall be done before being used.

The magnetizing power of the yokes shall have been checked within the past year and whenever the yoke has been damaged or repaired.

A sufficient magnetizing field must be applied to lift a minimum of 10lbs (using a A/C rectifier) and a minimum of 40lbs (using a D/C rectifier) at the maximum prod spacing to be used during the inspection.

Calibration certificates shall be available for the buyer's representative review. Calibration date and the next due date for re calibration of the equipment shall be clearly displayed on the instrument and recorded in equipment log.

Each weight shall be weighed with a calibrated scale from a reputable manufacturer and permanently marked with the nominal weight prior to use.

Black lights shall be checked for cracked, damaged filters prior to use, cracked or broken filters shall be replaced immediately. Ultraviolet intensity shall be checked using a black light meter prior to use, every eight hours of use, whenever the power is interrupted or changed. Black lights shall achieve a minimum of 1000 uW/cm² on the surface of the part being examined.

11 Examination/written instructions

Before the magnetic particle examination is conducted, a check of the examination surface shall be conducted to locate any discontinuity surface openings which may not attract and hold magnetic particles because of their width.

Using the continuous method, the inspection medium shall be applied in two perpendicularly opposite directions of magnetism to ensure 100% coverage, and shall include a band of base metal at least 25mm wide on each side of the weld joint to be examined. Magnetizing field shall remain on while the medium is applied and while excess is removed. If geometry of part to be inspected does not allow for magnetism to be applied in two perpendicularly opposite directions, it must be noted in the report.

Written instructions to be used in conjunction with the complete MP2 rev 4 document and referencing code acceptance / rejection criteria and specifications.

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Magnetic Particle Inspection - Yoke Technique. Procedure # M.P.2 Rev 4

11.1-Dry visible magnetic particle technique written instructions.

A pre inspection of test object shall be done in accordance to paragraph 4 of MP 2 rev 4 and referencing code. A thin back ground (WCP2) may be applied to test surface to increase the back ground contrast.

Energizing current shall be applied to the test surface produce a magnetizing field.

Dry powder shall be applied as to lightly dust the test surface. The field shall remain on while the particles settle on the surface of the part. Excess particles should be removed by light, dry air current while the energizing field remains on. The examination shall be performed twice at right angles and to ensure sufficient overlap for complete coverage.

Inspect the test surface for the formation of indications under the appropriate lighting conditions. (Minimum visible light)

Evaluate any indications to the referencing code, acceptance criteria and/or specifications.

11.2-Wet visible magnetic particle technique written instructions.

A pre inspection of test object shall be done in accordance to paragraph 4 of MP 2 rev 4 and referencing code. A thin back ground (WCP2) may be applied to test surface to increase the back ground contrast.

Energizing current shall be applied to the test surface to produce a magnetizing field.

Wet visible bath shall be applied to the test surface by spraying or flowing. The field shall remain on while the particles flow over the surface. Caution shall be used to ensure the application of particle has been stopped prior to removal of magnetic field. The examination shall be performed twice at right angles and to ensure sufficient overlap for complete coverage.

Inspect the test surface for the formation of indications under the appropriate lighting conditions. (Minimum visible light)

Evaluate any indications to the referencing code, acceptance criteria and/or specifications.

SPECTRUM

Magnetic Particle Inspection - Yoke Technique. Procedure # M.P.2 Rev 4

11.3-Wet fluorescent magnetic particle technique written instructions.

A pre inspection of test object shall be done in accordance to paragraph 4 of MP 2 rev 4 and referencing code. Energizing current shall be applied to the test surface to produce a magnetizing field.

Wet fluorescent bath shall be applied to the test surface by spraying or flowing. The field shall remain on while the particles flow over the surface. Caution shall be used to ensure the application of particle has been stopped prior to removal of magnetic field. The examination shall be performed twice at right angles and to ensure sufficient overlap for complete coverage.

Inspect the test surface using a black light in the appropriate darkened conditions. (Minimum ultraviolet and maximum visible)

Evaluate any indications to the referencing code, acceptance criteria and/or specifications.

12 Post Examination Cleaning

All foreign particles that may interfere with or be detrimental to the following processes or service of the test material shall be removed by means of cleaning. Detergents, organic solvents or mechanical means may be used.

13 Demagnetization

Demagnetization shall be performed in accordance with recommended procedures when customer and or governing specification requires. Residual field may be detected by use of field indicators.

This procedure employs the use of AC/DC yokes only therefore demagnetization is not generally required due to a circular magnetic field in a localized area.

If required for localized demagnetization. Using an AC yoke place the poles on the test surface, moving them around the area, and slowly withdraw the yoke while energized.

SPECTRUM

Magnetic Particle Inspection - Yoke Technique.
Procedure # M.P.2 Rev 4

14 Report of Indications

Rejectable indications shall be recorded. As a minimum, the type of indications (linear or rounded), location and extent (length or diameter or aligned) shall be recorded. The use of sketches or digital photography to show locations, directions and frequency of indications may be used. The report shall indicate the type of magnetization, including location of contacts and current used. Defect locations shall be marked on the test specimen with paint stick or equivalent, whenever practical. Non rejectable indications shall also be recorded if specified by the referencing code section.

15 Evaluations

- (a) All indications shall be evaluated in terms of the acceptance / rejection standard of the referencing code and or customer specifications. All referencing codes, acceptance / rejection criteria and specifications shall be made available to the inspector prior to and during inspection for reference.
- (b) Discontinuities on or near the surface are indicated by the retention of the examination medium. However, localized surface irregularities due to machining marks or other surface conditions may produce false indications.
- (c) Broad areas of particle accumulation, which might mask indications from discontinuities, are prohibited, and such areas shall be cleaned and re examined

Referencing codes and acceptance criteria (latest editions) include but not limited to:

ASME V, Article 7
ASME VIII Div I, Appendix 6, Paragraph 6-3 (A) (B) (C)
ASME V Article 25
ASME B31.1, Chapter VI, Paragraph 136.4.3 (A) (A.3) (A.4) (also see note)
ASME B31.3, Chapter I, Paragraph 300.2
ASME B31.8
CSA W59, 11.5.4.3 or 12.5.4.3
ASTM
AWS. D1.1
AWS D1.5
CSA Z-662

Note: Indication evaluation criteria of B31.3 shall be extended to B31.1 indications in order to evaluate indications, with "lengths equal to three times the width"

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**Magnetic Particle Inspection - Yoke Technique.
Procedure # M.P.2 Rev 4**

16 Records

The following information will be contained in the report



- I. Procedure identification and revision
- II. Equipment and type of current
- III. Code/Specification
- IV. Part to be examined: identification, material, thickness etc.
- V. Surface from which examination is conducted
- VI. Method (wet, dry, visible or fluorescent)
- VII. Particle size
- VIII. Map or sketch to show areas inspected/indications
- IX. Consumable type (number or letter designation of all consumables used)
- X. Lighting equipment
- XI. Acceptance rejection criteria
- XII. Inspector's name who interprets the examination(s) shall sign and date the reports, noting their qualifications.

SPECTRUM

Magnetic Particle Inspection - Yoke Technique.
 Procedure # M.P.2 Rev 4

17 Performance Demonstrations

Element	Demonstration #				
	1013	1014	1015	1016	1017
Type	Dry Visible	Wet Visible	Wet Visible	Wet fluorescent	Wet fluorescent
Temp range test piece	40-120 F	60-120 F	60-120 F	60-120 F	60-120 F
Temp range contrast	40-120 F	40-120 F	40-120 F	N/A	N/A
Temp range medium	40-120 F	60-120 F	60-120 F	60-120 F	60-120 F
Recorded Ambient temp	Certified thermometer	Certified thermometer	Certified thermometer	Certified thermometer	Certified thermometer
Contrast	WCP 2	WCP 2	WCP 2	N/A	N/A
Particles	RED 63	7C	7HF	Miglo 778	14 AM
Carrier	N/A	CARRIER II	N/A	Water	N/A
Current	AC	AC	AC	AC	AC
Magnetism	Continuous	Continuous	Continuous	Continuous	Continuous
Test Piece S/N	UT2249	UT2248	UT2248	UT2248	UT2248
ABSA representative- Witness of demonstration	B. lonel	B. lonel	B. lonel	B. lonel	B. lonel
REPORT #	14468	14469	14470	14471	14472

PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards 	10/18/2007	REV2 01/20/2008 REV3 03/26/2010 REV4 04/12/2010	NO NO NO
ASNT-NDT-III 148347	DATE		
Kundae Han 	12/20/2012	REV4	NO

*****END OF DOCUMENT*****

June 01, 2012

ABSA
 1212-31 Avenue N.E
 Calgary Alberta, Canada
 T2E 7S8

Attention: Mr. Blair Ionel (C.E.T, Authorized Inspector Supervisor, Safety Codes Officer)

DEMONSTRATION OF NON-DESTRUCTIVE EXAMINATION PROCEDURES

The following procedures were demonstrated in accordance with ASME Section V, 2010 Edition, 2011 Addenda.

- Article 1 General Requirements, Section T-150
- Article 7 Magnetic Particle Examination, Section T-721

Spectrum NDT demonstrated the following Non-Destructive Examination Procedures on June 01, 2012.

PROCEDURE	DESCRIPTION	METHOD	SPECIMEN	REPORT	DEMO #
MP2 REV.4	MPI-AC	MTWV-820	UT-2248	87777	1011
MP2 REV.4	MPI-DC	MTWV-820	UT-2248	87778	1011
MP2 REV.4	MPI-DC	63 RED MT DRY NO CONTRAST	UT-2249	87775	1012
MP2 REV.4	MPI-AC	63 RED MT DRY NO CONTRAST	UT-2249	87774	1012
MP2 REV.4	MPI-DC	63 RED MT DRY W/ CONTRAST	UT-2249	87776	1013
MP2 REV.4	MPI-DC	MTWF-778	UT-2248	87779	1016


Spectrum NDT technicians that participated in the above procedures include:

P.Chwachka (Level II CGSB 14144/SNT-TC-1A)

Spectrum NDT Representative: Clint Magdee  SNT-TC-1A Level III
 Date: June 01 2012

Demonstrations Witnessed By:

AIS or AI
 ABSA


 (signature)

Date

12/7/6.

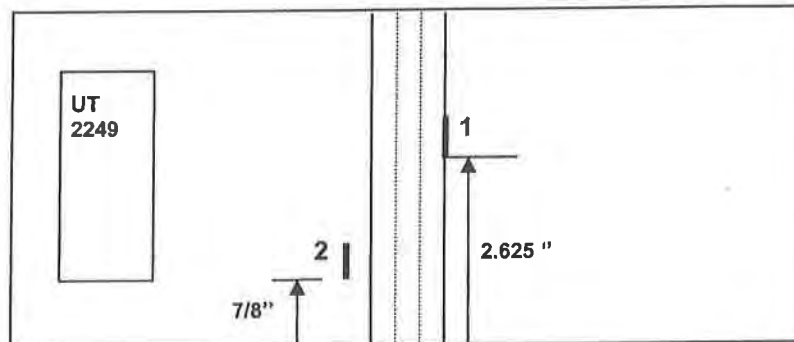


SPECTRUM N.D.T. LTD
MAGNETIC PARTICLE TEST REPORT

Client SPECTRUM DEMO	Job # UT 2249	Report # 14468 rev 1
	P/O #	Work Sheet #
Address CALGARY; ALBERTA	Requested by NA	Demo # 1013
		Procedure # MP2 REV0
Work Description INSPECTION OF SINGLE VEE PLATE WELD WITH FLUSH CROWN SPECIMEN # UT - 2249		
Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6	Equipment / Serial # HAND YOKE / 10123
Ambient Temp 25 DEG C	Material CARBON STEEL	Surface GOOD
Power AC 110 V	Technique CONTINUOUS MAGNETISM	Inspector M. EDWARDS
Lifting Capability Check 10 LB OK	Light Source GE 12 Volt Automotive Bulb	Light Intensity 1100 Lux

ID & OD INSPECTED

Ind No	Position	Length	Remarks
1 ID	HAZ ROOT	5/16 "	LONGITUDINAL CRACK, REJECTED
2 OD	BASE METAL	3/4 "	" " "



CLIENT	INSPECTOR 	LEVEL SNT III	DATE 07/07/2005
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SPECTRUM N.D.T. LTD
MAGNETIC PARTICLE TEST REPORT

Client SPECTRUM DEMO		Job # UT 2248	Report # 14469 rev1
Address CALGARY; ALBERTA		P/O #	Work Sheet #
Requested by NA		Demo # 1014	Procedure # MP2 REV 0
Work Description INSPECTION OF SINGLE VEE PLATE WELD WITH FLUSH CROWN SPECIMEN # UT - 2248			
Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6	Equipment / Serial # HAND YOKE / 10123	Particle Type CARRIER II / 7C
Ambient Temp 25 DEG C	Material CARBON STEEL	Surface GOOD	Batch # 99J023
Power AC 110 V	Technique CONTINUOUS MAGNETISM		Inspector M. EDWARDS
Lifting Capability Check 10 LB OK	Light Source GE 12 Volt Automotive Bulb	Light Intensity 1100 Lux	
OD INSPECTED			
Ind No	Position	Length	Remarks
1	Weld centre	5/16 "	LONGITUDINAL CRACK, REJECTED
2	"	3/8 "	TRANSVERSE CRACK, REJECTED
CLIENT	INSPECTOR 	LEVEL SNT III	DATE 07/07/2005



SPECTRUM N.D.T. LTD
MAGNETIC PARTICLE TEST REPORT

Client SPECTRUM DEMO		Job # P/O #	UT 2248	Report # Work Sheet #	14470 rev1
Address CALGARY; ALBERTA		Requested by NA		Demo # Procedure #	1015 MP2 REV 0
Work Description INSPECTION OF SINGLE VEE PLATE WELD WITH FLUSH CROWN SPECIMEN # UT - 2248					
Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6	Equipment / Serial # HAND YOKE / 10123		Particle Type 7HF	Batch # 04D04K 01357
Ambient Temp 25 DEG C	Material CARBON STEEL	Surface GOOD		Background WCP-2	
Power AC 110 V	Technique CONTINUOUS MAGNETISM			Inspector M. EDWARDS	
Lifting Capability Check 10 LB OK		Light Source GE 12 Volt Automotive Bulb		Light Intensity 1100 Lux	
OD INSPECTED					
Ind No	Position	Length	Remarks		
1	Weld centre	5/16 "	LONGITUDINAL CRACK, REJECTED		
2	"	3/8 "	TRANSVERSE CRACK, REJECTED		
CLIENT	INSPECTOR 		LEVEL SNT III	DATE 07/07/2005	



SPECTRUM N.D.T. LTD
MAGNETIC PARTICLE TEST REPORT

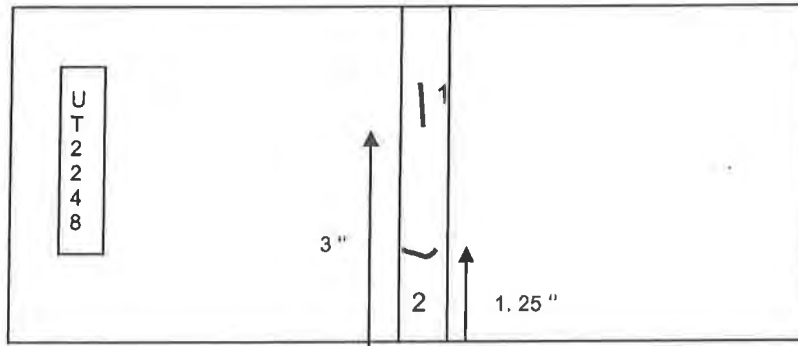
Client SPECTRUM DEMO	Job # P/O #	UT 2248	Report # Work Sheet #	14471
Address CALGARY; ALBERTA	Requested by NA		Demo # Procedure #	1016 MP2 REV 0

Work Description
INSPECTION OF SINGLE VEE PLATE WELD WITH FLUSH CROWN SPECIMEN # UT - 2248

Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6	Equipment / Serial # HAND YOKE / 10123	Particle Type MIGLO 778	Batch # B143
Ambient Temp 25 DEG C	Material CARBON STEEL	Surface GOOD	Background NA	
Power AC 110 V	Technique CONTINUOUS MAGNETISM		Inspector M. EDWARDS	
Lifting Capability Check 10 LB OK	Light Source Black Light S/N 649256	Light Intensity 3100 MW/CM2		

OD INSPECTED

Ind No	Position	Length	Remarks
1	Weld centre	5/16 "	LONGITUDINAL CRACK, REJECTED
2	"	3/8 "	TRANSVERSE CRACK, REJECTED



CLIENT	INSPECTOR 	LEVEL SNT III	DATE 07/07/2005
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SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client SPECTRUM DEMO		Job # P/O #	UT 2248	Report # Work Sheet #	14472
Address CALGARY; ALBERTA		Requested by NA		Demo # Procedure #	1017 MP2 REV 0
Work Description INSPECTION OF SINGLE VEE PLATE WELD WITH FLUSH CROWN SPECIMEN # UT - 2248					
Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6	Equipment / Serial # HAND YOKE / 10123		Particle Type 14AM	Batch # 04E10K 00498
Ambient Temp 25 DEG C	Material CARBON STEEL	Surface GOOD		Background NA	
Power AC 110 V	Technique CONTINUOUS MAGNETISM			Inspector M. EDWARDS	
Lifting Capability Check 10 LB OK		Light Source Black Light S/N 649256		Light Intensity 3100 MW/CM2	
OD INSPECTED					
Ind No	Position	Length	Remarks		
1	Weld centre	5/16 "	LONGITUDINAL CRACK, REJECTED		
2	"	3/8 "	TRANSVERSE CRACK, REJECTED		
CLIENT	INSPECTOR		LEVEL	DATE	
			SNT III	07/07/2005	

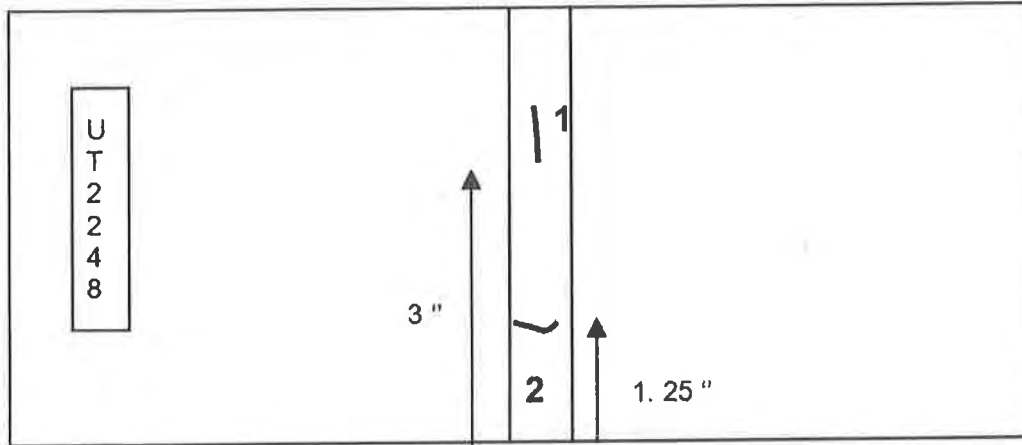


SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client Spectrum NDT Demonstration		Job # UT2248	Report # 87778
Address Calgary; Alberta		Reg # or PO #	Work Sheet # 66753
Work Description INSPECTION OF DEMONSTRATION BLOCK		Requested by Mr. B. Ionel	Demo # 1011
Code ASME V ART 7		Material Carbon Steel	Procedure # MP2 REV4
Technique Continuous Magnetism		Ambient Temp 20 Deg C	Surface Ground Flush
Particle type Mi-Glow 820		Power DC 110 V	Background / Batch Magnaflux WCP2 / 11L13K
Light Source 500 Watt Halogen		Particle Size 1.5 µm Average	Lifting Capability Check 40 lbs.
Acceptance Criteria ASME VIII DIV 1 APP 6		Inspection surface External	Particle Manufacture Circle Systems
Equipment/Serial # Parker DA-400 / 1939		Inspector P. Chwachka	
Batch # 17381			
Light intensity 2000 lux			

Identification	Description	Comments
Flawtech UT2248	Single V Welded Plate	Rejected (See Below)



Ind No	Position	Length	Remarks
#1	Top Weld Centre	5/16"	Longitudinal Crack
#2	Top Weld Centre	3/8"	Transverse Crack

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR <i>P. Chwachka</i>	LEVEL CGSB II #14144 SNT II	DATE June 1, 2012
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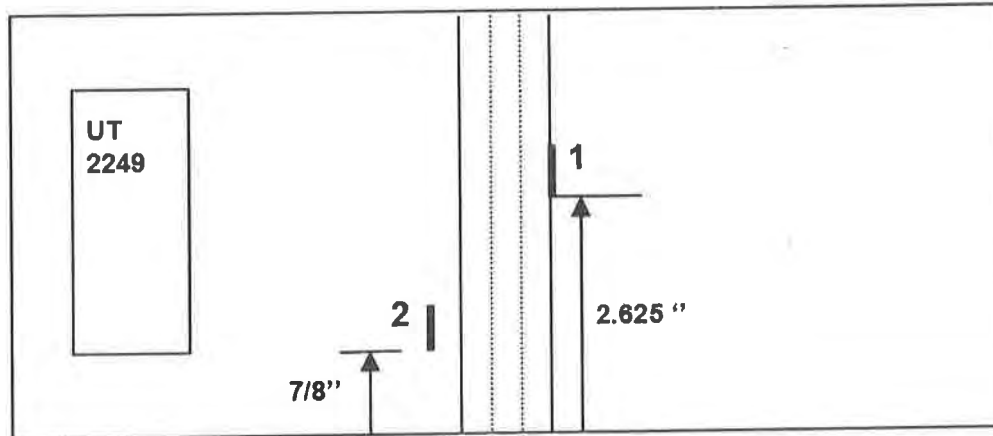


SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client Spectrum NDT Demonstration		Job # Req # or PO #	UT2249	Report # Work Sheet #	87776 66753
Address Calgary; Alberta		Requested by Mr. B. Ionel		Demo # Procedure #	1013 MP2 REV4
Work Description INSPECTION OF DEMONSTRATION BLOCK			Material Carbon Steel	Surface Ground Flush	
Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6	Ambient Temp 20 Deg C		Background / Batch Magnaflux WCP-2 / 11L13K	
Technique Continuous Magnetism	Equipment/Serial # Parker DA-400 / 1939	Power DC 110 V		Lifting Capability Check 40 lbs.	
Particle type 63 Red	Batch # 16899	Particle Size 75 µm Average		Particle Manufacture Circle Systems	
Light Source 500 Watt Halogen	Light intensity 2000 lux	Inspection surface External		Inspector P. Chwachka	

Identification	Description	Comments
Flawtech UT2249	Single V Welded Plate	Rejected (See Below)



Ind No	Position	Length	Remarks
#1	Bottom Base Metal	5/16"	Longitudinal Crack
#2	Top Base Metal	3/4	Longitudinal Crack

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR <i>P. Chwachka</i>	LEVEL CGSB II #14144 SNT II	DATE June 1, 2012
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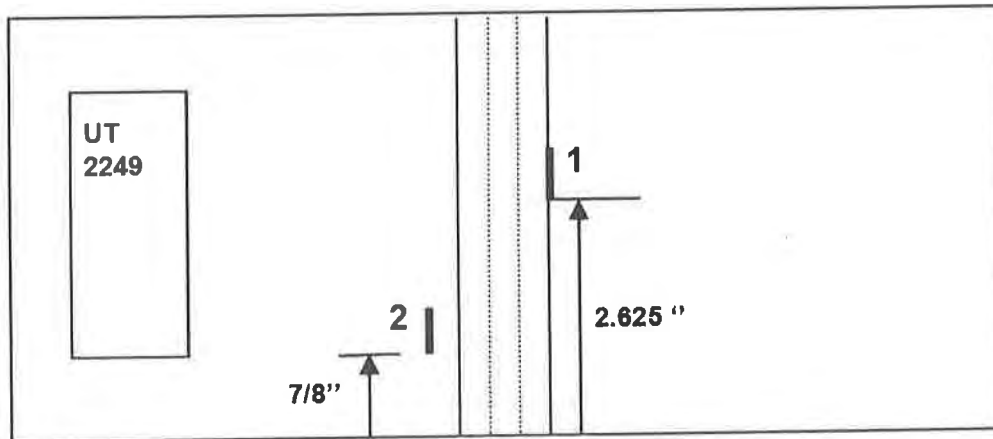


SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client Spectrum NDT Demonstration		Job # Req # or PO #	UT2249	Report # Work Sheet #	87775 66753
Address Calgary; Alberta		Requested by Mr. B. Ionel		Demo # Procedure #	1012 MP2 REV4
Work Description INSPECTION OF DEMONSTRATION BLOCK			Material Carbon Steel	Surface Ground Flush	
Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6		Ambient Temp 20 Deg C	Background / Batch None	
Technique Continuous Magnetism	Equipment/Serial # Parker DA-400 / 1939		Power DC 110 V	Lifting Capability Check 40 lbs.	
Particle type 63 Red	Batch # 16899	Particle Size 75 µm Average		Particle Manufacture Circle Systems	
Light Source 500 Watt Halogen	Light intensity 2000 lux	Inspection surface External		Inspector P. Chwachka	

Identification	Description	Comments
Flawtech UT2249	Single V Welded Plate	Rejected (See Below)



Ind No	Position	Length	Remarks
#1	Bottom Base Metal	5/16"	Longitudinal Crack
#2	Top Base Metal	3/4	Longitudinal Crack

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR <i>P. Chwachka</i>	LEVEL CGSB II #14144 SNT II	DATE June 1, 2012
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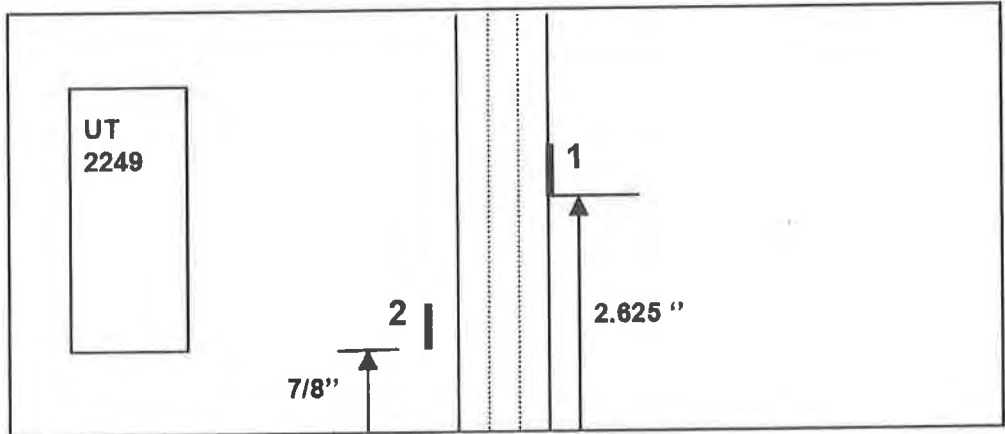


SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client Spectrum NDT Demonstration		Job # UT2249	Report # 87774
Address Calgary; Alberta		Req # or PO #	Work Sheet # 66753
Work Description INSPECTION OF DEMONSTRATION BLOCK		Requested by Mr. B. Ionel	Demo # 1012
Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6	Material Carbon Steel	Procedure # MP2 REV4
Technique Continuous Magnetism	Equipment/Serial # Parker DA-400 / 1939	Ambient Temp 20 Deg C	Surface Ground Flush
Particle type 63 Red	Batch # 16899	Power AC 110 V	Background / Batch None
Light Source 500 Watt Halogen	Light intensity 2000 lux	Particle Size 75 µm Average	Lifting Capability Check 10 lbs.
		Inspection surface External	Particle Manufacture Circle Systems
			Inspector P. Chwachka

Identification	Description	Comments
Flawtech UT2249	Single V Welded Plate	Rejected (See Below)



Ind No	Position	Length	Remarks
#1	Bottom Base Metal	5/16"	Longitudinal Crack
#2	Top Base Metal	3/4	Longitudinal Crack

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR <i>P. Chwachka</i>	LEVEL CGSB II #14144 SNT II	DATE June 1, 2012
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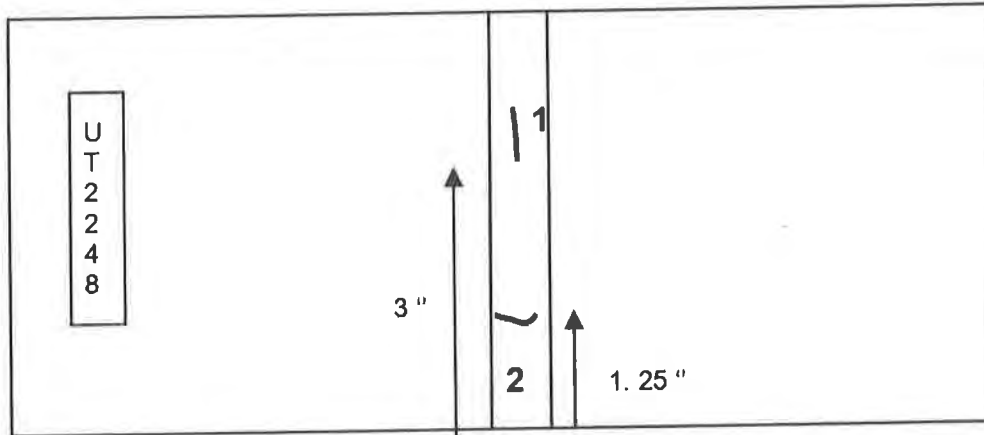


SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client Spectrum NDT Demonstration		Job # UT2248	Report # 87777
Address Calgary, Alberta		Req # or PO # Mr. B. Ionel	Work Sheet # 66753
Work Description INSPECTION OF DEMONSTRATION BLOCK		Material Carbon Steel	Surface Ground Flush
Code ASME V ART 7	Acceptance Criteria ASME VIII DIV 1 APP 6	Ambient Temp 20 Deg C	Background / Batch Magnaflux WCP2 / 11L13K
Technique Continuous Magnetism	Equipment/Serial # Parker DA-400 / 1939	Power AC 110 V	Lifting Capability Check 10 lbs.
Particle type Mi-Glow 820	Batch # 17381	Particle Size 1.5 µm Average	Particle Manufacture Circle Systems
Light Source 500 Watt Halogen	Light intensity 2000 lux	Inspection surface External	Inspector P. Chwachka

Identification	Description	Comments
Flawtech UT2248	Single V Welded Plate	Rejected (See Below)



Ind No	Position	Length	Remarks
#1	Top Weld Centre	5/16"	Longitudinal Crack
#2	Top Weld Centre	3/8"	Transverse Crack

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR <i>P. Chwachka</i>	LEVEL CGSB II #14144 SNT II	DATE June 1, 2012
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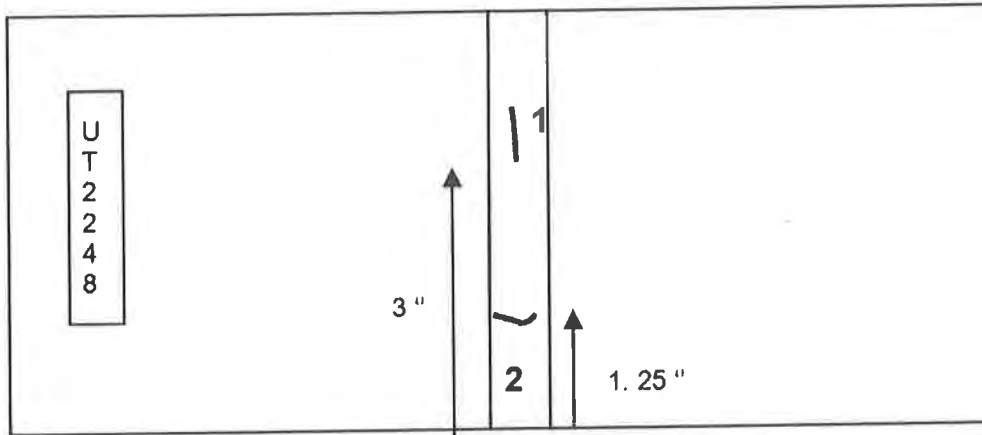


SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client Spectrum NDT Demonstration		Job # UT2248	Report # 87779
Address Calgary, Alberta		Reg # or PO #	Work Sheet # 66753
Work Description INSPECTION OF DEMONSTRATION BLOCK		Requested by Mr. B. Ionel	Demo # 1016
Code ASME V ART 7		Material Carbon Steel	Procedure # MP2 REV4
Acceptance Criteria ASME VIII DIV 1 APP 6		Ambient Temp 20 Deg C	Surface Ground Flush
Technique Continuous Magnetism		Power DC 110 V	Background / Batch N/A
Equipment/Serial # Parker DA-400 / 1939		Particle Size Avg. 5 µm	Lifting Capability Check 40 lbs.
Particle type Mi-Glow 778		Inspection surface External	Particle Manufacture Circle Systems
Batch # 17061		Inspector P. Chwachka	
Light Source Blacklight / 1776116		Light intensity 1800 µW/cm ²	

Identification	Description	Comments
Flawtech UT2248	Single V Welded Plate	Rejected (See Below)



Ind No	Position	Length	Remarks
#1	Top Weld Centre	5/16"	Longitudinal Crack
#2	Top Weld Centre	3/8"	Transverse Crack

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR <i>P. Chwachka</i>	LEVEL CGSB II #14144 SNT II	DATE June 1, 2012
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SPECTRUM

Liquid Penetrant Examination General Requirements Basic Reference to Current Mandatory Edition of ASME V Document L.P.2. Rev 2

General

The liquid penetrant examination method is an effective means for detecting discontinuities which are open to the surface of non porous metals and other materials.

A liquid penetrant is applied to the surface to be examined and allowed to enter discontinuities. All excess penetrant is then removed and part is dried and a developer is applied. The dyes in penetrants are either color contrast, or fluorescent. (Refer to processing flow sheet table III).

Materials that may be inspected using this procedure are Aluminum, magnesium, steel, brass and bronze, titanium and high-temp alloys

The technician performing the liquid penetrant examination shall consider the following;

- i) The materials, shapes or sizes to be examined
- ii) Type of each penetrant, penetrant remover, emulsifier and developer
- iii) Processing for pre-examination cleaning and drying
- iv) Processing for applying the penetrant; the length of time that the penetrant will remain on the surface (dwell time), the temperature of the surface.
- v) Processing for removing excess penetrant
- vi) Processing for applying the developer
- vii) Processing for post-examination cleaning

A revised procedure and performance demonstration is required:

- a) Whenever a change or substitution is made in the type or family group of penetrant materials (including developers).
- b) For any change in part processing that can close surface openings of discontinuities or leave interfering deposits.

SPECTRUM

Liquid Penetrant Examination General Requirements Basic Reference to Current Mandatory Edition of ASME V Document L.P.2. Rev 2

1 Personnel

Individuals performing examination shall be qualified and certified PT level II in accordance with SNT-TC-1A 2011, ed.

2 Techniques

Either a color contrast penetrant technique or a fluorescent penetrant technique shall be used (refer to table 1):

- i) Water washable
- ii) Post emulsifying
- iii) Solvent removable

3 Surface Preparation

Satisfactory results may be obtained when the surface of the part is in the as-welded, as-rolled, as-cast, or as-forged condition. Prior to all liquid penetrant examinations, the surface to be examined and all adjacent areas within at least 1" shall be dry and free of all dirt, grease, lint, scale, welding flux, weld spatter, oil and other extraneous matter that could obscure surface openings or otherwise interfere with the examination.

Typical cleaning agents which may be used are detergents, organic solvents, descaling solutions and paint removers. Degreasing and ultrasonic cleaning methods may also be used.

A time period of 5 minutes shall be allowed to ensure cleaning solutions have completely evaporated.

4 Standard Temperatures

Penetrants identified for this procedure operate satisfactorily within a temperature range of 41 – 122 deg F (5 deg to 50 deg C), but operation outside this range may result unsatisfactory results.

The temperature of the penetrant and the surface of the part to be processed shall not be below 50°F nor above 122°F (10-50 deg C) throughout the examination period. Temperature shall be verified by use of thermometer at site during examinations.

5 Application of Penetrant

The penetrant may be applied by any suitable means, such as dipping, brushing or spraying.

SPECTRUM

Liquid Penetrant Examination General Requirements Basic Reference to Current Mandatory Edition of ASME V Document L.P.2. Rev 2

6 Dwell Time

As required in Table 2 or as qualified by demonstration for specific instructions. Any decrease in penetrant dwell times shall be qualified by an acceptable performance demonstration.

After the specified penetration time has elapsed, any penetrant remaining on the surface shall be removed.

7 Water Washable Penetrant Removal

The excess penetrant shall be removed with a gentle water spray. The water pressure shall not exceed 50psi and the water temperature shall not exceed 110°F.

8 Post-Emulsifying Penetrant (Hydrophilic) Removal

Prior to emulsification parts shall be prerinsed for not more than 1 min using the same process as for water-washable penetrants. The emulsifier shall be applied by spraying or dipping. Bath concentration and mixture removal shall be as recommended by the manufacturer for pressure and temperature requirements.

9 Solvent Removable Penetrant Removal

Excess penetrants shall be removed by wiping with a cloth or absorbent paper, repeating the operation until most traces of penetrant have been removed by lightly wiping the surface with cloth or absorbent paper moistened with solvent. Care shall be taken to avoid the use of excess solvent. (Flushing the surface with solvent, following the application of the penetrant and prior to developing, is prohibited).

10 Drying After Excess Penetrant Removal

For the water-washable or post emulsifying technique, the surfaces may be dried by blotting with clean materials or by using circulating warm air, provided the temperature of the surface is not raised above 122°F.

For the solvent removable technique, the surfaces may be dried by normal evaporation, blotting, wiping or forced air.

A time period of 5 minutes shall be allowed to ensure cleaning solutions have completely evaporated.

SPECTRUM

Liquid Penetrant Examination General Requirements Basic Reference to Current Mandatory Edition of ASME V Document L.P.2. Rev 2

11 Developing

The developer shall be applied, by means of aerosol spray, as soon as possible after penetrant removal; with color contrast penetrants, only a wet developer shall be used. With fluorescent penetrants, a wet or dry developer shall be used. The developing time (aqueous and non-aqueous) shall not be less than 10 minutes from the time the wet developer coating is dry.

Any increase in developer dwell times shall be qualified by an acceptable performance demonstration.

12 Black Light

For the fluorescent method the technician will require a black light. . A 10-minute period shall be allowed for the black light to warm up. An extra 5-minute period shall be allowed for the operator's eyes to become accustomed to the darkness. The intensity of the black light shall be 1000 $\mu\text{W}/\text{cm}^2$ at the surface of the part to be examined. Intensity checks will be carried out prior to use, whenever light power is interrupted or changed and at the completion of the examination or series of examinations. Light intensity shall be recorded in the report.

13 Visible Light Level

Natural or artificial visible light at the inspection site shall be 1000 Lux minimum (see demonstration # 1002).

14 Light Meter Calibration

The light meters shall be calibrated at least once every year or whenever the meter is repaired.

15 Interpretation

The true size and type of discontinuities are difficult to evaluate if the penetrant diffuses excessively into the developer. Consequently, the surface shall be closely observed during the application of the developer to monitor the behavior of indications, which tend to bleed-out profusely. Final interpretation shall be made after allowing the penetrant to bleed-out for 10 to 60 minutes. If bleed-out does not alter the examination results longer periods are permitted. If the surface to be examined is large enough to preclude complete examination within the prescribed time, the surface shall be examined in increments. Longer bleed out

SPECTRUM

Liquid Penetrant Examination General Requirements Basic Reference to Current Mandatory Edition of ASME V Document L.P.2. Rev 2

times shall be only be permitted if a demonstration of selected time has been performed satisfactorily.

16 Evaluation

Acceptance criteria shall be in accordance with ASME VIII Div 1. Appendix 8.

17 Post Examination Cleaning.

All foreign particles that may interfere with or be detrimental to the following processes or service of the test material shall be removed by means of cleaning. Detergents, organic solvents or mechanical means may be used.

18 Technique Restrictions

Fluorescent penetrant examination shall not follow a color contrast penetrant examination. Intermixing of penetrant materials from different family groups is not permitted. The user obtains certification of contaminant content for all liquid penetrant materials used on nickel based alloys, austenitic stainless steels and titanium. When examining nickel based alloys, all penetrant materials shall be analyzed for sulphur content. When examining austenitic stainless steel or titanium all penetrant materials shall be analyzed for chlorine content. The chlorine content shall not exceed 1% of the residue, by weight.

19 Reports

The following information shall be recorded:

- i) procedure identification and revision
- ii) penetrant type (visible or fluorescent)
- iii) type(number or letter designation of all consumables used)
- iv) personnel identity and qualification level
- v) map/record of indications
- vi) part to be examined: identification, material, thickness etc
- vii) lighting equipment
- viii) acceptance rejection criteria
- ix) data and time of test

SPECTRUM

Liquid Penetrant Examination General Requirements
 Basic Reference to Current Mandatory Edition of ASME V
 Document L.P.2. Rev 2

20 Tables

TABLE 1; CLASSIFICATION OF LIQUID PENETRANT INSPECTION METHOD AND TYPES

METHOD A: Fluorescent, Liquid Penetrant inspection
Type 1 – water – washable Type 2 – post – emulsifiable Type 3 – solvent – removable
METHOD B: Visible, Liquid Penetrant Inspection
Type 1 – water – washable Type 2 – post – emulsifiable Type 3 – solvent – removable

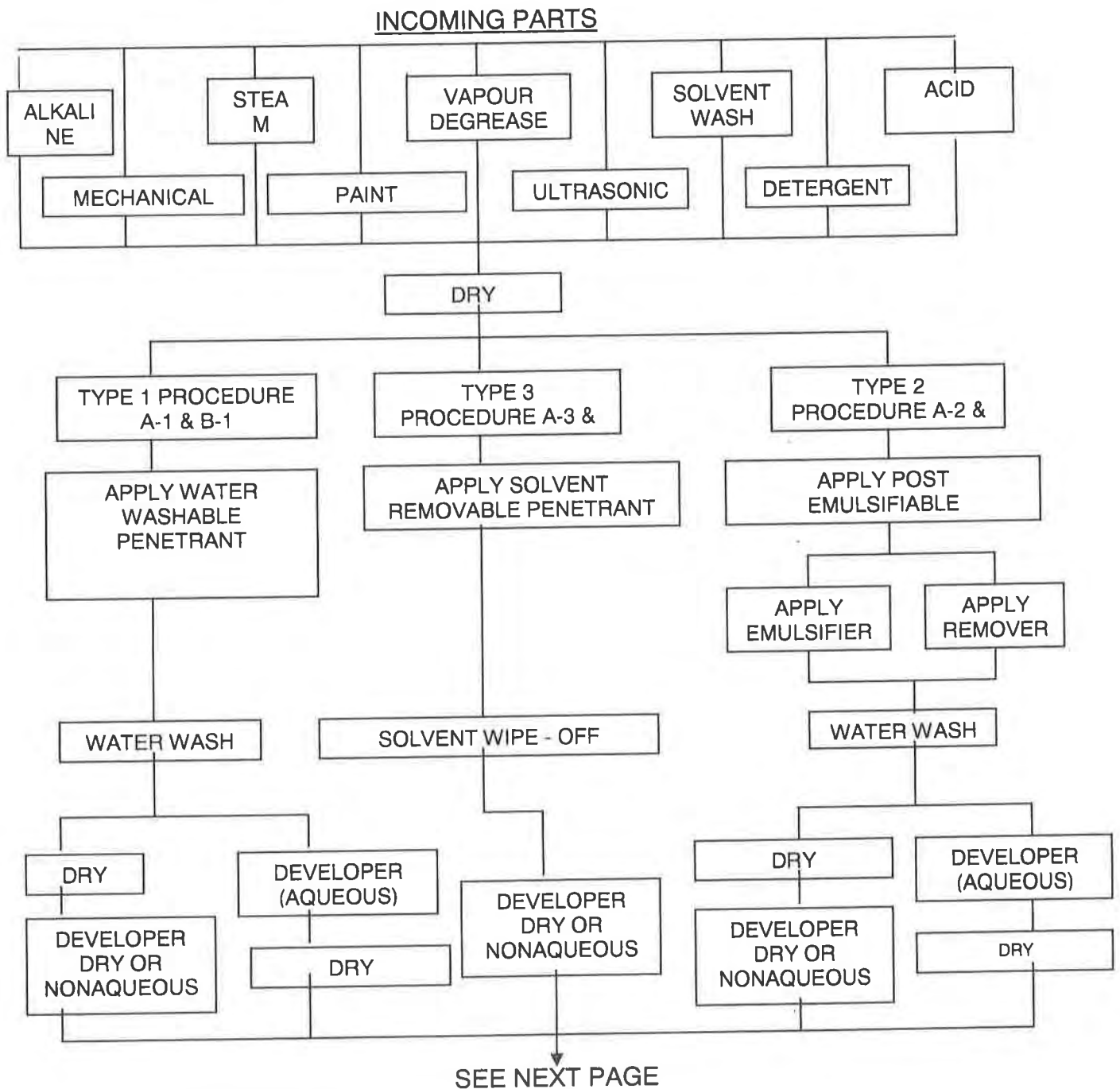
TABLE 2; RECOMMENDED DWELL TIMES

Material	Form	Type of Discontinuity	Dwell Times (in mins)	
			Penetrant	Developer
Aluminum, magnesium, steel, brass and bronze, titanium and high-temp alloys	Cast – castings and welds	Cold shuts, porosity, lack of fusion, cracks	5	10
	Wrought – plate, extrusions forgings	Laps, cracks etc	10	10
Carbide – tipped tools		Lack of fusion, porosity, cracks	5	10

SPECTRUM

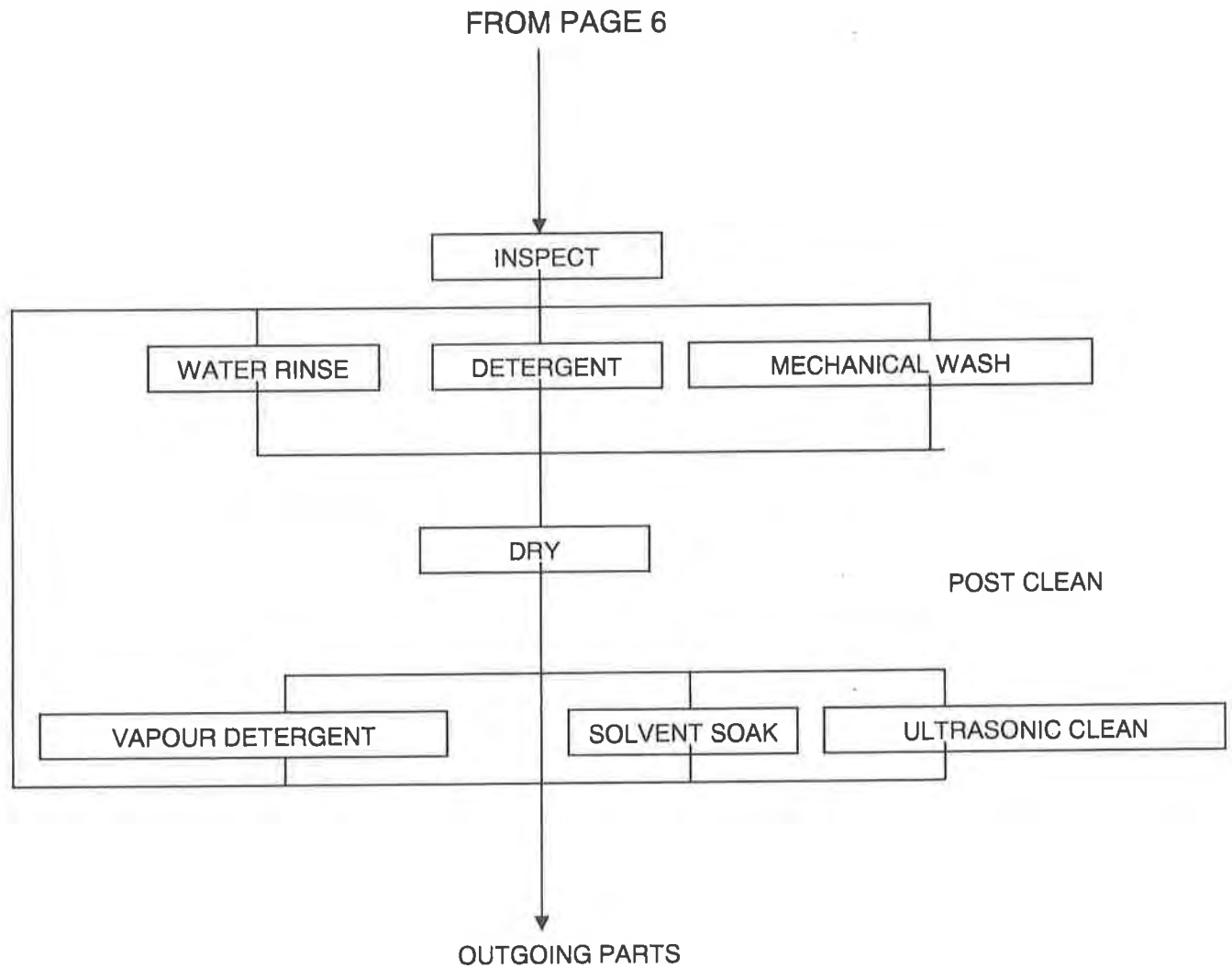
Liquid Penetrant Examination General Requirements
 Basic Reference to Current Mandatory Edition of ASME V
 Document L.P.2. Rev 2

TABLE 3: PROCESSING FLOW CHART



SPECTRUM

Liquid Penetrant Examination General Requirements
Basic Reference to Current Mandatory Edition of ASME V
Document L.P.2. Rev 2





SPECTRUM

Liquid Penetrant Examination General Requirements
 Basic Reference to Current Mandatory Edition of ASME V
 Document L.P.2. Rev 2

21 Performance Demonstrations

Element	Demonstration #	
	1009	1010
Type	Visible	visible
Surface prep	Para 3	Para 3
Light Intensity	Para 13	Para 13
Temp range	50-122 F	50-122 F
Consumables/part		
Recorded Ambient temp	Certified thermometer	Certified thermometer
Penetrant	Water washable SKL-WP	Solvent removable SKL-SP
Cleaner	Water spray	SKC-S
Developer	SKD-S2	SKD-S2
Test Piece S/N	UT2245 Castings/welds	UT2249 Wrought – plate, extrusions forgings
ABSA representative- Witness of demonstration	B. Ionel	B. Ionel
REPORT #	14466	14467

PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards 	10/18/2007	REV 2 01/20/2008	NO
ASNT-NDT-III 148347	DATE		
Kundae Han 	12/20/2012		

*****END OF DOCUMENT*****



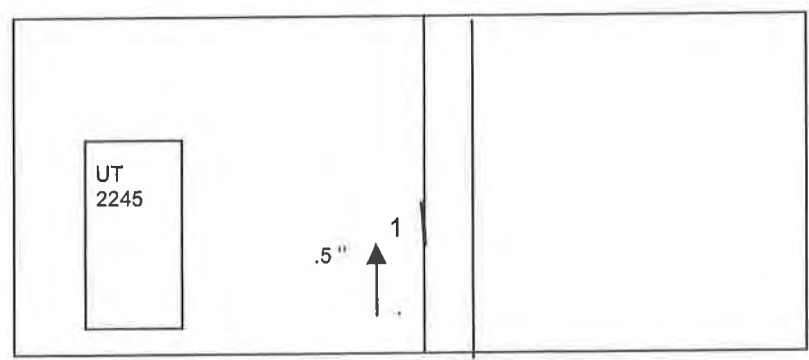
SPECTRUM N.D.T. LTD

LIQUID PENETRANT REPORT

Client SPECTRUM DEMO		Job # UT 2245	Report # 14466
Address CALGARY; ALBERTA		P/O #	Work Sheet #
Requested by NA		Demo # 1009	Procedure # LP 2 REV1
Work Description INSPECTION OF SINGLE VEE PLATE WELD SPECIMEN # UT - 2245		Code ASME V ART 6	Acceptance Criteria ASME V III DIV 1 APP 8
Penetrant Type MAGNAFLUX SKL-WP	Penetrant Batch # 04B10K 01219	Removal WATER SPRAY	Developer MAGNAFLUX SKD-S2
Surface GOOD	Material CARBON STEEL	Light Source 500 WATT HALOGEN LAMP	
Dwell Time 5 min	Dev Time 10 min	Surface Temperature 25 deg C	Black Light Intensity NA
		Inspector M. EDWARDS	

OD SURFACE INSPECTED

Ind No	Position	Length	Remarks
1	TOE	5/16"	CRACK, REJECTED



CLIENT	INSPECTOR 	LEVEL SNT III	DATE 07/07/2005
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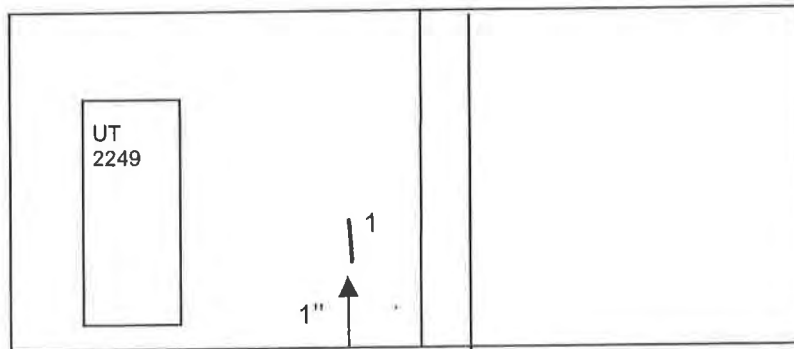
SPECTRUM N.D.T. LTD

LIQUID PENETRANT REPORT

Client SPECTRUM DEMO		Job # UT 2249	Report # 14467
Address CALGARY; ALBERTA		P/O #	Work Sheet #
Requested by NA		Demo # 1010	Procedure # LP 2 REV1
Work Description INSPECTION OF SINGLE VEE PLATE WELD SPECIMEN # UT - 2249		Code ASME V ART 6	Acceptance Criteria ASME V III DIV 1 APP 8
Penetrant Type MAGNAFLUX SKL-SP	Penetrant Batch # 97502K 03158	Removal SKC-CS	Developer MAGNAFLUX SKD-S2
Developer Batch # 04B08K 01963	Surface GOOD	Material CARBON STEEL	Light Source 500 WATT HALOGEN LAMP
Dwell Time 10 min	Dev Time 10 min	Surface Temperature 25 deg C	Black Light Intensity NA
		Inspector M. EDWARDS	

OD SURFACE INSPECTED

Ind No	Position	Length	Remarks
1	BASE METAL	1/2"	CRACK, REJECTED



CLIENT	INSPECTOR 	LEVEL SNT III	DATE 07/07/2005
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SPECTRUM

Positive material identification of elements and alloys using X-ray fluorescence analyzer.

Procedure #. P.M.I. 1 Rev 1

1. Scope

This PMI procedure shall be used when clients of Spectrum NDT request positive material identification of metals. It shall be performed in accordance with the client's specifications.

2. Safety

Radiation Safety guidelines are to be strictly adhered to (Health Canada spec #1114-4-11 responsibility for using an analytical device).

3. Personnel Requirements

Minimum certified level 1 CGSB radiographer or NRCAN certified operator or equivalent ticket for analytical devices.

4. Equipment

The Innovex-X alloy analyzer. This analyzer is a portable instrument designed for onsite material verification and accurate elemental analysis.

It is the purpose of this procedure to give a material identification of metallic material within the specific capabilities of this equipment, and give the alloy composition of a material as required and requested by the technician in accordance with the customers specifications. This equipment does not provide the capability to perform carbon content measurements.

5. Items to be examined

Before commencing the test the following information is required:

- a) Product form: plate, pipe, forging, casting etc.
- b) Material: type, length, diameter, heat treatment, surface condition etc.
- c) Extent of examination.
- d) Customer requirements as to the location and quantities of tests, as well as the acceptable alloy composition ranges for the materials being tested.
- e) Other specified referencing codes that may jointly apply to the inspection.

SPECTRUM

Positive material identification of elements and alloys using X-ray fluorescence analyzer.

Procedure #. P.M.I. 1 Rev 1

6. Surface Preparation

Test surfaces shall be prepared in a manner that ensures proper and accurate data is collected. The surface may be buffed with non-metallic abrasives such as sanding discs or sandpaper to get a clean uncontaminated surface.

7. Calibration

The standardization and calibration shall be performed at the start and conclusion of the examination. In addition checks shall also be performed if power source is changed is turned off at any time during the inspection process. The standardization is performed using the certified and serialized calibration block provided with the instrument. This block is traceable to national standards.

8. Operation

After turning the instrument on wait for a series of system self checks to be completed. The instrument will indicate on the color TFT display that it is ready for measurement. The preset calibration shall be checked at this point using the block (as described in Para 7) by placing over the aperture and activating the instrument holding trigger in the on position until the display indicates test complete with the accurate identification and analysis of the calibration standard. If errors are logged by the display TFT at any time or equipment is not performing correctly, as per the manufacturer's specifications, the equipment is to be taken out of service until such time as any required repairs may be performed.

After calibration and test specimen has been suitably prepared, the testing can commence. The probe is placed on the area prepared for testing and then activated. When the unit displays the findings they are recorded in accordance with client's specifications and as outlined in the reporting criteria of this procedure. If a positive ID is displayed the technician may proceed to the next test location. Each element will display a value in percent and an alloy type.

9. Evaluation and Acceptance Standards

The customer will supply requirements as to the location and quantities of tests, as well as the acceptable alloy composition ranges for the materials being tested.

10. Reporting

SPECTRUM

Positive material identification of elements and alloys using X-ray fluorescence analyzer.

Procedure #. P.M.I. 1 Rev 1

All test results will be recorded onto an official report in a manner that will allow an accurate record of test results and locations of all tests performed. The examination report shall contain the following information.

- . Customer name and address
- . Customer job number
- . Procedure specification and revision number
- . Information for complete documentation and tractability
- . Acceptance/rejection criteria
- . Code and/or customers specification
- . Equipment, type/model/serial number
- . Personnel name and qualification level
- . Calibration blocks and standards
- . Component Identification
- . Inspection results (specific element compositions)
- . Date and time of test
- . Other special equipment used during the inspection

All reports to be submitted to the client

SPECTRUM

Hardness Testing Technique Using the Portable Telebrineller. Procedure # H.P.1. Rev 1

1. Before commencing test the following information is required:
 - i) Material to be inspected
 - ii) Specifications or special instructions.
For FMC work the minimum requirements of Q03009 where applicable shall apply.

2. Test surfaces will be free from grease/dirt etc. and shall be made as smooth as possible, usually minimal grinding is undertaken to give a flat spot.

3. Making a test:

Insert standard bar in holder with the spacing button in the extreme forward position. After the first impression has been made, place spacing button one notch toward rear so that the next impression will be properly spaced. Continue this procedure for succeeding impressions until one-half of one side of bar is covered with spaced impressions.

Then remove and reverse the bar, first moving the spacing button again to the extreme front position. To avoid double impressions, it is good practice to move the spacing button just before an impression is to be made.

Having made an impression, its diameter may be read with the microscope. Also now read diameter of impression in material (specimen).

4. Making the impressions:

The impressions should be made with a hammer weighing not less than 3lbs. The blow should be made squarely upon the anvil nut; otherwise an unsatisfactory oblong impression will result. The force of the blow is not a critical factor, but it is advisable that it be regulated so that the diameter of the impression will be between 3.0 and 4.0mm, except when using bars of over 450 BHN when a smaller impression will be satisfactory.

It may happen that the hammer will return from rebound and strike the anvil a second time, thus superimposing a small "ghost" impression over the original one. This may be prevented by pulling the hammer away on the rebound.

5. Reading the impressions:

SPECTRUM

Hardness Testing Technique Using the Portable Telebrineller. Procedure # H.P.1. Rev 1

In reading the impressions, the microscope should be placed over it so that the center of the scale is approximately at the center. The nearest numbered line of the scale should then be brought into coincidence with one edge and the reading at the opposite edge of the impression should be noted.

It is best to position the scale so that the scale markings are crosswise to the file or grinder marks upon the surface.

6. Determining Hardness:

Having made the impressions in the bar and in the specimen under test and having measured the diameters of these impressions:

Call D_B the diameter of impression in bar.

D_S the diameter of impression in specimen.

BHN Brinell hardness number.

H the BHN stamped on bar

Then BHN (of specimen) = $H (D_B \div D_S)^2$

Example:

Let $D_B = 3.05$

$D_S = 3.15$

H = 350

Then BHN = $350 (30.5 \div 31.5)^2 = 328$

The calculation may be conveniently and quickly made with the telebrineller computer.

7. Report: The following information shall be contained in the report: (Form HTR 1)

- i) Procedure and/or specifications
- ii) Equipment
- iii) Personnel identity and qualification
- iv) Test material identification
- v) Test location (component/weld identification)
- vi) Inspection date
- vii) BHN of test bar
- viii) Rejection level

Exhibit of form HTR1 in section 8.

SPECTRUM

Hardness Testing Technique Using the Microdur MIC 10 hardness tester on low alloy and non-alloyed steels.

Procedure #. H.P.2. Rev 2 - With Addendum for high alloy materials.

1. Before commencing test the following information is required:
 - i) Material to be inspected
 - ii) Specifications or special instructions
 - iii) Evaluation limits

2. The operator shall be qualified to HT 1 level as outlined in Spectrum Manual NDTP1.

3. Test surfaces will be free from grease/dirt etc. and shall be made as smooth as possible, usually minimal grinding is undertaken to give a flat spot.

4. Operation.
 - i) After turning on the MIC 10 wait for the system self-checks to be completed. The instrument gives a short signal tone indicating that it is ready for measurement.

 - ii) The preset instrument calibration shall be checked at the beginning and end of an inspection using test blocks of known hardness and similar hardness to the material to be inspected.

 - iii) Select measurement reading display single or average.

 - iv) Select hardness scale

 - v) Position probe tip vertically onto the surface of the test material. Pay attention to correct probe handling. The probe symbol on the display will indicate that correct contact has been made. The measurement must be carried out within 3 seconds after the probe has made contact with test material or an error message will appear on the display and test will have to be restarted.

 - vi) Press the probe down to its limit for about 1 second. An acoustic signal indicates the end of the measurement and the measured value is displayed.

SPECTRUM

Hardness Testing Technique Using the Microdur MIC 10 hardness tester on low alloy and non-alloyed steels.

Procedure #. H.P.2. Rev 2 - With Addendum for high alloy materials.

vii) Position the probe to another point on the test material and carry out a further measurement.

5. Report: The following information shall be contained in the report: (Form HTR 1)

- i) Procedure and/or specifications
- ii) Equipment
- iii) Personnel identity and qualification
- iv) Test material identification
- v) Test location (component/weld identification)
- vi) Inspection date
- vii) Hardness of test bar
- viii) Rejection level

Exhibit of form HTR1 in App C

6. Note:

The MIC 10 is a multifunctional instrument. Operator shall consult handbook to access special functions such as;

- set averaging
- storing measurements in data logger
- measuring other materials
- alarm thresholds.

Addendum for high alloy materials.

This addendum is to accommodate the testing of high alloy materials such as High Nickel or Chrome.



Using the hardness testing technique as described in H.P. 2 Rev 1 the Microdur MIC 10 hardness tester shall be the only instrument used to inspect high nickel alloy because of its capability to be accurately calibrated to known to hardness reference blocks. A high nickel alloy test block of similar hardness shall be used to calibrate the unit before the inspection and checked after inspection is completed.

All other requirements of HP2 shall be strictly adhered to.

SPECTRUM

Hardness Testing Technique Using the Microdur MIC 10 hardness tester on low alloy and non-alloyed steels.

Procedure #. H.P.2. Rev 2 - With Addendum for high alloy materials.

PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards 	10/18/2007	REV1 08/18/2008 REV2 12/08/2010	NO NO
ASNT-NDT-III 148347	DATE		
Kundae Han 	12/20/2012		

*****END OF DOCUMENT*****

SPECTRUM

ULTRASONIC WELD INSPECTION USING PHASED ARRAY COMPUTERIZED IMAGING TECHNOLOGY PROCEDURE MET 100 REV 8

1 General

This procedure covers the 100% Ultrasonic Inspection of carbon steel pressure vessel welds using automatic computer enhanced data acquisition in accordance with **ASME Code Case 2235-9 Oct 11, 2005**

The following elements are supplementary to the minimum requirements established in Spectrum Procedure UP 4 Rev 0.

2 Scope

Joints to be inspected are welds over .5 of an inch thickness in pressure vessels and power boilers after the weld has cooled to room temperature. The examination will be used to detect any defects oriented parallel to the fusion line related to the fabrication process.

3 Technique

The signal processing technique utilizes RF waveforms from Phased Arrays to create A-B and C scan representations, at a **bandwidth range** of 0.25 -20 mHz.

4 Personnel Qualification

Personnel performing and evaluating UT examinations shall be qualified and certified in accordance with MET Procedures Manual NDT.P1. Only level 2 or 3 personnel shall analyze the data or interpret the results. Personnel who acquire and analyze UT data shall be trained using the equipment described in paragraph 6 below and participate in the demonstration of procedure described in paragraph 15.

5 Safety Requirements

All personnel shall work safely and adhere to the policies in place at the customers work site with respect to the safe handling of weldments, protective equipment and reporting accidents.

SPECTRUM

ULTRASONIC WELD INSPECTION USING PHASED ARRAY COMPUTERIZED IMAGING TECHNOLOGY PROCEDURE MET 100 REV 8

6 Equipment

- (i) Intraspect Laptop System Version 6.10
- (ii) Intraspect 5080 Scanner System
- (iii) Intraspect 4040 Field Mouse Manual encoder scanner
- (iv) Search units may be of single or dual element type. The nominal frequency shall be from 1 MHz to 5 MHz and shall be rectangular or circular in shape with a maximum element dimension of 1". Straight beam search units shall be normal incident longitudinal wave propagation. Angle beam search units shall be selected for a single angle or, for phased array, to sweep within a range of 35 to 70 degrees and propagate shear waves within the material, whichever beam angle or combination of beam angles pass through weld and interfaces most perpendicularly.

7 Calibration Blocks

IIW Calibration Block -A1 Block

Primary reference reflector block(s) as described in ASME V 2004 edition Fig 1 UP 4 Rev 0.

A qualification block as described in ASME Boiler and Pressure Vessel Code Case 2235-9 table 1 or table 2.

8 Instrument Linearity Checks

Vertical and horizontal linearity checks shall be performed at intervals not exceeding 3 three months or prior to first use thereafter.

9 Couplant

Use Exosen water based couplant. Separate couplant containers and new brushes shall be used for stainless steel materials to avoid contamination. The requirements for contamination control are not more than 250 ppm of sulfur for nickel base alloys and not more than 250 ppm of halides for austenitic stainless steel or titanium.

SPECTRUM

ULTRASONIC WELD INSPECTION USING PHASED ARRAY COMPUTERIZED IMAGING TECHNOLOGY PROCEDURE MET 100 REV 8

10 Surface Conditions

The contact surface shall be free from any roughness or obstructions that would interfere with the free movement of the search unit/ automated scanning arm or impair the transmission of ultrasonic vibrations. Weld surfaces shall be finished so they cannot mask or be confused with reflections from defects and should merge smoothly into the surfaces of the adjacent base metal.

11 Extent Of Scanning

The scanning of the examination volume shall be conducted from both sides of the weld on the same surface where feasible. Scanning shall be conducted at right angles and skewed for transverse indications to the weld axis wherever feasible. Areas where this is not feasible shall be documented in the examination report. A transverse scan may be employed manually in accordance with Spectrum procedure UP 4. The examination area shall include the volume of the weld plus the lesser of 1 inch or t on each side of the weld.

12 Scan Plans

A **scan plan** shall be calculated for the inspection and shall include beam angles and directions. **Maximum scan speed** shall be established so that the search unit can be pulsed 6 times within the time necessary to move the search unit one half of the transducer dimension parallel to the weld axis direction.

13 Calibrations For Straight Beam Examination

Adjust the horizontal sweep for distance calibration to present the equivalent of at least two-plate thickness on screen. Adjust sensitivity at a location free from indications so that the first back reflection from the far side of plate will be 50% to 75% of full screen height. For this purpose the reject shall be turned off. This is the primary reference response.

14 Calibrations For Phased Array Examination

Range to be calibrated using IIW block after establishing full material path from the scan plan.

SPECTRUM

ULTRASONIC WELD INSPECTION USING PHASED ARRAY COMPUTERIZED IMAGING TECHNOLOGY PROCEDURE MET 100 REV 8

Reference sensitivity shall be established by an 80% FSH response and distance amplitude correction from the relevant reflectors in the primary reference reflector block. See UP 4

Acceptable performance at reference sensitivity shall be proven by the response from the maximum allowable flaw in the qualification block as described in code case 2235-9.

Scanning sensitivity shall be set at twice the reference sensitivity.

15 Calibration Frequency

Calibrations shall be made by the operator just prior to and at the location of examination of each weld and at intervals no greater than 30 minutes as examination proceeds. Calibration checks shall be done each time there is a change of personnel, operation, when transducers are changed, when new batteries are installed, when equipment is operating from a 115-V source or connected to a different power outlet and also at end of weld examination.

16 Detection And Sizing Techniques

For angle beam flaw sizing the dimension of the flaw shall be determined by the size of a rectangle that fully contains the size of the flaw as described in code case 2235-9.

17 Flaw Discriminations (Acceptance Level)

The operator shall determine relevance of indications in accordance with the data analysis criteria in paragraph (i) of code case 2235-9. When reflectors are determined to be flaws table 1 or 2 for acceptance criteria shall apply.

18 Datum

A datum point shall be stamped at the start point of the weld to be inspected.

19 Recording Criteria

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ULTRASONIC WELD INSPECTION USING PHASED ARRAY COMPUTERIZED IMAGING TECHNOLOGY PROCEDURE MET 100 REV 8

Reflectors greater than 20% of the reference level shall be subject to investigation. Any reflector interpreted as a flaw shall be investigated regardless of amplitude.

20 Demonstration Of Procedure

A demonstration shall be performed to detect real flaws in a welded test piece of similar material, thickness and geometry to intended items to be inspected.

The calibration for demonstration shall be as follows:

Reference and scanning sensitivity shall be established using the Primary reference block. Acceptable performance shall be defined as the response from the maximum allowable flaw detected at the reference level. This shall be done using the qualification block as described in code case 2235-9 which shall include at least three planar flaws (ID surface, OD surface and one subsurface) parallel to intended fusion line. The block may be flipped so that one flaw may represent both the ID and OD surfaces.

21 Data To Be Recorded

The minimum sampling rate (analog to digital conversion) shall be a minimum of four times the center frequency of the transducer being used. Data shall be recorded in unprocessed form. A complete data set with no gating, filtering or thresholding for response from examination volume shall be included in the data record. Results shall be presented in C Scan form for review by customer and/or customers authorized representative. A Scan and B Scan data are primarily interpretation tools for use by qualified operators.

22 Reports

The final report shall contain as a minimum the following information:

- Procedure identification and revision
- Equipment model and serial number
- Computer program identification and revision
- Simulation block and electronic simulator identification when used
- Search Units Frequency, size, angle, type and serial number
- Couplant brand or type
- Personnel identity and qualification
- Calibration block and Qualification block identity

SPECTRUM

ULTRASONIC WELD INSPECTION USING PHASED ARRAY COMPUTERIZED IMAGING TECHNOLOGY PROCEDURE MET 100 REV 8

Calibration data (reference level and damping/reject settings if used)
Demonstration number
Part identification
Scan Plan
Scanning surfaces
Areas of restricted access or inaccessible welds
Identification and location of weld volume scanned
Surface condition
C – Scan and relevant A/B Scans
Special equipment
Indications, rejectable or recordable
Date and time of test
Inspector's signature
Acceptance rejection criteria

The report shall be filed and maintained in accordance with the referencing codes section.

23 Final Data Package

The final data package shall be reviewed by a UT level 3 and shall include the ultrasonic data record, data interpretations and flaw evaluations/characterizations performed by another qualified individual.

24 Performance Demonstrations



Element	Demonstration #		
	1021		
Type	Butt Weld		
Test Piece S/N	UT2250		
Temp differential (25 F max)	0		
ABSA representative- Witness of demonstration	B. Ionel		
REPORT #	8166		

SPECTRUM

ULTRASONIC WELD INSPECTION USING PHASED ARRAY COMPUTERIZED
IMAGING TECHNOLOGY
PROCEDURE MET 100 REV 8

25 Code Case Supplement Review

No re-demonstration of procedure is required as a result reviewing all essential variables contained within 2235-9.

PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards 	10/18/2007	REV8 04/12/2010	NO
ASNT-NDT-III 186344	DATE		
Scot Beavan 	11/26/2010		

*****END OF DOCUMENT*****

Sc in UT-2250

H = .100"

35-7A

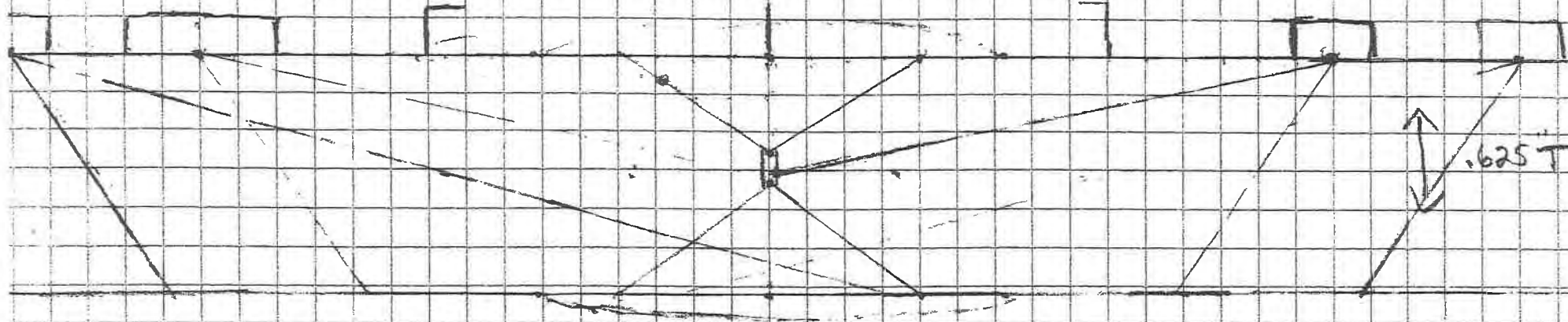
B-WC

+ 1/2" Back from W.C.

+ WC

- 1/2" Back WC

- 2"





SPECTRUM N.D.T. LTD

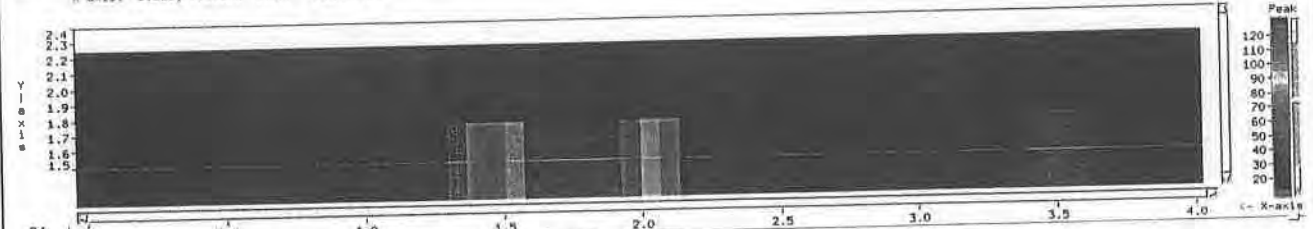
ULTRASONIC TEST REPORT

Client SPECTRUM DEMO	Report No 8166	Job No F/T DEMO BLOCK	Weld Identification BLOCK UT#2250 4" SCAN	
Code ASME V/VIII DIV 1 & 2 CODE CASE 2235-6	Procedure No MET 100 Rv6	Demo No 1021	Calibration Std IIW BLOCK	Cal Block CAL B1
Instrument model & S/N INTRASPECT LAPTOP V-6.10.1 & 5080 SCANNER W/PHASED ARRAY. S/N DAS - P/N SS-1007 S/N 129, BANDWIDTH (.25-20 MHZ) W/ RF WAVEFORM				
Search Unit & S/ Ns PA 5.0 MHZ S/N 00P17C 35-72 DEG	Material CAR BON STEEL	Thickness .625 INCHES	Surface GOOD	Couplant EXOSEN/23003401
				Qual Block QUA B1
				Scan Plan SP 1

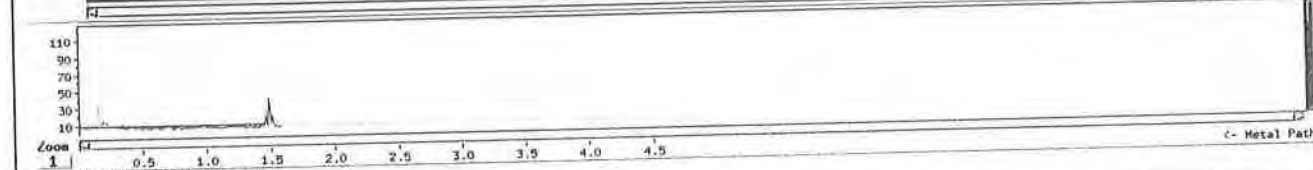
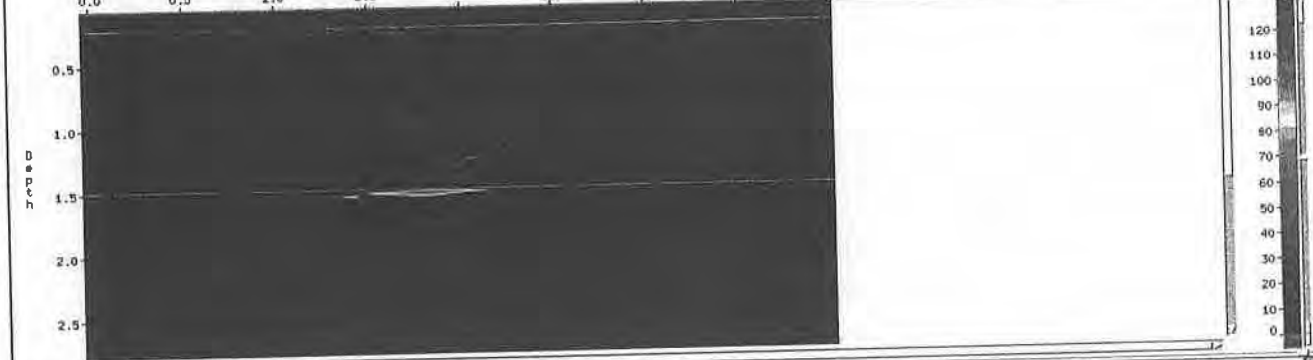
UT Scan image

File Channel Gate C-Scan B-Scan A-Scan Tools Display Settings Help

File: dem_block Exam Date: 07/07/2005 Time: 09:23 - 09:23 WP: N/A MT:0.
 Channel: 1 Gate: SW 1 Mode: Max Video Mode: Full Video Filter: 5
 Gain: 69.0 dB Dac: 00 Offset: 0.0 dB Pulser Voltage: 250
 X-axis: 1.330, Y-axis: 1.500 Peak: 41 X



Zoom 16:1 X-axis: 1.330 Y-axis: 1.500 D10F: 22,300 us Meas: HA C
 SX-axis: 1.330 SY-axis: 0.403 Soft Gain: 0.0
 AMP: 7X TOF: 39.950 us TOF2: 13.650 us WP: 1.488 in Dpth: 0.163 Thickness: 26.06% @ 2/2 V



Ind loc	Type	a/t	L	a/L	Comments	Classification
1.33-2.24"	SUBSURFACE		.910"		.300" DEEP	REJECTABLE
3.29-3.78"	SURFACE		.490"		.100" DEEP	REJECTABLE

INSPECTION CONDUCTED FROM THE LABELED SURFACE. TRANSVERSE, LAMINATION SCAN COMPLETED MANUALLY.

ACCEPTABLE		REJECTABLE	
Inspector Name CLINT MAGDEE	Level SNT LEVEL 2	Data Reviewed By MARK EDWARDS	Level SNT LEVEL 3
Signature <i>[Signature]</i>	Date 07/07/05	Signature <i>[Signature]</i>	Date 07/07/05
		Client Signature	
		Date	

SPECTRUM

ULTRASONIC WELD INSPECTION USING OMNISCAN PHASED ARRAY ULTRASONIC TECHNIQUE # MET 300 REV 10

1 General

Technique is for the requirements of direct contact of pulse echo ultra sonic weld inspection. Due to the specific nature of the Omniscan instrument this procedure is exclusive to the Omniscan.

2 Scope

To define the requirements of pulse echo ultra sonic inspection of welds using Omniscan phased array equipment for code inspection.

3 Techniques

Automated/semi automated or manual Phased array Ultrasonic weld inspection for vessel welds 12.7mm thickness and up covered by ASME V 2010 Edition and 2011 Addenda CC-2235-9 in plate or pipe material.

Automated/semi automated or manual Phased array Ultra sonic weld inspection for pipe welds covered by ASME V 2010 Edition and 2011 Addenda B31-CC181 in plate or pipe material.

4 Personnel Qualification

Personnel performing and evaluating UT examinations shall be qualified and certified following the guide lines of SNT-TC-1A and Spectrum Procedures Manual NDT.P1.

Only level II or III personnel shall analyze the data or interpret the results. Personnel who acquire and analyze UT data shall be trained and qualified using the equipment described in paragraph 6 below and participates in the demonstration of procedure described in paragraph 15.

Level I personal may perform limited duties under the direction of a certified level II or level III operator.

Each operator may be required to demonstrate their abilities to perform the techniques to these and or customer procedures. Only those assessed as capable shall be employed to examine welds.

SPECTRUM

ULTRASONIC WELD INSPECTION USING OMNISCAN PHASED ARRAY ULTRASONIC TECHNIQUE # MET 300 REV 10

5 Safety Requirements

All personnel shall work safely and adhere to Spectrum safety program and the policies in place at the customers work site with respect to the safe handling of weldments, equipment and protective equipment and reporting accidents.

6 Equipment

This procedure is for the exclusive use of the Omni scan phased array ultrasonic unit only, and the use of a scanner, mini encoder, probes, wedges, holders and Tomoview acquisition/analysis software.

Search units will be of phased arrays using linear and or sectoral scans using shear waves in the material between 40 degrees and 70 degrees. The nominal frequency shall be from 2 MHz to 10 MHz and shall be linear (azimuthal).

Transducers may be rectangular or square in shape. Phased array transducers shall have an element width of 6mm to 15mm.

Wedges shall be machined to contour surfaces under 20 inches in diameter.

When required the use of special search units, wedges, shoes or saddles may be incorporated.

7 Calibration Blocks

IIW Calibration Block –Block type II

Primary reference reflector block(s) as described in ASME V 2010 Edition And 2011 Addenda Fig 1 UP 4 Rev 0.

A qualification block as described in ASME Boiler and Pressure Vessel Code Case 2235-9, table 1 or 2. And/or ASME B31 Code Case 181, table 1 or 2

Standard thickness calibration block. (step wedge)

8 Performance Checks

Instrument vertical and horizontal linearity checks shall be performed at intervals not Exceeding 3 three months or prior to first use thereafter.

Transducers shall be tested for dead elements at a minimum of every month or when deemed appropriate.

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ULTRASONIC WELD INSPECTION USING OMNISCAN PHASED ARRAY ULTRASONIC TECHNIQUE # MET 300 REV 10

9 Couplant

Use Exosen/UT-X water based couplant.

10 Surface Conditions

The contact surface shall be free from any roughness or obstructions that would interfere with the free movement of the search unit/scanner or impair the transmission of ultrasonic vibrations. Weld surfaces shall be finished so they cannot mask or be confused with reflections from defects and should merge smoothly into the surfaces of the adjacent base metal.

11 Extent of Scanning

The scanning of the examination volume shall be conducted from both sides of the weld on the same surface when accessible. Scanning shall be conducted perpendicular to the weld axis. Areas where this is not feasible shall be documented in the examination report. The examination area shall include the volume of the weld plus the lesser of 1 inch or t on each side of the weld to include the heat affected zone.

Inspection shall be carried out from the outside surface. Inspection may be performed from the inside surface when the outside surface is obstructed and the inspection can only be completed from the inside surface. A raster scan and transverse scan will be employed manually in accordance with Spectrum procedure UP 4.

12 Scan Plans

A computer generated scan plan using ES beam tool shall be calculated for the inspection and submitted along with reports.

13 Calibrations For Straight Beam Examination

Adjust the horizontal sweep for distance calibration to present the equivalent of at least two-plate thickness on screen. Adjust sensitivity at a location free from indications so that the first back reflection from the far side of plate will be 50% to 75% of full screen height. For this purpose the reject shall be turned off. This is the primary reference response.

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ULTRASONIC WELD INSPECTION USING OMNISCAN PHASED ARRAY ULTRASONIC TECHNIQUE # MET 300 REV 10

14 Calibrations For Phased Array Examination

Range to be calibrated using IIW block after establishing full material path from the scan plan. An appropriate range shall be selected for the inspection.

Reference sensitivity shall be established by an 80% FSH response from the relevant reflectors in the primary reference reflector block. See UP 4

Acceptable performance at reference sensitivity shall be proven by the response from the maximum allowable flaw in the qualification block as described in the referencing code cases.

TCG/DAC. Time corrected gain shall be used and verified.

Scanning sensitivity shall be set at twice the reference sensitivity (+6dB).

Temperature control shall be within +/- 10 deg. C between the test piece and the examination surface.

Operating temperature of equipment shall be maintained to manufacture recommended practice.

Encoding of data shall be used for recording and storage. Encoders shall be calibrated at a minimum of once per day.

Records of calibration shall be encoded and stored. Instrument settings and transducer information shall be recorded.

15 Calibration Frequency

Calibrations shall be made by the operator just prior to and at the location of examination of each weld. Calibration checks shall be done each time there is a change of personnel, operation, when transducers are changed, when new batteries are installed, when equipment is operating from a 115-V source or connected to a different power outlet and also at end of weld examination.

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ULTRASONIC WELD INSPECTION USING OMNISCAN PHASED ARRAY ULTRASONIC TECHNIQUE # MET 300 REV 10

16 Detection And Sizing Techniques

Relevant indications greater than 20% of the reference level shall be subject to investigation. The length shall be determined using the 6 dB drop method. Any reflector interpreted as a flaw shall be investigated regardless of amplitude.

17 Flaw Discriminations (Acceptance Level)

Indications as the result of geometry such as weld to base metal interface, root or cap shall be classified as geometrical reflectors and are not classified as indications therefore not compared to indication standards.

All root indication shall be examined regardless of classification to geometrical reflector.

18 Datum

A datum point shall be marked at the start point of the weld to be inspected.

19 Recording Criteria

Relevant indications of -6dB reference shall be recorded on the inspection report. Rejectable indication shall be recorded on the report and the location plotted on the test surface indicating position length and dimensions.

20 Demonstration of Procedure

A demonstration shall be performed to detect real flaws in a welded test piece of similar material, thickness and geometry to intended items to be inspected.

The calibration for demonstration shall be as follows:

Reference and scanning sensitivity shall be established using the Primary reference block. Acceptable performance shall be defined as the response from the maximum allowable flaw detected at the reference level. This shall be done using the qualification block as described in referencing ASME code case which shall include at least three planar flaws (ID surface, OD surface and one subsurface) parallel to intended fusion line. The block may be flipped so that one flaw may represent both the ID and OD surfaces.

SPECTRUM

ULTRASONIC WELD INSPECTION USING OMNISCAN PHASED ARRAY ULTRASONIC TECHNIQUE # MET 300 REV 10

21 Data To Be Recorded

Data shall be recorded in unprocessed form. A complete data set with no gating, filtering or thresholding for response from examination volume shall be included in the data record. Results shall be presented in C Scan form for review by customer and/or customers authorized representative. A Scan, C Scan, S scan data are primarily interpretation tools for use by qualified operators.

22 Reports

The final report shall contain as a minimum the following information:

- Procedure identification and revision
- Equipment model and serial number
- Computer program identification and revision
- Simulation block and electronic simulator identification when used
- Search Units Frequency, size, angle, type and serial number
- Couplant brand or type
- Personnel identity and qualification
- Calibration block and Qualification block identity
- Calibration data (reference level and damping/reject settings if used)
- Demonstration number
- Part identification
- Scan Plan
- Scanning surfaces
- Areas of restricted access or inaccessible welds
- Identification and location of weld volume scanned
- Surface condition
- C – Scan and relevant A/B Scans
- Special equipment
- Indications, rejectable or recordable
- Date and time of test
- Inspector's signature
- Acceptance rejection criteria

The report shall be filed and maintained in accordance with the referencing codes section.

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ULTRASONIC WELD INSPECTION USING OMNISCAN PHASED ARRAY ULTRASONIC TECHNIQUE # MET 300 REV 10



23 Final Data Package

The final data package shall be reviewed by a UT level 3 and shall include the ultrasonic data record, scan plan, data interpretations and flaw evaluations/characterizations performed by another qualified individual.

24 Performance Demonstrations

Element	Demonstration # 14480		
Type	Vessel welds ASME CC2235-9	Piping welds ASME CC181	
Test Piece S/N	UT-098	UT-098	
Temp differential (25 F max)	0	0	
ABSA representative- Witness of demonstration	B. Ionel	B. Ionel	
REPORT #	64917	64917	

SEE AI WITNESS DEMO MET 300

PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards 	10/18/2007	REV8 11/06/2009 REV9 09/18/2010	NO NO
ASNT-NDT-III 148347	DATE		
Kundae Han 	11/20/2012		

*****END OF DOCUMENT*****

November 06, 2009

ABSA
 1212-31 Avenue N.E
 Calgary Alberta, Canada
 T2E 7S8

Attention: Mr. Blair Ionel (C.E.T, Authorized Inspector Supervisor, Safety Codes Officer)

DEMONSTRATION OF NON-DESTRUCTIVE EXAMINATION PROCEDURES

The following procedures were demonstrated in accordance with ASME Section V, 2007 Edition, 2008 Addenda.

- Article 1 General Requirements, Section T-150
- Article 4 Ultrasonic Examination for Welds, Section T-421 (Including Code Case 2235-9, and B31 Case 181).

Spectrum NDT demonstrated the following Non-Destructive Examination Procedures on November 06, 2009.


PROCEDURE	DESCRIPTION	METHOD	SPECIMEN	REPORT
MET 300 REV8	AUT Phased array	PA-UT	UT-098	64917

Spectrum NDT technicians that participated in the above procedures include:

Scot Beavan (Level II CGSB 6637/SNT-TC-1A, Level III ASNT 186344)

Spectrum NDT Representative: Mark Edwards  Date: Nov 6th 2009

Demonstrations Witnessed By:

AIS or AI _____ Date 9/11/11
 ABSA  (signature)



SPECTRUM N.D.T. LTD
ULTRASONIC TEST REPORT

Client ABSA DEMO		Job #	OMNISCAN		Report #	64917	
Address CALGARY; ALBERTA		Unit #	Requested by MR. B. IONEL		Work Sheet #	67617	
Work Description		OMNI SCAN DEMO			Demo #	14480	
Code		ASME V ART 4			Acceptance criteria	ASME VIII DIV. 1 CC2235-9 / B31 CC181 TABLE 1	
Material	CARBON STEEL	Surface	AS WELDED		Size	6" X SCH120	
Instrument	OMNI-MX	Serial #	OMNI-101102		Phased array Acquisition Module	OMNI-M-PA32128	
Scanner	N/A	Serial #	N/A		Encoder	ENC1-2.5-DE	
Calibration Block		3/32 INCH DIAMETER HOLE (OMNI. 3-32) TCG.			Calibration Std	IIW BLOCK TYPE 2 S/N 19642	
Acquisition software		Analysis / Storage software		Scan plan file	Couplant	Temperature	
OMNISCAN MXU VERSION 2.0		TOMOVEIW VERSION 2.7 R10		ABSA demo.ebwk	EXOSEN/WATER	20 degrees C	
Search unit (s)	Serial Number	Size (mm)		Frequency	Reference Sensitivity	Scanning sensitivity	
5L64-A2	G1152	38.4 x 10.0		5 MHZ	17.9 dB TCG	+6 dB	
Wedge (s)	Angle	Radius	Position		Index Offset	"Y" Splitter	
SA2-N55S-IHC DUAL	55 degree SW	FLAT	Reverse 2L64		18MM	N/A	
Weld Identification/Description			File name	Stamp	Remarks		
UT-098 (0 to 555mm)			UT-098 MERGE	N/A	SEE BELOW		
Indication	Location (mm)	(A) Height (mm)	(L) Length (mm)	a/t	a/L	Comments/Description	Accept/reject
1	125	1	5	0.0699	N/A	ROOT CRACK	REJECT
2	205	2	5	0.139	N/A	LACK OF FUSION	REJECT
3	381	1	5	0.0699	N/A	TOE CRACK	REJECT
Client Signature	Inspector Name	Level		Data Reviewed By		Level	
	S. BEAVAN	CGSB-CAN 48.9712 II 6637 ASNT-NDT-III 186344		S. BEAVAN		CGSB-CAN 48.9712 II 6637 ASNT-NDT-III 186344	
Date	Signature	Date	Signature		Date		
	<i>S. Beavan</i>	November 6, 2009	<i>S. Beavan</i>		November 6, 2009		

SPECTRUM

Ferrite Content Measurement using the Feritscope MP30E Procedure# F.T.1. Rev 0

1. Before commencing test the following information is required:
 - i) Material to be inspected
 - ii) Specifications or special instructions
 - iii) Evaluation limits
2. The operator shall be fully versed in the operation of the unit and method. Knowledge about configuration, operation and programming of the computer as well as of the software used, is necessary.
3. Calibration Standard set contains a base and 3 ferrite calibration standards (various ferrite ranges). These certified blocks are used at the start and end of inspections to verify equipment accuracy. The certified blocks are examined at each time of use visually and only if physical damage is apparent do the blocks need to be sent for away for re-certification.
4. Operation. (check operator's manual for details)
 - i) After turning on the MP30E perform the instrument start up.
 - ii) Determine the significant surface and reference areas.
 - iii) Make sure, that the reference area is not damaged and clean.
 - iv) Connect printer if necessary.
 - v) Select application that fits measuring object.
 - vi) Check normalization and calibration by reference measurement on an object with known ferrite content and if a correction factor needs to be taken into consideration.
 - vii) Check for other influencing factors that can be corrected with corresponding correction factors in the user's manual such as:
 - curvature of measuring object
 - thickness of measuring object
 - layer thickness

SPECTRUM

Ferrite Content Measurement using the Feritscope MP30E Procedure# F.T.1. Rev 0

distance of measuring position to the edge

viii) Place probe vertically on surface of measuring object within the reference area. After the accept appearing on the display lift probe 50 mm and the unit is ready to read again.

ix) press "enter"

x) If erroneous measurement is recognized immediately after the accept signal delete reading by pressing "delete".

5. Evaluation.

- i) The final result is displayed as the mean value and standard deviation.
- ii) The mean value can be assessed in relation to the customers acceptance and rejection criteria.

6. Report: The following information shall be contained in the report: (Form FTR 1)

- i) Procedure and/or specifications
- ii) Equipment
- iii) Personnel identity and qualification
- iv) Test material identification
- v) Test location (component/weld identification)
- vi) Inspection date
- vii) Rejection level

7. Note:

The MP30E is a multifunctional instrument. Operator shall consult handbook to access special functions.

Written by: M. Brennan	 SPECTRUM N.D.T. LTD	Number & Rev Level (Rev. Date) 001 0 (08/03/04)
Revised by:		Original Issue Date: August 3, 2004
Approved by:		Page 1 of 1
Title: Visual Examination Procedure		

1.0 SCOPE

This procedure may cover dimensional, mechanical, and visual inspection with the use of visual aids, etc., and a variety of components manufactured in accordance with the applicable code.

2.0 REFERENCES

- Construction drawings
- Customer specifications
- Referenced acceptance criteria
- Visual Examination Report (#001.1)

3.0 METHOD

- 3.0.1 An overall examination schedule and inspection plan should be plotted and followed to assure all areas are checked in a systematic manner to assure that production is maintained and the required examination are performed as required during all stages of manufacturing.
- 3.0.2 All areas that require examination must be cleaned and prepared in a manner that is suitable to assure that the required results can be adequately interpreted from the various tests and examinations performed. The area to be examined shall be illuminated to a minimum of 100 foot candles during the examination. If required, grinding or cleaners should be used to assure proper surface preparation for the required examinations.
- 3.0.3 If required by restricted access etc. special viewing apparatus such as mirrors, boroscopes or special RVT devices may be utilized.
- 3.0.4 Sequence of examinations should be noted on the examination report if it is applicable.
- 3.0.5 In all cases the examination shall be documented on a report. The report must give the required information for complete documentation and traceability, detailing the customer, item being inspected and results

4.0 EVALUATION OF TESTS

Evaluation will be as per the agreed acceptance criteria.

5.0 INSPECTION PERSONNEL

Personnel shall be certified visual inspectors as per Spectrum NDT written practice.

6.0 RECORDS

Records and reports generated by examinations in this procedure shall be considered as quality records that are retained in the project file and submitted to the customer as documentation of completion.



**GENERAL PROCEDURE FOR THE NONDESTRUCTIVE TESTING
OF DIELECTRIC MATERIAL VIA GROUND PENETRATING
RADAR**



Ground Penetrating Radar Inspection Procedure # G.P.R.1

1.0 GENERAL

This procedure establishes general requirements to be utilized in the nondestructive testing of dielectric materials (i.e. concrete, soil, roadways, etc.) using Ground Penetrating Radar, for the purposes of locating buried utilities, soil conditions, or applications as specified by the client. It is intended for use as a Quality Assurance / Quality Control tool during the testing of said components in a field setting.

2.0 PERSONNEL QUALIFICATIONS

2.1 Level III Personnel

Level III Personnel may write and approve NDT procedures, provide training and supervision to Level I and II personnel, and perform all Level I, II, and III steps or tasks outlined in this procedure

2.2 Level II Personnel

Level II personnel may provide training and supervision to Level I personnel, and perform any Level I and II steps or tasks outlined in this procedure.

2.3 Level I Personnel

Level I Personnel may perform Level I steps in this procedure, and may perform Level II steps under instruction and direct supervision of a Level II or Level III qualified person. Level I may not independently perform examinations and evaluate data.

3.0 SAFETY REQUIREMENTS

All personnel shall work safely and adhere to the Spectrum NDT safety program, as well as the policies in place at the work site with respect to the safe handling of materials and equipment, as well as the appropriate use of Personal Protective Equipment and the reporting of incidents.

4.0 PROCEDURE DESCRIPTION

4.1 General

Personnel performing nondestructive testing utilizing this procedure shall have been qualified in accordance with manufacturer specifications. Unless noted otherwise, specific instructions called out in this procedure may be performed by a Level I, Level II or Level III inspector. Any steps with (Level II) appended to them shall be performed by a Level II or Level III inspector. Any steps with (Level III) appended to them shall be performed by a Level III inspector only.

4.2 Materials and Configurations

4.2.1 Materials suitable for inspections using this procedure are non-conductive materials in any form, including any associated jointing or coupling. Suitability for inspection must be validated before beginning any work.

4.2.2 Thickness limitations regarding these inspections are related to the antenna configuration; this must be analyzed and chosen for application by a Level II or higher inspector.



**Ground Penetrating Radar Inspection
Procedure # G.P.R.1**

Technical Procedure:

Procedure #G.P.R.1.1 Ground Penetrating Radar Inspection of Concrete

	Name	Signature	Position
Prepared by:	Steven Foote		GPR Tech
Reviewed by:	Brian Gray		ANDE Manager
Approved by:	Brian Gray		ANDE Manager

**2013
Contents**

-
- 1.0 Scope
 - 2.0 References
 - 3.0 Personnel Qualifications and Responsibilities
 - 4.0 Safety
 - 5.0 Technical Limitations
 - 6.0 Equipment and Materials
 - 7.0 Inspection
 - 8.0 Interpretation
 - 9.0 Report
 - 10.0 Definitions

Appendices

1.0 Scope

This procedure provides instruction to technicians performing Ground Penetrating Radar surveys to image subsurface conditions and objects typically found in concrete in accordance with ASME D6432-99. Ground Penetrating Radar is useful in finding and tracking water pipes, conduit, rebar, stress cables, grade beams, voids beneath slab on grade and determining thickness of slabs, both suspended and on grade.

2.0 References

ASTM Standard D6432-99



Ground Penetrating Radar Inspection Procedure # G.P.R.1

3.0 Qualification of personnel and responsibilities

Technicians operating the Ground Penetrating Radar system require manufacturer's course specific to the type of inspection being performed.

Technicians shall have 3 months on the job training supervised by level 2 technician.

Record of all training shall be documented and kept in personnel files.

4.0 Safety

All technicians shall follow Spectrum NDT Safety Management system requirements for job performance

Kneepads must be worn as required.

Technicians shall obey all site requirements for PPE put in place by the client or as identified during pre job hazard assessment. At a minimum CSA approved safety boots, CSA approved hard hat, gloves and CSA approved safety glasses shall be required on the majority of construction sites and should be carried with the technician at all times.

5.0 Equipment

(GSSI) Sir-3000 head unit coupled with antennae. Currently we have 1600MHz and 2000 MHz antennae to inspect concrete.

Laminated grid for imaging, 1x1, 2x2, 2x4

Duct tape

Marking crayons: red, blue, yellow and white

Measuring tape

Digital camera

Laptop with GSSI Radan software (No software package at this time)

GPR field report

6.0 Limitations

Surface conditions: surface must relatively clean and free from dirt construction materials, water etc.

A minimum of 3 feet x 3 feet clear to perform grid imaging.

Fibre concrete floors cannot be accurately imaged due to distortion of the signal.



Ground Penetrating Radar Inspection Procedure # G.P.R.1

Foam insulation and buffalo board must be removed before GPR can be performed.

Maximum thickness of 16 inches (400 mm) can be examined reliably.

GPR will not find objects that are tied directly to or beneath rebar. 3/8" is the smallest object that can be found.

Strong electrical current or magnetic field in area will affect reliability of GPR signal

Cold weather will freeze the LCD screen

There is no known hazard emanating from the use of GPR. The signal strength is approximately .60 % of the energy being put out by a cell phone. Personnel do not have to be cleared from the site to perform GPR.

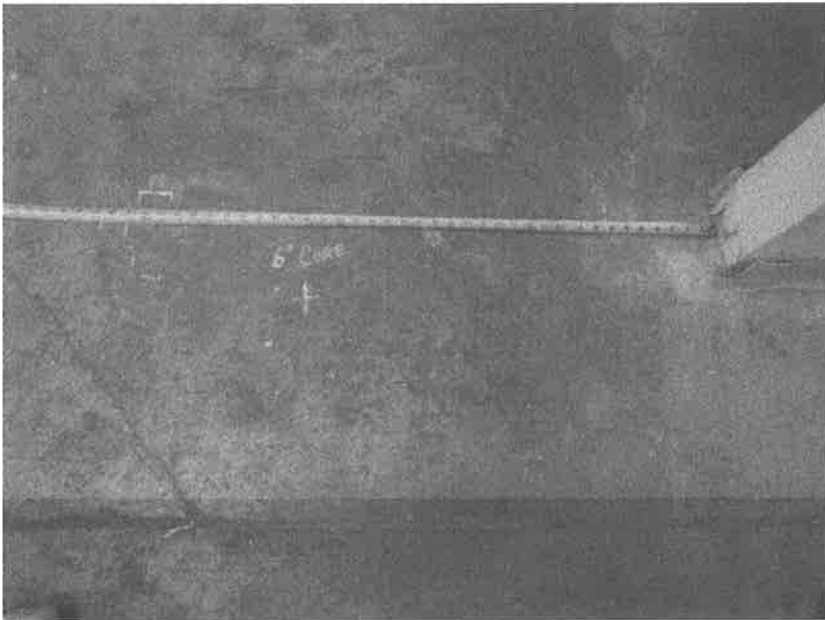
Surface water will degrade signals enough that a reliable image cannot be obtained. Ice however is sufficient to achieve a good image.

7.0 General Procedure

Complete JHA and control any hazards

Target area must be free of debris and garbage and as clean as possible given site conditions, at a least 3 foot square area

Target area **must** be clearly identified before scanning will commence, even areas that tracking or tracing is required.





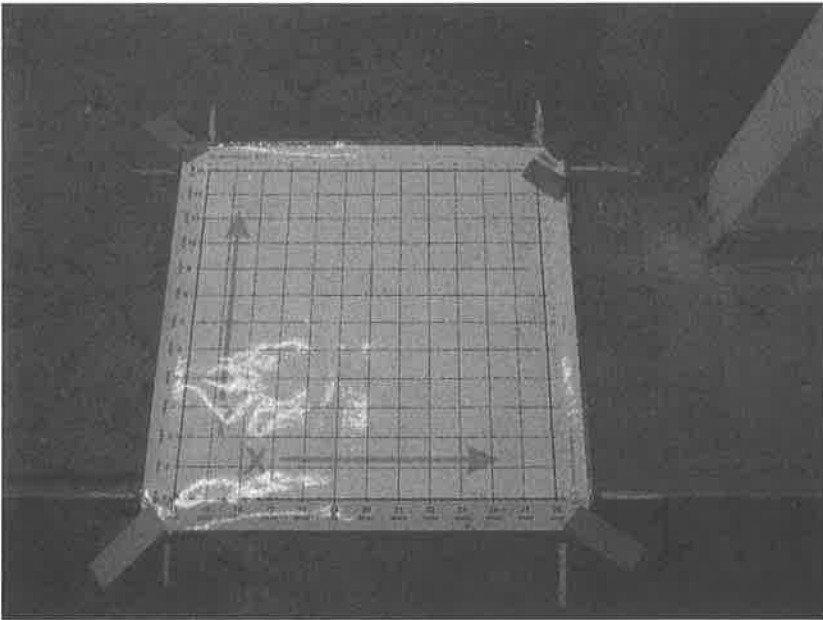
Ground Penetrating Radar Inspection Procedure # G.P.R.1

Look around site for conduit entering floor near scan area, or any obstructions to scan. Look below as well if possible, while not required for GPR it helps to know what is below the slab to identify any surface mounted obstructions etc.

Complete JHA and control any hazards

Have liability and scope form and job acknowledgement signed before commencing any work.

An appropriate size grid should be placed over the scan area and secured using duct tape. Try to align the grid with direction of rebar using columns for guidance. The grid outline should be marked with white crayon.



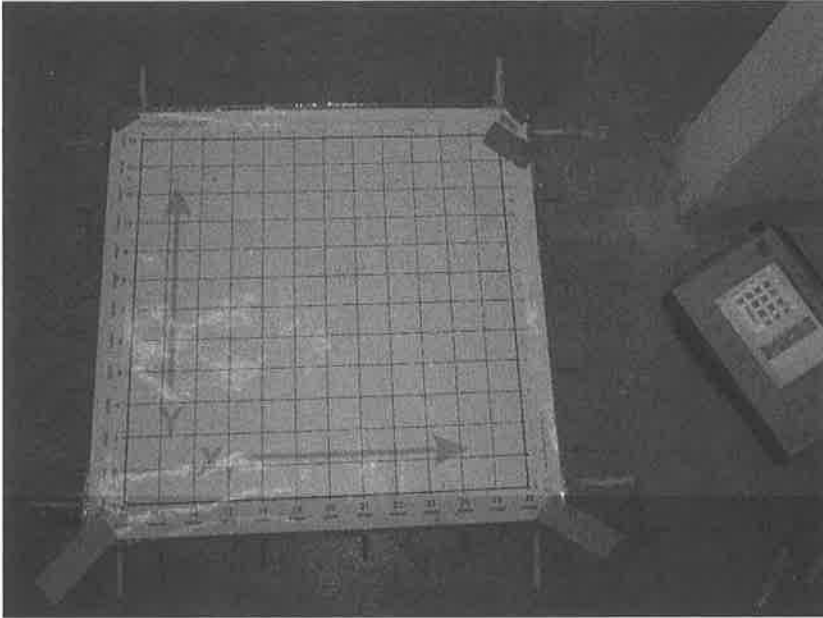
The dielectric and surface % of the concrete can now be determined and set in the Sir-3000. This **must** be noted on the field report for repeatability.

All lines on the grid should be completed if possible. Some situations will arise that a complete grid cannot be taken. Try to arrange grid so that as much data will be collected as possible.

In a situation that the interpolated image does not agree with the raw data, the raw data shall be considered correct, and another image should be taken on another plane to try to clarify the problem.

Once all grid lines have been collected the image should be developed on the SIR-3000 and the results marked on the floor using the numbered/lettered grid system for reference. Scroll through the layers created by the 3d mapping and mark each object next to its corresponding letter or number.

Ground Penetrating Radar Inspection Procedure # G.P.R.1



Red shall be used for conduit, stress cables, beams, beam edges and any unidentifiable objects.

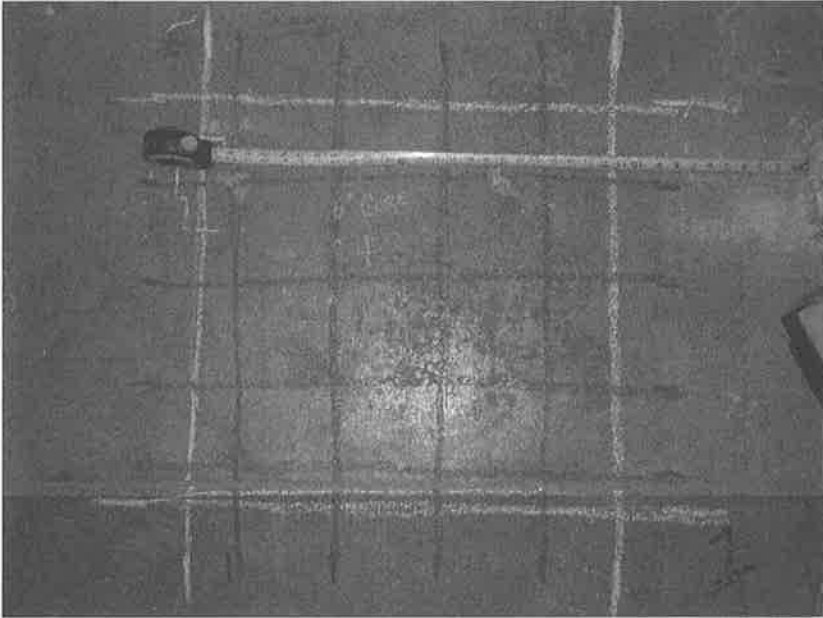
Blue shall be used for bottom layers and back layers or when only a single layer of rebar is present.

Yellow shall be used for top layer and front layers of rebar

Once all objects have been marked around the grid, remove the grid from the area and connect the objects on the surface.

A tape measure should be placed on the surface extending to the nearest permanent fixture for reference where possible.

Ground Penetrating Radar Inspection Procedure # G.P.R.1



Each grid should be numbered/identified in sequence.

8.0 Interpretation

Evaluation of radar data requires experience and understanding of the basic underlying concepts. The system provides software evaluation of the data and creates an interpolated image with no input from the operator.

Interpretation also relies on the operator's ability, for this reason, it is required to assess the area and surrounding for additional information as to what may be in the slab. This will add clues when interpreting the data.

The operator shall make certain that the raw data agrees with the software image. In a case of any discrepancy between the two, the raw data shall be considered correct in all situations.

It is difficult to determine the difference between stress cables and rebar. In the presence of stress cables all objects should be marked red. Other methods can be used to determine the location of stress cables (i.e. porpoising)

GPR is not to be used to decipher the size of an object, although depths can be obtained.

If the client requires knowing the precise nature or location of a target, then the target shall be tracked back to an identifiable source for identification.

Other NDT methods may be required to determine position size and orientation.

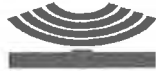
When an image is not clear enough to be interpreted through either raw data acquisition or interpolated results, the scan shall be determined to be incomplete and other methods of investigation will need to be considered.

8.0 Reports and records

The result for all GPR examinations shall be recorded. The records shall consist of a field report, digital photos and grid scans. The field report should be filled out and made as complete as possible.



**Ground Penetrating Radar Inspection
Procedure # G.P.R.1**



Spectrum NDT Ltd.

**GROUND PENETRATING RADAR
FIELD REPORT**

GPR

PAGE 1 OF 2

CLIENT _____	DATE _____	TIME _____	Hours _____
WORK LOCATION _____	SPECTRUM NDT JOB No. _____		
ATTENTION _____	Phone # _____	PO/WO No. _____	
SITE CONTACT _____	Phone # _____	CLIENT ADDRESS _____	
PROJECT _____	ACCEPTANCE STANDARD _____	Client information	
ITEM(S) EXAMINED _____	PROCEDURE No. GPR 2013-001	REV./DATE 2013	
	TECHNIQUE No. ANDE-001/ANDE-002	REV./DATE 2013	

JOB DESCRIPTION

SCOPE GROUND PENETRATING RADAR SCAN OF _____

TEST DETAILS

NO. OF SCANS _____	SCANNING <input type="checkbox"/>	TRACKING <input type="checkbox"/>	GPR INSTRUMENT _____	GSSI SIR 3000	CAL DUE DATE NA			
THICKNESS _____	FLOOR <input checked="" type="checkbox"/>	WALL <input type="checkbox"/>	ROOF <input type="checkbox"/>	CEILING <input type="checkbox"/>	GPR-001 <input type="checkbox"/>	GPR-002 <input checked="" type="checkbox"/>	GPR-003 <input type="checkbox"/>	
POST TENSION _____	Yes <input type="checkbox"/>	No <input type="checkbox"/>	DEPTH REQUIRED Yes <input type="checkbox"/>	No <input type="checkbox"/>	ANTENNA <input type="checkbox"/>	400 MHZ <input type="checkbox"/>	1600 MHZ <input type="checkbox"/>	<input checked="" type="checkbox"/> 2000MHZ

TEST SURFACE

SURFACE CONDITION SUSPENDED SLAB CONCRETE SLAB ON GRADE BARE GROUND WALLS

SCAN REPORT

Dielectric	_____
Surface %	_____

Mark-Up Legend

BLUE	Pattern Indicates Possible Rebar--Allow minimum Two (2) inches or Five (5) Centimeters from object for coring/drilling
RED	Pattern Indicates possible Conduit / Stress Cable -Allow minimum Two (2) inches or Five (5) Centimeters from object for coring/drilling

SIGNATURES

CLIENT REPRESENTATIVE _____	PRINT _____	SIGNATURE _____	HOURS _____
TECHNICIAN (SIGN) _____	1 ST TECHNICIAN _____	2 ND TECHNICIAN _____	REPORT REVIEW _____
			INITIAL _____

Scope of Services
The agreement of Spectrum NDT to perform services extends only to those services provided for in writing. Under no circumstances shall such services extend beyond the performance of the requested services. It is expressly understood that all descriptions, comments and expressions of opinion reflect the opinions or observations of Spectrum NDT based on information and assumptions supplied by the owner/operator and are not intended nor can they be construed as representations or warranties. Spectrum NDT is not assuming any responsibilities of the owner/operator and the owner/operator retains complete responsibility for the engineering, manufacture, repair and use decisions as a result of the data or other information provided by Spectrum NDT. In no event shall Spectrum NDT's liability in respect of the services referred to herein exceed the amount paid for such services.

Standard of Care
In performing the services provided, Spectrum NDT uses the degree, care and skill ordinarily exercised under similar circumstances by others performing such services in the same or similar locality. No other warranty, expressed or implied, is made or intended by Spectrum NDT.



**Ground Penetrating Radar Inspection
Procedure # G.P.R.1**

ACKNOWLEDGEMENT AND LIMITATION OF LIABILITY

The Customer acknowledges that: (a) when providing inspection services, Spectrum Ndt employees shall utilize ground penetrating radar designed to locate metal cables, rebar, post-tensioning cables and other objects located within floors and walls; (b) such equipment has inherent limitations and is susceptible to interference from strong electrical currents, power fluctuations, radio waves, microwaves and the like which affect its accuracy; (c) objects may be masked or hidden by the presence of other objects; (d) although Spectrum's technicians have received training in the operation and interpretation of information produced by the ground penetrating radar, there remains the possibility of errors in reading and interpreting the resulting information. Therefore, Spectrum NDT provides no warranty or representation as to the accuracy of the inspection reports produced from the use of ground penetrating radar, and Spectrum's sole responsibility herein is limited to providing the ground penetrating radar equipment and technicians who have been reasonably trained for its use and operation.

Notwithstanding any other provision in this agreement or any applicable statutory provisions, Spectrum NDT shall not be liable to the Customer for special or consequential damages or damages for loss of use arising directly or indirectly from any breach of this agreement, fundamental or otherwise or from any negligent or tortuous acts or omissions of Spectrum's employees or agents. In no event shall the liability in respect of the services exceed the amount paid for such services.

If the Customer is not the owner of the property being inspected, the Customer will ensure that owner is informed of the above provisions and has agreed to be bound by such terms before any work is performed by Spectrum, and if the Customer shall fail to obtain the owner's binding agreement to be bound by the above terms, the Customer shall indemnify and save Spectrum Ndt harmless from all liability that would otherwise have been limited by the above provisions if the owner had agreed to bound thereto.

The undersigned hereby agrees to the above written acknowledgement and limitation of liability:

Client Name

Owner's Name

Client Signature

Owner's Signature



Ground Penetrating Radar Inspection Procedure # G.P.R.1

Surface % and dielectric must be recorded from the SIR-3000 to ensure repeatability. A copy of the field report, photos, and grid scans should be kept on "N" drive under the appropriate year.

The field report should be filed in the folder created by dispatch containing other information about the job, and renamed using the Spectrum NDT standard naming convention using file numbers provided to the technician. Photos and grid scans shall be placed in this file as well to complete the file. Files will be archived to DVD or other storage as directed and kept for a (7) seven year period.

10.0 Definitions

GPR = Ground penetrating radar

Target area = the area the client wants scanned

Raw data = data produced without software interpolation

Interpolated data = data that has been processed

Grid Scan = the area covered by the laminated grid, scanned
and processed using software

SPECTRUM NDT LTD

DEMONSTRATION #1002

This is a demonstration of a visible light intensity check for light sources used at examination sites when inspecting parts in accordance with NDTP1 procedures MP1 & LP1.

500 watt halogen lamp at a distance of 8 ft from visible light meter = 5500 lux

Minimum requirement is 1000 lux.

Visible light meter S/N L627315

DEMONSTRATION WITNESSED BY ABSA REPRESENTATIVE

INSPECTOR	DATE	SIGNED
DUANE SEARS	Mar 25/02	D. Sears

SPECTRUM N.D.T. LTD

DEMONSTRATION # 1003


This is a demonstration of a visible light intensity check for light sources at examination sites when inspecting parts in accordance with NDT P1 procedure MP2 .

GE 12 Volt Automotive Bulb at a distance of 6" from visible light meter = 1100 Lux

Minimum requirement is 1000 Lux.

Visible Light Meter S/N L627315

Demonstration witnessed by ABSA representative.

Inspector	Signed	Date
B. Ionel		07/07/2005

SPECTRUM

Basic Ultrasonic Examination Procedure for Weld Inspection (Basic Reference to ASME V Current Mandatory Edition).
 Procedure # U.P.4 Rev 0

- xiii) Special equipment
- xiv) Computer program identification and revision if used
- xv) Simulation block and electronic simulator identification when used
- xvi) Reference level and damping/reject settings if used
- xvii) Areas of restricted access or inaccessible welds
- xviii) Acceptance rejection criteria

The report shall be filed and maintained in accordance with the referencing codes section.

16 Performance Demonstrations

Element	Demonstration #		
	1018	1019	1020
Type	Butt Weld	Pipe	Tee
Test Piece S/N	2250	2242	2243
Temp differential (25 F max)	0	0	0
ABSA representative-Witness of demonstration	B. lonel <i>B.L.</i>	B. lonel <i>B.L.</i>	B. lonel <i>B.L.</i>
REPORT #	14473	14474	14475

PROCEDURE REVIEW AND APPROVAL	
SNT LEVEL III	DATE
<i>[Signature]</i>	10/18/2007

*****END OF DOCUMENT*****

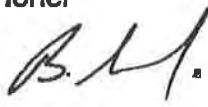
SPECTRUM


Ultrasonic Technique for Thickness Measurements (*DIGITAL and/or A-Scan*)
Procedure # U.P.5 Rev 0

Surface from which examination is conducted
Map or sketch to show areas inspected showing grid locations, bands etc.
Acceptance rejection criteria
Date and time of test
Couplant brand or type
Surface condition
Notes referring to defective or thinning areas to be correlated with a sketch
Simulation block and electronic simulator identification when used
Areas of inaccessible or restricted access

The report shall be filed and maintained in accordance with the referencing codes section.

12 Performance Demonstrations

Element	Demonstration #		
Type	1023		
Test Piece S/N	UT2241		
Temp differential (25 F max)	0		
ABSA representative-Witness of demonstration	B. Ionel 		
REPORT #	14476		

PROCEDURE REVIEW AND APPROVAL	
SNT LEVEL III	DATE
	10/18/2007

*****END OF DOCUMENT*****


SPECTRUM


Ultrasonic Technique for Plate Inspection
Procedure # U.P.6 Rev 0

Computer program identification and revision if used
Identification and location of area scanned
Test material identification
Surface from which examination is conducted
Map or sketch to show areas inspected showing grid locations, bands etc.
Acceptance rejection criteria
Date and time of test
Couplant brand or type
Surface condition
Notes referring to defective areas to be correlated with a sketch
Simulation block and electronic simulator identification when used
Areas of inaccessible or restricted access.

The report shall be filed and maintained in accordance with the referencing codes section.

14 Performance Demonstrations

Element	Demonstration #		
Type	1024		
Test Piece S/N	UT2241		
Temp differential (25 F max)	0		
ABSA representative-Witness of demonstration	B. Ionel 		
REPORT #	14477		

PROCEDURE REVIEW AND APPROVAL	
SNT LEVEL III	DATE
	10/18/2007

*****END OF DOCUMENT*****

SPECTRUM

Magnetic Particle Inspection - Yoke Technique.
 Procedure # M.P.2 Rev 4

17 Performance Demonstrations

Element	Demonstration #				
	1013	1014	1015	1016	1017
Type	Dry Visible	Wet Visible	Wet Visible	Wet fluorescent	Wet fluorescent
Temp range test piece	40-120 F	60-120 F	60-120 F	60-120 F	60-120 F
Temp range contrast	40-120 F	40-120 F	40-120 F	N/A	N/A
Temp range medium	40-120 F	60-120 F	60-120 F	60-120 F	60-120 F
Recorded Ambient temp	Certified thermometer	Certified thermometer	Certified thermometer	Certified thermometer	Certified thermometer
Contrast	WCP 2	WCP 2	WCP 2	N/A	N/A
Particles	RED 63	7C	7HF	Miglo 778	14 AM
Carrier	N/A	CARRIER II	N/A	Water	N/A
Current	AC	AC	AC	AC	AC
Magnetism	Continuous	Continuous	Continuous	Continuous	Continuous
Test Piece S/N	UT2249	UT2248	UT2248	UT2248	UT2248
ABSA representative-Witness of demonstration	B. lonel <i>B. lonel</i> Demo's performed 10/18/2007	B. lonel <i>B. lonel</i> Demo's performed 10/18/2007	B. lonel <i>B. lonel</i> Demo's performed 10/18/2007	B. lonel <i>B. lonel</i> Demo's performed 10/18/2007	B. lonel <i>B. lonel</i> Demo's performed 10/18/2007
REPORT #	14468	14469	14470	14471	14472



PROCEDURE REVIEW AND APPROVAL		REVISIONS	
SNT-NDT-III	DATE	REV # DATE	ESSENTIAL VARIABLE
Mark Edwards <i>[Signature]</i>	10/18/2007	REV2 01/20/2008 REV3 03/26/2010 REV4 04/12/2010	NO NO NO
ASNT-NDT-III 186344	DATE		
Scot Beavan <i>[Signature]</i>	11/26/2010		


*****END OF DOCUMENT*****

SPECTRUM

Liquid Penetrant Examination General Requirements
 Basic Reference to Current Mandatory Edition of ASME V
 Document L.P.2. Rev 2

21 Performance Demonstrations

Element	Demonstration #	
	1009	1010
Type	Visible	visible
Surface prep	Para 3	Para 3
Light Intensity	Para 13	Para 13
Temp range	50-122 F	50-122 F
Consumables/part		
Recorded Ambient temp	Certified thermometer	Certified thermometer
Penetrant	Water washable SKL-WP	Solvent removable SKL-SP
Cleaner	Water spray	SKC-S
Developer	SKD-S2	SKD-S2
Test Piece S/N	UT2245 Castings/welds	UT2249 Wrought – plate, extrusions forgings
ABSA representative- Witness of demonstration	B. Ionel 	B. Ionel 
REPORT #	14466	14467

PROCEDURE REVIEW AND APPROVAL	
SNT LEVEL III	DATE
	10/18/2007

*****END OF DOCUMENT*****

SPECTRUM

ULTRASONIC WELD INSPECTION USING PHASED ARRAY COMPUTERIZED IMAGING TECHNOLOGY PROCEDURE MET 100 REV 8


Calibration data (reference level and damping/reject settings if used)
Demonstration number
Part identification
Scan Plan
Scanning surfaces
Areas of restricted access or inaccessible welds
Identification and location of weld volume scanned
Surface condition
C – Scan and relevant A/B Scans
Special equipment
Indications, rejectable or recordable
Date and time of test
Inspector's signature
Acceptance rejection criteria

The report shall be filed and maintained in accordance with the referencing codes section.

23 Final Data Package

The final data package shall be reviewed by a UT level 3 and shall include the ultrasonic data record, data interpretations and flaw evaluations/characterizations performed by another qualified individual.

24 Performance Demonstrations

Element	Demonstration #		
	1021		
Type	Butt Weld		
Test Piece S/N	UT2250		
Temp differential (25 F max)	0		
ABSA representative- Witness of demonstration	B. Ionel 		
REPORT #	8166		



November 06, 2009

ABSA
1212-31 Avenue N.E
Calgary Alberta, Canada
T2E 7S8

Attention: Mr. Blair Ionel (C.E.T, Authorized Inspector Supervisor, Safety Codes Officer)

DEMONSTRATION OF NON-DESTRUCTIVE EXAMINATION PROCEDURES

The following procedures were demonstrated in accordance with ASME Section V, 2007 Edition, 2008 Addenda.

- Article 1 General Requirements, Section T-150
- Article 4 Ultrasonic Examination for Welds, Section T-421 (including Code Case 2235-9, and B31 Case 181).

Spectrum NDT demonstrated the following Non-Destructive Examination Procedures on November 06, 2009.

PROCEDURE	DESCRIPTION	METHOD	SPECIMEN	REPORT
MET 300 REV8	AUT Phased array	PA-UT	UT-098	64917

Spectrum NDT technicians that participated in the above procedures include:

Scot Beavan (Level II CGSB 6637/SNT-TC-1A, Level III ASNT 186344)

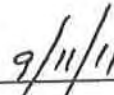
Spectrum NDT Representative: Mark Edwards  Date: Nov 6th 2009

Demonstrations Witnessed By:

AIS or AI
ABSA


(signature)

Date





SPECTRUM N.D.T. LTD
ULTRASONIC TEST REPORT

Client ABSA DEMO	Job #	OMNISCAN	Report #	64917
	Unit #		Work Sheet #	67617
Address CALGARY; ALBERTA	Requested by MR. B. IONEL		Demo #	14480
			Procedure#	MET 300 Rev. 8
Work Description OMNI SCAN DEMO			Calibration date	July 9, 2009

Code ASME V ART 4		Acceptance criteria ASME VIII DIV. 1 CC2235-9 / B31 CC181 TABLE 1		
Material CARBON STEEL	Surface AS WELDED	Size 6" X SCH120	Scanning Surface EXTERNAL	
Instrument OMNI-MX	Serial # OMNI-101102	Phased array Acquisition Module OMNI-M-PA32128	Serial # OMNI-600032	
Scanner N/A	Serial # N/A	Encoder ENC1-2.5-DE	Serial # 191753-17	

Calibration Block 3/32 INCH DIAMETER HOLE (OMNI. 3-32) TCG.		Calibration Std IIW BLOCK TYPE 2 S/N 19642	Qualification Block FLAW SPEC UT-098	
Acquisition softwear OMNISCAN MXU VERSION 2.0	Analysis / Storage softwear TOMOVEIW VERSION 2.7 R10	Scan plan file ABSA demo.ebwk	Couplant EXOSEN/WATER	Temperature 20 degrees C

Search unit (s)	Serial Number	Size (mm)	Frequency	Reference Sensitivity	Scanning sensitivity
5L64-A2	G1152	38.4 x 10.0	5 MHZ	17.9 dB TCG	+6 dB
Wedge (s)	Angle	Radius	Position	Index Offset	"Y" Splitter
SA2-N55S-IHC DUAL	55 degree SW	FLAT	Reverse 2L64	18MM	N/A

Weld Identification/Description	File name	Stamp	Remarks
UT-098 (0 to 555mm)	UT-098 MERGE	N/A	SEE BELOW

--	--	--	--	--	--	--	--

Indication	Location (mm)	(A) Height (mm)	(L) Length (mm)	a/t	a/L	Comments/Description	Accept/reject
1	125	1	5	0.0699	N/A	ROOT CRACK	REJECT
2	205	2	5	0.139	N/A	LACK OF FUSION	REJECT
3	381	1	5	0.0699	N/A	TOE CRACK	REJECT

Client Signature	Inspector Name S. BEAVAN	Level CGSB-CAN 48.9712 II 6637 ASNT-NDT-III 186344	Data Reviewed By S. BEAVAN	Level CGSB-CAN 48.9712 II 6637 ASNT-NDT-III 186344
Date	Signature <i>S. Beavan</i>	Date November 6, 2009	Signature <i>S. Beavan</i>	Date November 6, 2009

SPECTRUM

PROCEDURE REVISION RECORD

Procedure #	Rev #	Revision	Date	Level III
UP4	1	Equipment added USN 58	03/15/2010	
UP5	2	Equipment added USN 58	03/15/2010	
UP6	2	Equipment added USN 58	03/15/2010	
LP2	2	Black Light cal freq	01/20/2008	
MP2	2	Black Light cal freq	01/20/2008	
MET 100	8	Flaw discrimination acceptance level (rephrase text)	08/14/2008	
MET 300	8	Procedure demonstration	06/11/2009	
MET 300	9	Minimum thickness	09/18/2010	
MET 300	10	Sweep angle range 40-70	08/04/2011	
PMI 1	1	Evaluation and acceptance standards (rephrase text)	08/14/2009	
H.P.2.	1	Addendum for high alloy materials	08/18/2008	
H.P.2.	2	Addendum for high alloy materials	12/08/2010	
MP2	3	General -size and shape of parts added.	March 26, 2010	
MP2	3	Personal par. 1 SNT-TC-1A current revised.	March 26, 2010	
MP2	3	Light intensity par. 7 filter replacement/inspection	March 26, 2010	
MP2	3	Calibrations par. 10 black lights, equipment tagging added	March 26, 2010	
MP2	3	Examination/written instruction par. 11 added techniques	March 26, 2010	
MP2	3	Demagnetization par. 13 demag. technique added	March 26, 2010	
MP2	3	Reporting of indications par. 14 digital photography added	March 26, 2010	
MP2	3	Evaluation par. 15 revised	March 26, 2010	
MP2	3	Records par. 16 inspector name, signature and qualifications added	March 26, 2010	
MP2	3	Demo reports 14468, 14469, 14470 light intensity revised to LUX.	March 26, 2010	

Dry Method Magnetic Particles

#1 Gray

General Purpose

General Purpose Dry Method Particles. Choose the color that offers the best contrast to the surface you are inspecting.

Part #:	Container Size:
01-1716-72	12 – 1 lb. Containers
01-1716-69	10 lb. – Pail
01-1716-81	25 lb. – Pail
01-1716-87	45 lb. – Pail

#3A Black

General Purpose

General Purpose Dry Method Particles. Choose the color that offers the best contrast to the surface you are inspecting.

Part #:	Container Size:
01-1748-72	12 – 1 lb. Container
01-1748-69	10 lb. – Pail
01-1748-81	25 lb. – Pail
01-1748-87	45 lb. – Pail

#2 Yellow

General Purpose

General Purpose Dry Method Particles. Choose the color that offers the best contrast to the surface you are inspecting.

Part #:	Container Size:
01-1732-69	10 lb. – Pail
01-1732-81	25 lb. – Pail
01-1732-87	45 lb. – Pail

#8A Red

General Purpose

General Purpose Dry Method Particles. Choose the color that offers the best contrast to the surface you are inspecting.

Part #:	Container Size:
01-1780-72	12 – 1 lb. Containers
01-1780-69	10 lb. – Pail
01-1780-81	25 lb. – Pail
01-1780-87	45 lb. – Pail

Water Bath Additives

AX-52

Corrosion Inhibitor

AX-52 is a Corrosion Inhibitor. Corrosion Inhibitors retard water's attack on the magnetic particles and thus extend bath life. They also help prevent corrosion of parts during processing and protect any exposed parts of inspection machinery. They are not designed to provide long-term corrosion protection for parts during storage after testing. When long term protection is required, an oil vehicle or separate anticorrosion treatment is recommended.

Form: Yellow Liquid

Recommended Concentration: 1% – 5% by Volume

Part #:	Container Size:
01-2190-40	5 Gallon Pail
01-2190-45	55 Gallon Drum

WA-4

Water Bath Additive

WA-4 consists of a Wetting Agent and Corrosion Inhibitor.

Form: Amber Liquid

Recommended Concentration: 1% by Volume

Part #:	Container Size:
01-2172-20	1 Gallon Jug
01-2172-40	5 Gallon Pail

WA-2B

Water Bath Additive

WA-2B is a wetting agent and corrosion inhibitor and antifoam water bath additive. Wetting Agents enable easier suspension of magnetic particles in water.

Form: White Granular Powder

Recommended Concentration: 1.33 oz./gallon (10 grams/liter)

Part #:	Container Size:
01-2148-63	5 lb. Container
01-2148-84	30 lb. Container

ZAF-2

Antifoaming Additive

Antifoaming agents suppress the natural tendency of any water bath to foam when agitated.

Form: Clear Liquid

Recommended Concentration: 3 – 5 Drops/15 gallons

Part #:	Container Size:
01-9410-20	1 Gallon Jug

Wet Method Visible Magnetic Particles

7C Black

Visible Particles
(to be mixed with Carrier II or Water/Additives)

Non-fluorescent black magnetic particles. Provides excellent color contrast on shiny or light colored surfaces.

Suspension: Water/Oil

Recommended Concentration: 1.25 oz./gallon (9.36 grams/liter)

Part #:	Container Size:
01-1116-66	8 lb. Container

9C Red

Visible Particles
(to be Mixed with Carrier II or Water/Additives)

Non-fluorescent red magnetic particles. Similar to 7C but preferred for good contrast on gray, black or dark surfaces.

Suspension: Water/Oil

Recommended Concentration: 1.25 oz./gallon (9.36 grams/liter)

Part #:	Container Size:
01-1132-66	8 lb. Container

7HF Black

Visible Premix with Carrier II

7C Black Powder premixed with Carrier II packaged in an aerosol can.

Suspension: Oil

Recommended Concentration: Premixed in Aerosols

Available in 16 oz. aerosol cans.

9CM

Visible Premix with Carrier II

9C Red powder premixed with Carrier II packaged in an aerosol can.

Suspension: Oil

Recommended Concentration: Premixed in Aerosols

Available in 16 oz. aerosol cans.

WCP-2

White Contrast Paint

Available in 16 oz. aerosol cans.

Oil Petroleum Vehicle

Carrier II

Oil Vehicle

Suspension Vehicle formulated for magnetic particle testing; odor-free, low-viscosity, high flash point.

Part #:	Container Size:
012122-40	5 Gallon Pail
012122-30	20 Gallon Drum
012122-45	55 Gallon Drum

Wet Method Fluorescent Magnetic Particles

14A

Fluorescent Particles
(to be mixed with Carrier II or Water/Additives)

14A is a dry, free flowing, brown magnetic powder which fluoresces bright yellow-green under black light. 14A is intended for use in high sensitivity wet method magnetic particle inspection. It may be suspended in either a petroleum-based vehicle (oil) such as MAGNAFLUX®/MAGNAGLO® Carrier II, or in water. When water is used as a vehicle, conditioning agents such as WA-2B, or WA-4 are required.

Suspension: Water/Oil

Recommended Concentration: 1/2 oz./gallon (1.25 grams/liter)

Part #:	Container Size:
01-0130-57	1 lb. Container
01-0130-71	Six Pack of 1 lb. Containers
01-0130-69	10 lb. Container
01-0130-75	20 lb. Container

14A Aqua-Glo™

Fluorescent Premix with Water

Fluorescent green prepared solution of 14A fluorescent particles in a water based medium designed to offer the benefits of water and the convenience of aerosol form.

Suspension: Water Only

Recommended Concentration: Comes as a prepared bath

Part #:	Container Size:
01-1725-38	Case of 12 Aerosols

20B Preblended Dry Mix Fluorescent Particles (14A+Additives)

20B is composed of fluorescent magnetic powder, nonionic surfactants, and corrosion inhibitors. It is a pre-blended dry mix of 14A magnetic powder and WA-2B water conditioner.

Suspension: Water Only

Recommended Concentration: 1.5 oz./gallon of water (11.25 grams/liter)

Part #:	Container Size:
01-0179-71	Six Pack of 1 lb. Containers
01-0179-70	15 lb. Container
01-0179-84	30 lb. Container

14AM

Fluorescent Premix with Carrier II

Fluorescent prepared bath of 14A powder and Carrier II (a high flash point petroleum vehicle). Ready to use without measuring and mixing.

Suspension: Oil

Recommended Concentration: Comes as a prepared bath

Part #:	Container Size:
01-0145-40	5 Gallon Pail
Also available in 16 oz. aerosol cans.	

14A Redi-Bath™

Fluorescent Premix Concentrate for Water

Preblended concentrate of our 14A fluorescent green magnetic particle powder, mixed with water, wetting agent and corrosion inhibitor. Easiest method of water bath preparation. Simply add pre-blended concentrate to water.

Suspension: Water Only

Recommended Concentration: 2.7 oz./gallon (21 ml/liter)

Part #:	Container Size:
01-9130-41	6 pack of 27 oz. bottles

MG-3410

Fluorescent Particles to be Mixed with Water

The powder contains conditioners which improve the magnetic particle suspendibility, mobility and wetting of test part surface. No additional wetting or conditioning agents are required when MG-3410 is used.

Suspension: Water Only

Recommended Concentration: 1/2 oz./gallon (0.75 gram/liter)

Part #:	Container Size:
01-0199-84	30 lb. Container

MG-410

Fluorescent Particles
(to be Mixed with Carrier II or Water/Additives)

MG-410 is a dry, free flowing, green magnetic powder which fluoresces bright green under black light

Suspension: Water/Oil

Recommended Concentration: 1/2 oz./gallon of vehicle (0.75 gram/liter)

Part #:	Container Size:
01-0191-57	1 lb. Container
01-0191-69	10 lb. Container
01-0191-81	25 lb. Container

Penetrants

SKL-SP1

Solvent Removable Penetrant

Most widely used, general purpose solvent removable penetrant.
Good for rough surfaces and large parts.

Approved Developers: SKD-S2 & ZP-5B

Approved Cleaner: SKC-S

Part #:	Container Size:
01-5150-35	Case of 4 – 1 Gallon Containers
01-5150-40	5 Gallon Pail
01-5150-45	55 Gallon Drum

Also available in 16 oz. aerosol cans.

SKL-WP

Water Washable Penetrant

General purpose water washable penetrant.

Approved Developers: SKD-S2 & ZP-5B

Approved Cleaner: Not Required

Part #:	Container Size:
01-5182-35	Case of 4 – 1 Gallon Containers
01-5182-40	5 Gallon Pail
01-5182-45	55 Gallon Drum

Also available in 16 oz. aerosol cans.

SKL-4C

Water Based Penetrant

Bright red in the daylight; fluorescent orange in UV light.
Liquid oxygen compatible. For non-certified applications.
Used as a leak detector and for inspection of plastic.

Approved Developer: SKD-S2

Approved Cleaner: Not Required

Part #:	Container Size:
01-5125-40	5 Gallon Pail
01-5125-45	55 Gallon Drum



Cleaners/Removers

SKC-S

Solvent Cleaner

The recommended, general purpose cleaner/remover.
Non-Chlorinated. Flammable. Meets major requirements
for major specifications.

Part #:	Container Size:
01-5750-35	Case of 4 – 1 Gallon Containers
01-5750-40	5 Gallon Pail
01-5750-45	55 Gallon Drum

Also available in 16 oz. aerosol cans.

SKC-HF

Solvent Cleaner

High Flash point. Low odor cleaner/remover. Meets sulfur and
chlorine requirements of major specifications.

Part #:	Container Size:
01-5725-40	5 Gallon Pail
01-5725-45	55 Gallon Drum

Also available in 16 oz. aerosol cans.

Developers

SKD-S2

Solvent Developer

General purpose solvent developer.

Part #:	Container Size:
01-5352-35	Case of 4 – 1 Gallon Containers
01-5352-40	5 Gallon Pail
01-5352-45	55 Gallon Drum

Also available in 16 oz. aerosol cans.

ZP-5B

Aqueous Water Suspensible Developer

General purpose water suspensible developer.

Part #:	Container Size:
01-3341-81	25 lb. Container

ZYGLO Water Washable Penetrants

ZYGLO Water Washable Penetrants are used to check for cracks in a wide range of sensitive applications. Our penetrants fluoresce a greenish-yellow color under ultraviolet radiation. Use black light sources with peak wavelength of 365 nanometers such as MAGNAFLUX ZB-100F Fan-Cooled Black Light.

ZL-15B

Water Washable Fluorescent Penetrant

(Level ½ – Lowest sensitivity)

Exhibits excellent washability for castings and rough surfaces.

Approved Developers: ZP-4B, ZP-9F, ZP-5B & SKD-S2

Part #:	Container Size:
01-3159-40	5 Gallon Pail
01-3159-30	20 Gallon Drum
01-3159-45	55 Gallon Drum

ZL-19

Water Washable Fluorescent Penetrant

(Level 1 – Low sensitivity penetrant)

Higher brightness and sensitivity than ZL-15B

Approved Developers: ZP-4B, ZP-9F, ZP-5B & SKD-S2

Part #:	Container Size:
01-3263-40	5 Gallon Pail
01-3263-30	20 Gallon Drum
01-3263-45	55 Gallon Drum

ZL-60D

Water Washable Fluorescent Penetrant

(Level 2 – Medium Sensitivity)

Exhibits excellent washability for castings and rough surfaces; and is typically used on castings, forgings, extrusions and rough machined surfaces to find cracks, seams, laps, cold shuts, laminations and porosity.

Approved Developers: ZP-4B, ZP-9F, ZP-5B & SKD-S2

Part #:	Container Size:
01-3272-35	Case of 4 – 1 Gallon Containers
01-3272-40	5 Gallon Pail
01-3272-30	20 Gallon Drum
01-3272-45	55 Gallon Drum

Also available in 16 oz. aerosol cans.

ZL-67

Water Washable Fluorescent Penetrant

(Level 3 – High Sensitivity)

Provides an excellent combination of sensitivity/washability and is typically used on critical applications including investment castings, jet engine components, and highly machined surfaces to find cracks, seams and porosity.

Approved Developers: ZP-4B, ZP-9F, ZP-5B & SKD-S2

Part #:	Container Size:
01-3274-35	Case of 4 - 1 Gallon Containers
01-3274-40	5 Gallon Pail
01-3274-30	20 Gallon Drum
01-3274-45	55 Gallon Drum

ZL-56

Water Washable Fluorescent Penetrant

(Level 4 – Ultra High Sensitivity)

Ultra-high sensitivity penetrant for critical applications. ZL-56 is a fluorescent, high sensitivity, water washable penetrant. ZL-56 is typically used on smooth, nonporous, highly machined surfaces to find cracks, seams, and scratches.

Approved Developers: ZP-4B, ZP-9F, ZP-5B & SKD-S2

Part #:	Container Size:
01-3267-40	5 Gallon Pail
01-3267-30	20 Gallon Drum
01-3267-45	55 Gallon Drum



ZYGLO® Post Emulsifiable Fluorescent Penetrants

The ZYGLO post emulsifiable fluorescent penetrants are used for a wide range of sensitive applications and are formulated to be impervious to water to assure against being over washed from defects. The MAGNAFLUX Post Emulsifiable Penetrants require the application of a lipophilic emulsifier or a hydrophilic emulsifier to render it washable with water. All of our penetrants are formulated for rapid separation from water for efficient clean up by coalescer, or charcoal filtration. Each penetrant fluoresces a bright greenish-yellow color under ultraviolet radiation. Use of a black light source, with peak wavelength of 365 nanometers, such as the MAGNAFLUX® ZB-100F Fan-Cooled black light, is recommended. Each penetrant is formulated to produce heat stable fluorescent indications under normal drying conditions (140°F/60° C).

ZL-2C

PE Fluorescent Penetrant

(Level 2 – Medium Sensitivity)

ZL-2C is typically used on castings, forgings, and extrusions, rough and machined surfaces to find cracks, seams, laps, laminations and porosity.

Approved Developers: ZP-4B, ZP-9F, ZP-5B, ZP-14A & SKD-S2

Approved Removers: ZR-10B, ZE-4B, SKC-S & SKC-HF

Part #:	Container Size:
01-3123-40	5 Gallon Pail
01-3123-30	20 Gallon Drum
01-3123-45	55 Gallon Drum

ZL-27A

PE Fluorescent Penetrant

(Level 3 – High Sensitivity)

ZL-27A is typically used on castings, forgings, and extrusions, rough and machined surfaces to find cracks, seams, laps, laminations and porosity.

Approved Developers: ZP-4B, ZP-9F, ZP-5B, ZP-14A & SKD-S2

Approved Removers: ZR-10B, ZE-4B, SKC-S & SKC-HF

Part #:	Container Size:
01-3187-35	Case of 4 – 1 Gallon Containers
01-3187-40	5 Gallon Pail
01-3187-30	20 Gallon Drum
01-3187-45	55 Gallon Drum

Also available in 16 oz. aerosol cans.

ZL-37

PE Fluorescent Penetrant

(Level 4 – Ultra-High Sensitivity)

ZL-37 is typically used on castings, forgings, and extrusions, rough and machined surfaces to find cracks, seams, laps, laminations and porosity.

Approved Developers: ZP-4B, ZP-9F, ZP-5B, ZP-14A & SKD-S2

Approved Removers: ZR-10B, ZE-4B, SKC-S & SKC-HF

Part #:	Container Size:
01-3188-35	Case of 4 – 1 Gallon Containers
01-3188-40	5 Gallon Pail
01-3188-30	20 Gallon Drum
01-3188-45	55 Gallon Drum

ZYGLO® Water Base Fluorescent Penetrant

ZL-4C

Water Base Fluorescent Penetrant

ZL-4C is typically used on plastics and ceramics to find cracks. ZL-4C is also used as a leaker penetrant to detect through leaks.

ZL-4C is a fluorescent, water base penetrant. ZL-4C is soluble in water and can be diluted, but is generally used as supplied or from 1:1 to 1:2 in water. ZL-4C contains no petroleum base solvents. ZL-4C fluoresces a greenish-yellow color under ultraviolet radiation of 365 nm, such as supplied by the MAGNAFLUX® ZB-100F fan-cooled black light.

Part #:	Container Size:
01-3137-40	5 Gallon Pail
01-3137-45	55 Gallon Drum

ZYGLO® Additive

ZL-5

Fluorescent Water Additive for Leak Detection

ZL-5 is a dry powder fluorescent organic material used as an additive for the detection of leaks in pressure vessels, storage tanks, radiators and other liquid system containers. ZL-5 is water-soluble and produces fluorescence when using a black light, (such as the MAGNAFLUX® ZB-100F fan cooled black light) at 365 nanometers.

Part #:

01-3141-57
01-3141-63

Container Size:

1 lb. Container
5 lb. Container

ZYGLO® Developers

ZP-4B

Dry Powder

ZP-4B is a free-flowing, white, fluffy powder used as a dry powder developer for ZYGLO penetrants. ZP-4B is supplied ready to use. ZP-4B forms a thin film on parts which enables it to enhance indications of ultra fine discontinuities. ZP-4B's high purity allows it to be used in applications demanding purity.

Part #:

01-3328-25
01-3328-69
01-3328-75

Container Size:

12 - 1 pt Cans
10 lb. Container
20 lb. Container

ZP-5B

Water Suspendible

ZP-5B is a white powder which is to be dispersed into water. ZP-5B disperses quickly to form an opaque white suspension. Must be continually agitated during use to ensure uniformity of mix as developer will settle out on standing. ZP-5B forms a uniform white coating which enhances fluorescent indications formed by ZYGLO penetrants. At higher concentration, ZP-5B forms an opaque white coating which provides contrasting background for SPOTCHECK indications.

Part #:

01-3341-81

Container Size:

25 lb. Container

ZP-9F

Non-Aqueous

ZP-9F is a ready-to-use suspension of white developing particles in a fast drying solvent. ZP-9F produces an opaque white coating, which provides an excellent contrasting background for SPOTCHECK or ZYGLO penetrant indications. ZP-9F is specially formulated to be low in sulfur and halogens and contains no chlorinated hydrocarbons.

Part #:

01-3354-40

Also available in 16 oz. aerosol cans.

Container Size:

5 Gallon Pail

ZP-14A

Water Soluble

ZP-14A is a white free-flowing powder, which dissolves in water to form a clear, colorless biodegradable developer solution. ZP-14A is used as a general purpose water-soluble developer for the enhancement of indications formed by ZYGLO penetrants. ZP-14A produces a uniform white porous coating when it dries. The developer film is easily removed in post inspection cleaning by a water spray. Once the developer bath has been made up, no in-use agitation is required to maintain developer uniformity.

Part #:

01-3381-75
01-3381-89

Container Size:

20 lb. Container
50 lb. Container

ZYGLO® Lipophilic Emulsifier

ZE-4B

Emulsifier

ZE-4B is a reddish, slightly viscous liquid used for the emulsification of ZYGLO PE penetrants. ZE-4B is a general purpose emulsifier with a moderate rate of action. ZE-4B can be used in open tanks due to its low volatility and high flash point.

Part #:

01-3546-40
01-3546-30
01-3546-45

Container Size:

5 Gallon Pail
20 Gallon Drum
55 Gallon Drum

ZYGLO® Hydrophilic Emulsifier

ZR-10B

Remover

ZR-10B is a pinkish, slightly viscous liquid. ZR-10B is a 100% active concentrate, which is diluted in water when used as an emulsifier for ZYGLO PE penetrants. ZR-10B is very low in sulfur, chlorine, and sodium content.

Part #:

01-3620-40
01-3620-30
01-3620-45

Container Size:

5 Gallon Pail
20 Gallon Drum
55 Gallon Drum

APPENDIX B

PERSONNEL RECORDS

1.0 Certifications and visual examination records for the following Spectrum NDT employees are located in this appendix.

Mark Edwards
Clint Magdee
Tom Ross
Ken Gowler
Tim Griggs
Alex Dachy
Phillip Chwachka
Don Titmus
Alan Swanick
Dwayne Shular
Brian Gray (Trainee)
Jordan Hynes (Trainee)
Devin Ulmer
Kundae Han
Severino Valente
Dylan Sundquist
Tyson Klein
Mike Basaraba
Patrick McLean
Steve Foote
Steve Taffs
Joël Phair
Mike Ridgwell

2.0 Technical Performance Evaluation Log.



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Mark Edwards

ORIGINAL CERTIFICATION						
LEVEL	BASIC	METHOD	SPECIFIC	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 3	85	79	83	82	NA	20/11/95
SNT TC 1A MT 3	85	90	96	90	NA	20/11/95
SNT TC 1A PT 3	85	84	95	89	NA	20/11/95
HT 1	NA	NA	NA	NA	ENG TECH CERTIFICATE	21/04/95
PM1	NA	NA	NA	NA	CGSB 1 #3043	21/03/04
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT/MT/PT LEVEL 3	27/03/97 20/07/99 01/01/02 03/03/2005 03/03/2010	LEVEL 3 PERFORMANCE REVIEW LEVEL 3 PERFORMANCE REVIEW LEVEL 3 PERFORMANCE REVIEW LEVEL 3 PERFORMANCE REVIEW (performed by Officer of the Company- C. Magdee)			MAR. 03 2015	
HT 1	21/02/03 21/02/06 21/02/2012	LEVEL 3 PERFORMANCE REVIEW			FEB. 21 2015	
PMI 1	26/05/04 02/05/2007 02/05/2010 02/05/2013	LEVEL 3 PERFORMANCE REVIEW			MAY 02 2015	

OFFICER OF THE COMPANY



Natural Resources
Canada

Ressources naturelles
Canada



Name/
Nom **Mark Edwards**
Reg. No. /
No. matricule **3043**
Issue Date/
Date d'émission **2011/09/30**

This card does not identify the stated individual as an employee or representative of Natural Resources Canada, Government of Canada.
Cette carte n'identifie pas l'individu d'être un employé ou un représentant de Ressources naturelles Canada, Gouvernement du Canada

Corrective lenses for [X] near [] far vision.
Verres correctifs pour la vision de [X] près [] distance.

Signature:  Canada



Natural Resources
Canada

Ressources naturelles
Canada

Certified to/Certifié selon : CAN/CGSB-48.9712

3043

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
RT	1	EMC	1984/01/01		2014/12/31
UT	2	EMC	1983/12/01		2014/12/31

For verification of certification status, policies and definitions, visit website:
<http://ndk.nrcan.gc.ca/> / Pour la vérification de la certification, les politiques, et les définitions,
visitez le site web: <http://ndk.nrcan.gc.ca/>

Manager, Certifying Agency
Gestionnaire, Organisme de certification

1-6-14



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Clint Magdee

ORIGINAL CERTIFICATION						
LEVEL	BASIC	METHOD	SPECIFIC	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 3	85	91	90	88.9	NA	7/05/12
SNT TC 1A MT 3	85	81.5	80	82.1	NA	7/05/12
SNT TC 1A PT 3	85	84	75	82.2	NA	7/05/12
HT 1	NA	NA	100	NA	NA	02/07/01
PM1	NA	NA	NA	NA	NA	21/02/04
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT/MT/PT LEVEL 3		ORIGINAL CERTIFICATION STILL CURRENT-SEE ABOVE			MAY 07 2017	
HT 1	21/02/03 21/02/06 21/02/2012	LEVEL 3 PERFORMANCE REVIEW			FEB. 21 2015	
PMI 1	02/05/2007 02/05/2010 02/05/2013	LEVEL 3 PERFORMANCE REVIEW			MAY 02 2016	

LEVEL 3 EXAMINER



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel Thomas Ross

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	NA	NA	NA	NA	NA	
SNT TC 1A MT 2	70	85	100	85.5	NA	15/03/04
SNT TC 1A PT 2	75	80	100	86.5	NA	25/03/04
HT 1	NA	NA	100	NA	NA	25/03/04
PM1	NA	NA	NA	NA	PCN LEVEL 2 Radation Safety # 200494	17/06/99
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	NA	NA			NA	
SNT TC 1A MT 2	02/05/2013 02/05/2010 02/05/2007 21/05/04 31/12/2004	LEVEL 3 PERFORMANCE REVIEW/ CGSB 2 REG 10908			MAY 02 2016	
SNT TC 1A PT 2	02/05/2013 02/05/2010 02/05/2007 21/05/04 31/12/2004	LEVEL 3 PERFORMANCE REVIEW/ CGSB 2 REG 10908			MAY 02 2016	
HT 1	02/05/2013 02/05/2010 02/05/2007 21/05/04 31/12/2004	LEVEL 3 PERFORMANCE REVIEW			MAY 02 2016	
PMI 1	02/05/2013 02/05/2010 02/05/2007 21/05/04 15/06/06	LEVEL 3 PERFORMANCE REVIEW/ CGSB XF LEVEL 1 REG 10908			MAY 02 2016	

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
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Name/
Nom Thomas Ross
Reg. No. /
No. matricule 10908
Issue Date/
Date d'émission 2011/02/01

Corrective lenses for [X] near [X] far vision.
Verres correctifs pour la vision de [X] près [X] distance.
Signature ↓



Natural Resources
Canada

Ressources naturelles
Canada

Qualified to i) CAN/CGSB-48.9712

10908

ii) ISO 20807 Qualifié selon

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	2004/12/13		2013/12/31
PT	2	EMC	2004/12/03		2013/12/31
XF	1		2006/05/03		2012/05/03

For proof of certification, visit website: <http://nrc.nrcan.gc.ca/>
Pour connaître la certification, visitez le site web: <http://nrc.nrcan.gc.ca/>

Rating: 0 (0/5) (0/5)
Certification: 0 (0/5) (0/5)




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Canada

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Canada



Name/ **Thomas Ross**
Nom
Reg. No. / **10908**
No. matricule
Issue Date/ **2012/06/15**
Date d'émission

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Corrective lenses for near far vision.
Verres correctifs pour la vision de près distance.
Signature:  **THOMAS ROSS**



Natural Resources
Canada

Ressources naturelles
Canada

Certified to / Certifié selon: ISO 30007, and Health Canada's and HRC's requirements for compliance with HC Safety Code 34 / ISO 30007, et les exigences de Ressources naturelles Canada et Santé Canada pour le respect du SC Code de sécurité 34 **10908**

Method	Level	Sector	Cert. Date	Date recert.	Expires
Méthode	Niveau	Secteur	Date cert.	Date recert.	Expiration
XF	1		2008/03/03	2012/06/12	2015/06/12

For verification of certification status, policies and definitions, visit website:
<http://nrc.zenatiq.ca/> Pour la vérification de la certification, les politiques, et les définitions,
visitez le site web: <http://nrc.zenatiq.ca/>

Manager, Certifying Agency
Destinataire, Organisme de certification





SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Kenneth W. J. Gowler

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	NA	NA	NA	NA	CGSB 2 REG # 1259	24/04/06
SNT TC 1A RT 2	NA	NA	NA	NA	CGSB 2 REG # 1259	24/04/06
SNT TC 1A MT 2	NA	NA	NA	NA	CGSB 2 REG # 1259	24/04/06
SNT TC 1A PT 2	NA	NA	NA	NA	CGSB 2 REG # 1259	24/04/06
HT 1	NA	NA	100	NA		24/04/06
PM1	NA	NA	NA	NA	CGSB 2 REG # 1259	24/04/06
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	24/04/09 20/04/12	CGSB EQUIVALENT			APR. 24 2015	
SNT TC 1A RT 2	24/04/09 20/04/12	CGSB EQUIVALENT			APR. 24 2015	
SNT TC 1A MT 2	24/04/09 20/04/12	CGSB EQUIVALENT			APR. 24 2015	
SNT TC 1A PT 2	24/04/09 20/04/12	CGSB EQUIVALENT			APR. 24 2015	
HT 1	24/04/09 20/04/12	LEVEL 3 PERFORMANCE REVIEW			APR. 24 2015	
PMI 1	24/04/09 20/04/12	LEVEL 3 PERFORMANCE REVIEW			APR. 24 2015	

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name/ Nom: **Kenneth W.J. Gowler**
 Reg. No. / No. matricule: **1259**
 Issue Date/ Date d'émission: **2013/01/14**

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Corrective lenses for [X] near / [] far vision.
 Verres correctifs pour la vision de [X] près / [] distance.

Signature:



Natural Resources
Canada

Ressources naturelles
Canada

Certified to/Certifié selon: CAN/CSS 48.9712

1259

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	1978/11/01		2015/12/31
PT	2	EMC	1978/11/01		2015/12/31
RT	2	EMC	1981/08/01		2015/12/31
RT	2	A/S	1981/12/01		2015/12/31
UT	2	EMC	1983/06/01		2015/12/31

For verification of certification status, policies and definitions, visit website:
<http://ndis.nrcan.gc.ca/> Pour la vérification de la certification les politiques, et les définitions,
 visitez le site web: <http://ndis.nrcan.gc.ca/>

Manager, Certifying Agency
 Gestionnaire, Organisme de certification

Kenneth W.J. Gowler
1259

Registration Number
Numéro de matricule



is certified by the Canadian
Nuclear Safety Commission
as an Exposure Device
Operator.

est accrédité par la Commission
canadienne de sûreté nucléaire
à titre d'opérateur d'appareil
d'exposition.

2013/02/01
Issue Date
Date d'émission

2019/07/01
Expiry Date
Date d'expiration


Designated Officer
Fonctionnaire désigné

 Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Canada



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Timothy D. Griggs

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	82	84	90	85	CGSB 2 REG # 1270	16/12/10
SNT TC 1A RT 2	NA	NA	NA	NA	CGSB 2 REG # 1270	29/10/07
SNT TC 1A MT 2	NA	NA	NA	NA	CGSB 2 REG # 1259	29/10/07
SNT TC 1A PT 2	NA	NA	NA	NA	CGSB 2 REG # 1270	29/10/07
HT 1	NA	NA	100	NA		29/10/07
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION		CURRENT CERT EXPIRES		
SNT TC 1A UT 2	24/10/13	CGSB EQUIVALENCY		OCT. 24 2016		
SNT TC 1A RT 2	24/10/13	CGSB EQUIVALENCY		OCT. 24 2016		
SNT TC 1A MT 2	24/10/13	CGSB EQUIVALENCY		OCT. 24 2016		
SNT TC 1A PT 2	24/10/13	CGSB EQUIVALENCY		OCT. 24 2016		
HT 1	24/10/13	LEVEL 3 PERFORMANCE REVIEW		OCT. 24 2016		
LEVEL 3 EXAMINER						



Natural Resources
Canada

Ressources naturelles
Canada



Name/ **Timothy D. Griggs**
Nom
Reg. No. **1270**
No. matricule
Issue Date/ **2012/12/06**
Date d'émission

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Cette carte n'identifie pas l'individu d'être un employé ou un représentant de Ressources naturelles Canada, Gouvernement du Canada

Corrective lenses for [X] near [X] far vision.
Verres correctifs pour la vision de [X] près [X] distance.

Signature | **Timothy D. Griggs** C1421542 BY



Natural Resources
Canada

Ressources naturelles
Canada

Certified to / Certifié selon CAN/CGSB 48.97.17

1270

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	1979/10/01		2015/12/31
PT	2	EMC	1979/10/01		2015/12/31
RT	2	VVV	1979/01/01		2015/12/31
UT	2	EMC	2010/12/16		2015/12/31

For verification of certificates status, policies and distributions, visit website:
<http://nrc.ca/nc.gc.ca/> Pour la vérification de la certification, les politiques, et les distributions,
visitez le site web: <http://nrc.ca/nc.gc.ca/>

Manager, Certifying Agency
Gestionnaire, Organisme de certification



CANADIAN WELDING BUREAU

TIMOTHY DOUGLAS GRIGGS

W178/2 Level 2 CERTIFIED WELDING INSPECTOR

The Inspector named herein has complied with the requirements of CSA Standard W178/2, Certification of Welding Inspectors.

5218 03/22/2015

REG. NO. EXPIRY (MM/DD/YY) AUTHORIZED SIGNATURE
CONDITIONS: Possession of this card does not imply that the holder represents an organization certified to CSA Standard W178/2 having personnel and procedures approved by the Canadian Welding Bureau.

This card is the property of the Canadian Welding Bureau and can be recalled, any time. Fraudulent use may involve permanent cancellation.

The certification of the person named on this card includes endorsements for the code(s) in standard(s) identified below. Code and Standard examinations must be rewritten every six (6) years from the date shown beside each code.

- CSA W47.1: Certification of Companies for Fusion Welding of Steel/CSA W59: Welded Steel Construction 07/08
- ASME VIII 1 & IX: Boiler and Pressure Vessel Code 03/12
- ASME B31.3: Chemical Plant and Petroleum Refinery Piping 05/12

CANADIAN WELDING BUREAU



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Alex Dachy

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	90	87	90	89	NA	01/12/08
SNT TC 1A MT 2	80	84	95	87.2	NA	27/02/08
SNT TC 1A PT 2	85	91	94	90		16/04/08
HT 1	NA	NA	100	NA	NA	24/02/08
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	01/12/2010 02/12/2011	ORIGINAL CERT CGSB # 14261			Feb. 12, 2014	
SNT TC 1A MT 2	24/05/2013 25/05/2010 10/06/2008	LEVEL 3 PERFORMANCE REVIEW CGSB # 14261			May 25, 2016	
SNT TC 1A PT 2	16/04/2010 12/04/2013	ORIGINAL CERT LEVEL 3 PERFORMANCE REVIEW			Apr. 12, 2016	
HT 1	24/02/2010 16/01/2013	ORIGINAL CERT LEVEL 3 PERFORMANCE REVIEW			Jan. 16, 2016	
PMI 1						

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name/
Nom **Alexander Dachy**
Reg. No. /
No. matricule **14261**
Issue Date/
Date d'émission **2012/01/23**

This card does not identify the stated individual as an employee or representative of Natural Resources Canada, Government of Canada.
Cetle carte n'identifie pas l'individu d'être un employé ou un représentant de Ressources naturelles Canada, Gouvernement du Canada.

Corrective lenses for || near || far vision.
Verres correctifs pour la vision de || près || distance.

Signature | *Alexander Dachy* | **C. Dachy**



Natural Resources
Canada

Ressources naturelles
Canada

Certified to/Certifié selon : CAN/CO90-46.9712

14261

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	2008/10/06		2014/12/31
UT	2	EMC	2010/10/15		2014/12/31

For verification of certification status, policies and definitions, visit website
http://nrc.can.ca/ For la vérification de la certification, les politiques, et les définitions,
visitez le site web: http://nrc.can.ca/

Manager, Certifying Agency
Gestionnaire, Organisme de certification

[Signature]



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Phillip Chwachka

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	96	98	88	93	NA	01/12/08
SNT TC 1A MT 2	99.5	94	97.5	97	NA	20/08/08
SNT TC 1A PT 2	99.5	98	98	97	na	20/08/08
HT 1	NA	NA	100	NA	NA	20/08/08
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION		CURRENT CERT EXPIRES		
SNT TC 1A UT 2	25/05/2010 07/01/2013	CGSB # 14144 LEVEL 3 PERFORMANCE REVIEW		07/01/2016		
SNT TC 1A MT 2	13/11/2009 11/11/2012	CGSB # 14144 LEVEL 3 PERFORMANCE REVIEW		11/11/2015		
SNT TC 1A PT 2	09/05/2012	LEVEL 3 PERFORMANCE REVIEW		09/05/2015		
HT 1	24/02/2010 07/01/2013	ORIGINAL CERT LEVEL 3 PERFORMANCE REVIEW		07/01/2016		
PMI 1						

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name /
Nom: **PHILIP C. Chwachka**
Reg. No: **14144**
No. matricule:
Issue Date /
Date d'émission: **2011/12/19**

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representative of Natural Resources Canada, Government of Canada.
(Cetle carte n'atteste pas l'identité d'être un employé ou un représentant de
Ressources naturelles Canada, l' gouvernement du Canada)

Collective issues for [] near [] for vision.
Verres collectifs pour la vision de [] près [] distance.

Signature

Signature




Natural Resources
Canada

Ressources naturelles
Canada

Certification Code: 14144

14144

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date receipt Date receipt	Expires Expiration
MT	2	EMC	2008/11/12		2014/12/31
UT	2	EMC	2009/09/30		2014/12/31

For verification of certification status, policies and definitions, visit website:
<http://www.nrcc.gc.ca/> Pour la vérification de la certification, les politiques, et les définitions,
visitez le site web: <http://www.nrcc.gc.ca/>

Manager, Certification Agency
Gestionnaire, Agence de certification



Certificate of Proficiency

EN 473 & ISO 9712 CERTIFICATION FOR NDT PERSONNEL

CSWIP CERT NO 50300

This is to certify that:

Phillip Chwachka

Date of birth 12 June 1984

has demonstrated proficiency as a Manual & Encoded Phased Array Ultrasonic Inspector Level 2 (Welds) in accordance with CSWIP requirements published in Document CSWIP-ISO-NDT-11/93-R, 5th Edition, October 2008, Appendix 1, Part 1b and amendments in force on the examination date.



PHILLIP CHWACHKA



Date of issue 5 November 2010

Date of expiry 2 September 2015

**MANUAL & ENCODED PHASED ARRAY
LEVEL 2 (W)**

EXPIRY: 02 09 2015

TWI Certification Ltd
Granta Park, Gt Abington
Cambridge, CB21 6AL UK
Tel: +44 (0) 1223 898000

*This card is the property of TWI Certification Ltd and must be surrendered on demand
It is not valid without the official CSWIP certificate*

Signed _____

(For CSWIP)

SIGNATURE OF HOLDER

(Person named above)

Date

Dec 7, 2010

PLEASE READ THE NOTES OVERLEAF

Photocopies are unauthorised by
TWI Certification Ltd

Issued by:
TWI Certification Ltd, Granta Park
Great Abington, Cambridge CB21 6AL, UK



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Alan Swanick

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	NA	NA	NA	NA	CGSB 2 REG # 11816	20/08/08
SNT TC 1A MT 2	NA	NA	NA	NA	CGSB 2 REG # 11816	20/08/08
SNT TC 1A PT 2	NA	NA	NA	NA	CGSB 2 REG # 11816	20/08/08
HT 1	NA	NA	100	NA	NA	22/11/08
PM1	NA	NA	NA	NA	NA	NA
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	14/08/13	CGSB 2 REG #11816			AUG 14 2016	
SNT TC 1A MT 2	14/08/13	CGSB 2 REG #11816			AUG 14 2016	
SNT TC 1A PT 2	14/08/13	CGSB 2 REG #11816			AUG 14 2016	
HT 1	14/08/13	LEVEL 3 PERFORMANCE REVIEW			AUG 14 2016	
PMI 1						

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada

Name/
Nom Alan Swanick
Reg. No./
No. matricule 11816
Issue Date/
Date d'émission 2011/01/06



Corrective lenses for near far vision.
Verres correctifs pour la vision de près distance.

Signature |



Natural Resources
Canada

Ressources naturelles
Canada

Qualified to CAN / CGSB-48.9732

ISO 20807 Qualifié selon

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.
MT	2	EMC	2004/01/30
PT	2	EMC	2004/01/25
UT	2	EMC	2008/09/07

11816
Date recert.
Date recert.

Expires
Expiration
2013/12/31
2013/12/31
2013/12/31

For product certification, visit website: <http://nrc.ca/nrc/11627>
Pour obtenir la certification, visitez le site web: <http://nrc.ca/nrc/11627>

Matricule: 11816 Alan Swanick
Certification: 2011/01/06



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Dwayne Shular

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	NA	NA	NA	NA	CGSB 2 REG # 12609	18/02/11
SNT TC 1A MT 2	NA	NA	NA	NA	CGSB 2 REG # 12609	18/02/11
SNT TC 1A PT 2	NA	NA	NA	NA	CGSB 2 REG # 12609	18/02/11
HT 1	NA	NA	100	NA	NA	18/02/11
PM1	NA	NA	NA	NA	NA	NA
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2		ORIGINAL CERT			31/12/13	
SNT TC 1A MT 2		ORIGINAL CERT			31/12/13	
SNT TC 1A PT 2		ORIGINAL CERT			31/12/13	
HT 1		ORIGINAL CERT			31/12/13	
PMI 1		NA				

LEVEL 3 EXAMINER




Natural Resources
Canada

Ressources naturelles
Canada



Name/
Nom Dwayne Shular
Reg. No. /
No. matricule 12609
Issue Date/
Date d'émission 2011/01/18

Corrective lenses for near far vision.
Verres correctifs pour la vision de près distance.
Signature 



Natural Resources
Canada

Ressources naturelles
Canada

Qualified to i) CAN CGSB-46.9712 12609

ii) ISO 20807 Qualifié selon

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	2006/05/31		2013/12/31
PT	2	EMC	2010/10/25		2013/12/31
UT	2	EMC	2010/12/14		2013/12/31

For product information, visit website: www.nrcc.gc.ca
For information on certification, visit the site: www.nrcc.gc.ca

Document: 02010000_A00001
Date: 2011/01/18

1-10-11



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Kundae Han

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 3	NA	NA	NA	NA	ASNT 3 REG# 148347	01/09/11
SNT TC 1A RT 3	NA	NA	NA	NA	ASNT 3 REG# 148347	06/06/12
SNT TC 1A MT 2	NA	NA	NA	NA	ASNT 3 REG# 148347	06/06/12
SNT TC 1A PT 2	NA	NA	NA	NA	ASNT 3 REG# 148347	06/06/12
HT 1	NA	NA	100	NA		01/09/11
PM1	NA	NA	NA	NA	NA	NA
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 3	ORIGINAL CERTIFICATION	ASNT 3 REG# 148347			JULY 7 2014	
SNT TC 1A RT 3	ORIGINAL CERTIFICATION	ASNT 3 REG# 148347			JUNE 06 2017	
SNT TC 1A MT 3	ORIGINAL CERTIFICATION	ASNT 3 REG# 148347			JUNE 06 2017	
SNT TC 1A PT 3	ORIGINAL CERTIFICATION	ASNT 3 REG# 148347			JUNE 06 2017	
HT 1	ORIGINAL CERTIFICATION	LEVEL 3 PERFORMANCE REVIEW			SEPT 01 2014	
PMI 1	NA					

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name/ Nom: **Kundae Han**
 Reg. No. / No. matricule: **16012**
 Issue Date/ Date d'émission: **2012/12/15**

This card does not identify the stated individual to be an employee or representative of Natural Resources Canada, Government of Canada.
 Cette carte n'atteste pas l'individu d'être un employé ou un représentant de Ressources naturelles Canada, Gouvernement du Canada.

Corrective lenses for || near || for vision
 Verres correctifs pour la vision de || près || distance.

Signature |



Natural Resources
Canada

Ressources naturelles
Canada

Leblond to Certifs only: CAN-CUSA 48 9711

16012

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	2010/08/13		2015/12/31
PT	2	EMC	2010/08/11		2015/12/31
UT	2	EMC	2010/07/07		2015/12/31

For verification of certification status, policies and definitions, visit website:
<http://nrc.ca/can.gc.ca/> Pour la vérification de la certification, les politiques et les définitions,
 visitez le site web: <http://nrc.ca/can.gc.ca/>

Manager, Certifying Agency
 Responsable, Organisme de certification



Certified Welding Inspector

KUNDAE HAN

REG # B912

is a certified Level 1 welding inspector in accordance with the requirements of CSA W170.2 "Certification of Welding Inspectors".

Valid until: June 11, 2018

This certification holds endorsements for the following codes and standards:
CSA W47.1/751 Valid until June 2018



Examination Results

July 09, 2012

Mr Kundae Han
3722 41st SW
Calgary T3E 3L7
CANADA

ASNT ID: 148347

Your NDT Level III certification examination results are as follows:

Method	Exam Date	Result
MT Method	6/6/2012	Pass
PT Method	6/7/2012	Pass
RT Method	6/5/2012	Pass

See the enclosed document *Results and Certification* to learn how your examination results affect ASNT certification.

ASNT Technical Services Department

The American Society for Nondestructive Testing, Inc.



Kundae Han

has met the heretofore published ASNT requirements for certification as

ASNT NDT Level III

in the nondestructive testing methods indicated

Method	Expiration Date
LT	7/14
MT	6/17
PT	6/17
RT	6/17
UT	7/14

ASNT Technical Services Manager

148347

Certificate Number



The American Society for Nondestructive Testing, Inc.

Be it known that

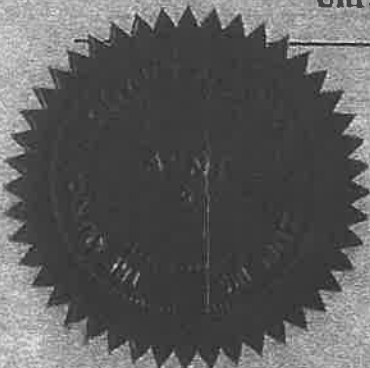
Kundae Han

has met the established and published Requirements for Certification by ASNT as

NDT Level III

in the following Nondestructive Testing Methods:

<u>Method</u>	<u>Issue Date</u>	<u>Expiration Date</u>
Leak Testing	7/09	7/14
Liquid Penetrant Testing	6/12	6/17
Magnetic Particle Testing	6/12	6/17
Radiographic Testing	6/12	6/17
Ultrasonic Testing	7/09	7/14



148347

Certificate Number

ASNT President

Certification Management Council Chair

This certificate is the property of ASNT, is not official without ASNT's raised gold seal and is subject to revocation prior to the listed expiration date. This certificate should be verified on the ASNT Web site or by contacting the ASNT Technical Services Department.



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Devin Ulmer

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 1	NA	NA	NA	NA	CGSB 1 REG # 16069	01/09/11
SNT TC 1A RT 2	NA	NA	NA	NA	NA	NA
SNT TC 1A MT 2	NA	NA	NA	NA	CGSB 2 REG # 16069	01/09/11
SNT TC 1A PT 2	NA	NA	NA	NA	CGSB 2 REG # 16069	03/16/12
HT 1	NA	NA	100	NA		01/09/11
PM1	NA	NA	NA	NA	NA	NA
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 1	ORIGINAL CERTIFICATION	NA			Jan. 09 2014	
SNT TC 1A RT 2	NA					
SNT TC 1A MT 2	ORIGINAL CERTIFICATION	NA			Jan. 09 2014	
SNT TC 1A PT 2	ORIGINAL CERTIFICATION	NA			Mar. 16 2015	
HT 1	ORIGINAL CERTIFICATION	NA			Jan. 09 2014	
PMI 1	NA					

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name/
Nom **Joseph D. Ulmer**
Reg. No. /
No. matricule **16069**
Issue Date/
Date d'émission **2012/03/19**

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Corrective lenses for | | near | | far vision.
Verres correctifs pour la vision de | | près | | distance.

Signature |  4 2 1 1 5 0 1 5 1



Natural Resources
Canada

Ressources naturelles
Canada

Certified to / Certifié selon CAN / COSB 48 9712

16069

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	2010/08/14		2013/12/31
PT	2	EMC	2012/03/16		2013/12/31
UT	1	EMC	2010/08/10		2013/12/31

For verification of certification status, policies and standards, visit website:
<http://nrcan.gc.ca/> Pour la vérification de la certification, des politiques, et les distributions,
visitez le site web: <http://nrcan.gc.ca/>

Manager, Certifying Agency
Gébonnaire, Organisme de certification



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Dylan Sunquist

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	76	83	83	80.9	NA	02/04/12
SNT TC 1A MT 2	76	88	83	82.4	NA	02/04/12
SNT TC 1A PT 2	76	85	91	84.7	NA	02/04/12
HT 1	NA	NA	100	NA	NA	02/04/12
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	NA	ORIGINAL CERT			02/04/2015	
SNT TC 1A MT 2	NA	ORIGINAL CERT			02/04/2015	
SNT TC 1A PT 2	NA	ORIGINAL CERT			02/04/2015	
HT 1	NA	ORIGINAL CERT			02/04/2015	
PMI 1	NA	NA			NA	

LEVEL 3 EXAMINER



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Mike Basaraba

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	96	100	95	96.8	NA	17/03/12
SNT TC 1A MT 2	96	91	90	92.1	NA	17/03/12
SNT TC 1A PT 2	96	88	92	92	NA	17/03/12
HT 1	NA	NA	100	NA	NA	17/03/12
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	NA	ORIGINAL CERT			17/03/2015	
SNT TC 1A MT 2	NA	ORIGINAL CERT			17/03/2015	
SNT TC 1A PT 2	NA	ORIGINAL CERT			17/03/2015	
HT 1	NA	ORIGINAL CERT			17/03/2015	
PMI 1						

LEVEL 3 EXAMINER



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Severino Valente

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	NA	NA	NA	NA	CGSB REG# 13783	23/03/12
SNT TC 1A MT 2	NA	NA	NA	NA	CGSB REG# 13783	23/03/12
SNT TC 1A PT 2	NA	NA	NA	NA	CGSB REG# 13783	23/03/12
HT 1	NA	NA	100	NA	NA	23/03/12
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	NA	ORIGINAL CERT			23/03/2015	
SNT TC 1A MT 2		ORIGINAL CERT			23/03/2015	
SNT TC 1A PT 2	NA	ORIGINAL CERT			23/03/2015	
HT 1		ORIGINAL CERT			23/03/2015	
PMI 1	NA	NA				

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name: **Severino A. Valente**
Nom:
Reg. No.: **13783**
No. matricule:
Issu: Date: **2011/04/21**
Date d'émission:

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Corrective lenses for near far vision.
Verres correctifs pour la vision de près distance

Signature: _____ Canada



Natural Resources
Canada

Ressources naturelles
Canada

— Niveau 2 / Niveau 2 — Secteur EMC

13783

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	2008/10/16		2013/12/31
PT	2	EMC	2008/12/7/4		2013/12/31
UT	2	PMC	2011/04/20		2013/12/31

For verification of participants status, policies and deadlines, visit website.
Pour vérifier le statut des participants, les politiques, et les délais, visitez le site web: <http://2011.nrcc.gc.ca/>

For details on the Agriplus
pour plus de détails de Agriplus



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Patrick McLean

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	NA	NA	NA	NA	CGSB REG# 13209	23/05/12
SNT TC 1A MT 2	NA	NA	NA	NA	CGSB REG# 13029	23/05/12
SNT TC 1A PT 2	NA	NA	NA	NA	CGSB REG# 13029	23/05/12
HT 1	NA	NA	100	NA	NA	23/05/12
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	NA	ORIGINAL CERT			MAY 23 2015	
SNT TC 1A MT 2	NA	ORIGINAL CERT			MAY 23 2015	
SNT TC 1A PT 2	NA	ORIGINAL CERT			MAY 23 2015	
HT 1	NA	ORIGINAL CERT			MAY 23 2015	
PMI 1	NA	NA				

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name/
Nom **Patrick M. McLean**
Reg. No. /
No. matricule **13209**
Issue Date/
Date d'émission **2013/05/06**

This card does not identify the stated individual to be an employee or representative of Natural Resources Canada, Government of Canada.
Cette carte n'identifie pas l'individu d'être un employé ou un représentant de Ressources naturelles Canada, Gouvernement du Canada.

Corrective lenses for [] near [] far vision.
Verres correctifs pour la vision de [] pres [] distance.

Signature :

Curran

Patrick McLean



Natural Resources
Canada

Ressources naturelles
Canada

Certified to / Certifié selon : CAN/CGSB-48.97-12

13209

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	2010/01/15		2015/12/31
PT	2	EMC	2010/01/15		2015/12/31
UT	2	EMC	2010/02/09		2015/12/31

For verification of certification status, policies and definitions, visit website:
<http://ndlrncan.gc.ca/> / Pour la vérification de la certification, les politiques, et les définitions,
visitez le site web: <http://ndlrncan.gc.ca/>

Manager, Certifying Agency
Gestionnaire, Organisme de certification

Patrick McLean



SPECTRUM NDT LTD
Certificate of Proficiency for NDT Personnel
Roy Donald Titmus

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	NA	NA	NA	NA	NA	
SNT TC 1A MT 2					CGSB # 521	05/03/09
SNT TC 1A PT 2	NA	NA	NA	NA	NA	
SNT TC 1A RT 2					CGSB # 521	05/03/09
HT 1	NA	NA	100	NA	NA	05/03/09
PM1					CGSB # 521 RT2	
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION		CURRENT CERT EXPIRES		
SNT TC 1A UT 2	NA	NA		NA		
SNT TC 1A MT 2	05/03/09 05/03/2012	CGSB EQUIVALENCY CGSB EQUIVALENCY		Mar. 05, 2015		
SNT TC 1A PT 2	NA	NA		NA		
SNT TC 1A RT 2	05/03/09 05/03/2012	CGSB EQUIVALENCY CGSB EQUIVALENCY		Mar. 05, 2015		
HT 1	05/03/2011	LEVEL 3 PERFORMANCE REVIEW		Mar. 05, 2014		

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name/
Nom Roy Donald Titmus

Reg. No.
No matricule 521

Issue Date/
Date d'émission 2010/12/23

Corrective lenses for: (| near | | far vision
Verres correctifs pour la vision de: (| près | | distance
Signature: |

R. Don Titmus



Natural Resources
Canada

Ressources naturelles
Canada

Qualified to: (1) CAN/CSA-45.9712

(2) ISO 20007 Qualifié selon

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	1998/05/09		2013/12/31
RT	2	EMC	1998/06/01		2013/12/31

521

For a full list of certified sites, visit website: <http://www.nrsc.gc.ca>
Pour connaître la liste des sites certifiés, visitez le site web: <http://www.rncm.gc.ca>

Maple Leaf Publishing Agency
La Société d'édition de la feuille d'érable

1 8 7



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Tyson Klein

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	83	94	81	85.5	NA	7/03/12
SNT TC 1A MT 2	83	90	82	84.7	NA	7/03/12
SNT TC 1A PT 2	83	86	86	85.1	NA	7/03/12
HT 1	NA	NA	NA	NA	NA	7/03/12
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	NA	NA			7/03/2015	
SNT TC 1A MT 2	NA	NA			7/03/2015	
SNT TC 1A PT 2	NA	NA			7/03/2015	
HT 1	NA	NA			7/03/2015	
PMI 1						

LEVEL 3 EXAMINER



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel Steven Taffs

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 1	NA	NA	NA	NA	CGSB # 12888	05/19/11
SNT TC 1A MT 2	81	85	89	85	NA	10/01/12
SNT TC 1A PT 2	80	87	91	86	NA	10/01/12
HT 1	NA	NA	100	NA	NA	10/01/12
PM1	NA	NA	NA	NA	NA	NA
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 1	NA	CGSB EQUIVALENT			JAN 10 2015	
SNT TC 1A MT 2	NA	LEVEL III EXAMINER			JAN 10 2015	
SNT TC 1A PT 2	NA	LEVEL III EXAMINER			JAN 10 2015	
HT 1	NA	LEVEL III EXAMINER			JAN 10 2015	
PMI 1	NA	NA			NA	

LEVEL 3 EXAMINER



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel Steven Foote

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	NA	NA	NA	NA	NA	
SNT TC 1A MT 2	NA	NA	NA	NA	NA	
SNT TC 1A PT 2	NA	NA	NA	NA	NA	
HT 1	NA	NA	100	NA	NA	
PM1	82	84	91	88	CGSB# 12873	23/04/13
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	NA	NA			NA	
SNT TC 1A MT 2	NA	NA			NA	
SNT TC 1A PT 2	NA	NA			NA	
HT 1	NA	NA			NA	
PMI 1	Apr.23 2013	LEVEL 3 PERFORMANCE REVIEW/ CGSB XF LEVEL 1 REG 12873			APR. 23 2016	

LEVEL 3 EXAMINER



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Mike Redgwell

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	96	98	88	93	CGSB # 11272	NOV. 01/13
SNT TC 1A MT 2	99.5	94	97.5	97	CGSB # 11272	NOV. 01/13
SNT TC 1A PT 2	99.5	98	98	97	CGSB # 11272	NOV. 01/13
HT 1	NA	NA	100	NA	NA	NOV. 01/13
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	NOV. 01/13	CGSB # 11272 LEVEL 3 PERFORMANCE REVIEW			NOV. 01/16	
SNT TC 1A MT 2	NOV. 01/13	CGSB # 11272 LEVEL 3 PERFORMANCE REVIEW			NOV. 01/16	
SNT TC 1A PT 2	NOV. 01/13	CGSB # 11272 LEVEL 3 PERFORMANCE REVIEW			NOV. 01/16	
HT 1	NOV. 01/13	ORIGINAL CERT LEVEL 3 PERFORMANCE REVIEW			NOV. 01/16	
PMI 1						

LEVEL 3 EXAMINER

Natural Resources
Canada

Ressources naturelles
Canada

11272

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expiry Expiration
MT	2	EMC	2008/11/16		2013/1/23/1
BT	2	EMC	2009/05/04		2013/1/23/1
	2	EMC	2007/02/15		2013/1/23/1

FLATLINE
RESPONSE INC.

Division of Flatline-ASI
Vocational College

Mike Redgwell

has successfully completed the performance requirements for
Standard First Aid with Health Care Provider C.P.R.
as outlined in the Alberta Workplace and Safety
Guidelines & ILCOR Guidelines.

Expiry Jan 16, 2016 Course No 011-613
Cert # 210 8974 Instructor D. Stewart



Issue No: 1 Expiry: 9/3/21

PCN No: 311582

Name: MICHAEL REDGWELL

[Signature]

(Holder's original signature)

This card, which is NOT a certificate of
competence, remains the property of The British
Institute of NDT, and must be surrendered on
demand (see further information on reverse).



CANADIAN WELDING BUREAU
MICHAEL GORDON REDGWELL

W1782

LEVEL 1 CERTIFIED WELDING INSPECTOR

The inspector named herein has completed with the requirements
of CSA Standard W178.2 "Certification of Welding Inspectors"

9382

11/24/2013

REG. NO. Expires (MM/DD/YYYY)

AUTHORIZED SIGNATURE

COMMENTS: Possession of this card does not imply that the holder represents an
original or certified to CSA Standard W178.1, having personnel and procedures
approved by the Canadian Welding Bureau.
It is the property of the Canadian Welding Bureau and can be recalled at any
time if necessary, in case of permanent cancellation.

Canadian Nuclear Resources Limited

OSSA SAFE WORK PERMITS

RCOP # SWP2010
Tracking # 2375

Aaron Storz
Authorization (Print)

Mike Gordon Redgwell
Candidate Name (Print)
First, Full Middle, Full Last

MAY 13 2013
Course Date

MAY 13 2016
Expiry Date

Initial
 Re-Certification

Authorization (Signature)

Michael Redgwell
11272

Registration Number
Numéro de matricule

is certified by the Canadian Nuclear Safety Commission as an Exposure Device Operator.
est accrédité par la Commission canadienne de sûreté nucléaire à titre d'opérateur d'appareil d'exposition.

2013/02/01
Issue Date
Date d'émission

2016/10/01
Expiry Date
Date d'expiration

Designated Officer
Fonctionnaire désigné

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada


ENFORM

Michael G. REDGWELL

Student ID No:
2099966

I2S Alive®

Completed: 27 Mar 2012
Expiry: 27 Mar 2015



Natural Resources Canada / Ressources naturelles Canada

Your certification card is only valid when presented with this photo card.
Votre certificat de poche est valide seulement si, est présenté avec cette carte d'identité

Michael Redgwell
Name / Nom

11272
Reg. No. / No. matricule

2002/05/27
Issue Date / Date d'émission

2007/12/31
Expiry Date / Expiration

ST5# FP2010-Rev01 OSHA# 20110705-26 Serial# B83422

COMPETENCY CERTIFICATE
Industrial/Commercial Employee
Fall Protection Program

ACSA Recognized
OSHA Accredited

Initial Re-Certification

Michael Gordon Redgwell

Training Date: April 17, 2013
Expiry Date: April 17, 2016

Trainer Name: Joshua Becker
Trainer Signature: [Signature]

Designed by Fall Protection Group Inc. (416) 278-1332

Natural Resources Canada / Ressources naturelles Canada

Michael Redgwell
Name / Nom

11272
Reg. No. / No. matricule

2010/12/20
Issue Date / Date d'émission

Corrective lenses for () near (X) far vision
Verres correctives pour la vision de () près (X) distance

Signature: [Signature]



SPECTRUM NDT LTD

NEAR - VISION ACUITY

TECHNICIAN	RESULT	EXAMINER	Signed	DATE OF TEST
M. Edwards	OK	C. Magdee Officer of the Company		May 02 2013
C. Magdee	OK	M. Edwards Level III		May 02 2013
T. Ross	OK	M. Edwards Level III		May 02 2013
K. Gowler	OK	M. Edwards Level III		May 02 2013
T. Griggs	OK	M. Edwards Level III		May 02 2013
A. Dachy	OK	M. Edwards Level III		May 02 2013
P. Chwachka	OK	M. Edwards Level III		May 02 2013
D. Titmus	OK	M. Edwards Level III		May 02 2013
A. Swanick	OK	M. Edwards Level III		May 02 2013
D. Shular	OK	M. Edwards Level III		May 02 2013
B. Gray	OK	M. Edwards Level III		Aug 14 th 2013
J. Hynes	OK	M. Edwards Level III		Aug 24 th 2013
D. Ulmer	OK	M. Edwards Level III		Sept 01 2013
K. Han	OK	M. Edwards Level III		Sept 01 2013
R. Savoie	OK	M. Edwards Level III		April 29 th 2013
S. Valente	OK	M. Edwards Level III		May 02 2013
D. Sunquist	OK	M. Edwards Level III		May 02 2013
M. Munoz	OK	M. Edwards Level III		May 02 2013
T. Klein	OK	M. Edwards Level III		May 02 2013
M. Basaraba	OK	M. Edwards Level III		May 02 2013
P. McLean	OK	M. Edwards Level III		May 02 2013
S. Taffs	OK	M. Edwards Level III		Oct 01 2013
M. Redgwell	OK	M. Edwards Level III		Nov 01 2013

FORM #
V1

JAEGER NUMBER 2 AT NOT LESS THAN 12 INCHES DISTANCE IN AT LEAST ONE EYE.
TEST CONDUCTED ANUALLY



SPECTRUM NDT LTD

COLOUR CONTRAST AND SHADES OF GREY

TECHNICIAN	RESULT	EXAMINER	Signed	DATE OF TEST
M. Edwards	OK	C. Magdee Officer of the Company		05/03/2012
C. Magdee	OK	M. Edwards Level III		05/15/2012
T. Ross	OK	M. Edwards Level III		05/15/2012
K. Gowler	OK	M. Edwards Level III		09/29/2011
T. Griggs	OK	M. Edwards Level III		09/02/2011
A. Dachy	OK	M. Edwards Level III		01/24/2011
P. Chwachka	OK	M. Edwards Level III		07/09/2011
D. Titmus	OK	M. Edwards Level III		May 3 rd 2012
A. Swanick	OK	M. Edwards Level III		08/08/2011
D. Shular	OK	M. Edwards Level III		02/18/2011
B. Gray	OK	M. Edwards Level III		08/14/2011
J. Hynes	OK	M. Edwards Level III		11/24/2011
K. Han	OK	M. Edwards Level III		09/01/2011
D. Ulmer	OK	M. Edwards Level III		09/01/2011
R. Savoie	OK	M. Edwards Level III		Apri 29 th 2012
S. Valente	OK	M. Edwards Level III		May 3 rd 2012
D. Sunquist	OK	M. Edwards Level III		May 7 th 2012
M. Basaraba	OK	M. Edwards Level III		May 10 th 2012
M. Munoz	OK	M. Edwards Level III		May 7 th 2012
P. McLean	OK	M. Edwards Level III		May 15 th 2012
S. Taffs	OK	M. Edwards Level III		Oct 01 st 2012
M. Redgwell	OK	M. Edwards Level III		Nov 01 st 2013

FORM #
V2-1

V2 TEST CONDUCTED EVERY 3 YEARS

APPENDIX C

EXHIBITS.

1 Examination questions

Magnetic Particle Level I - General Exam Questions.
Liquid Penetrant Level II - Specific Exam Questions.
Ultrasonic Level III - General Exam Questions.

2 Forms

Form QS3	Equipment Calibration Document.
Form QS4	Periodical Equipment Check Log.
Form V1	Annual Vision Test Form.
Form V2	Color contrast, shades of gray form.
Form C1	Certificate of Proficiency N.D.T. Personnel
Form PC1	Pocket Card Showing Certification (U.T., M.T and P.T.).
Form PC2	Pocket Card Showing Certification (H.T. & PMI).
UT Form	Ultrasonic Test Report.
MT Form	Magnetic Particle Test Report.
PT Form	Liquid Penetrant Test Report.
HTR1 Form	Hardness Test Report.

MAGNETIC PARTICLE

LEVEL I GENERAL

1. Why should a cracked filter on a 100 watt ultraviolet inspection lamp be changed immediately?
2. Describe how the inspection of a spring would be accomplished using fluorescent magnetic particles?
3. What is the approximate wave length of the ultraviolet (black light)?
4. What is meant by the term "Dark adaptation"?
5. Is inspection, using magnetic particles, possible on stainless steel parts?

LIQUID PENETRANT

LEVEL II SPECIFIC

1. The ability of a penetrant to enter a discontinuity is related to:
 - a) The viscosity of the penetrant.
 - b) Pressures generated by capillary action.
 - c) The chemical inertness of the penetrant.
 - d) The specific gravity of the penetrant.

2. A part was inspected with a water washable penetrant which had a penetration time of thirty (30) minutes. The part was rinsed with a water spray but the operator was unable to remove the excess penetrant. What would you do to remedy the problem?

3. By using sketches describe how penetrant, emulsifier and developer function during a penetrant test?

4. The following discontinuities might be found in a welded fabrication:
 - a) Shrinkage.
 - b) Lack of Fusion.
 - c) Tears.
 - d) Cold shuts.

5. Discuss some of the problems that could result if the following conditions were present:

- a) Material temperature too low.
- b) Penetration time too short.
- c) Penetration time too long.

ULTRASONIC

LEVEL III GENERAL

1. In not less than 100 words describe how immersion testing with the 'B' scan representation performs in comparison with 'C' scan representation when testing a cast steel block containing porosity, laminations and shrinkage.
2. Explain mode conversion within test specimens using Snells Law.
(100 words minimum)
3. How does the density and elasticity of the test material effect the following:
 - a) Piezoelectricity.
 - b) Soundbeam Reflection.
 - c) Wave Length.
 - d) Attenuation.
4. Sketch and label a block diagram of an ultrasonic flaw detector operating on the pulse echo method, describing each components function. (20 words for each component)
5. What is meant by the equation:
$$Z = Vd$$
 (50 to 100 words)
6. Solve:
Given that $V = FL$

Where $V = \text{Velocity}$

$F = \text{Frequency}$

$L = \text{Lamda or Wavelength}$

- a) Solve for L when $V = 585,00 \text{ cm/sec}$; $F = 2,250.00\text{Hz}$
- b) Solve for F when $V = 440,000\text{cm/sec}$; $L = .2\text{cm}$
- c) Solve for V when $F = 5\text{mHz}$; $L = .15\text{cm}$



SPECTRUM NDT LTD

EQUIPMENT CALIBRATION DOCUMENT

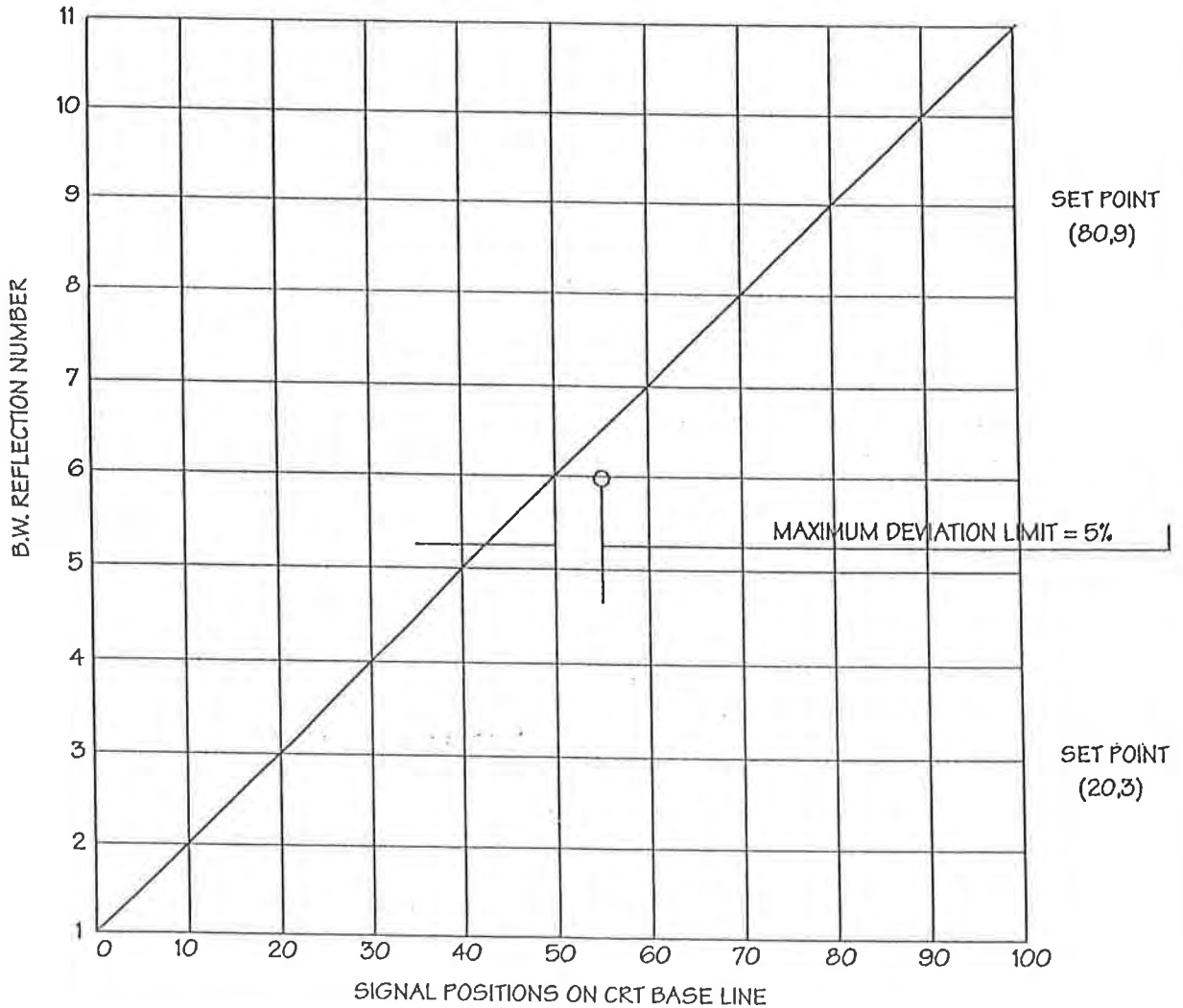
Instrument (make and model):

Serial number:

Qualification of Instrument functions:

Horizontal Limit and Linearity Check carried out in accordance with ASTM E317-85

HORIZONTAL LINEARITY GRAPH



Form

QS3.2

Date

Verified By

Level



SPECTRUM NDT LTD

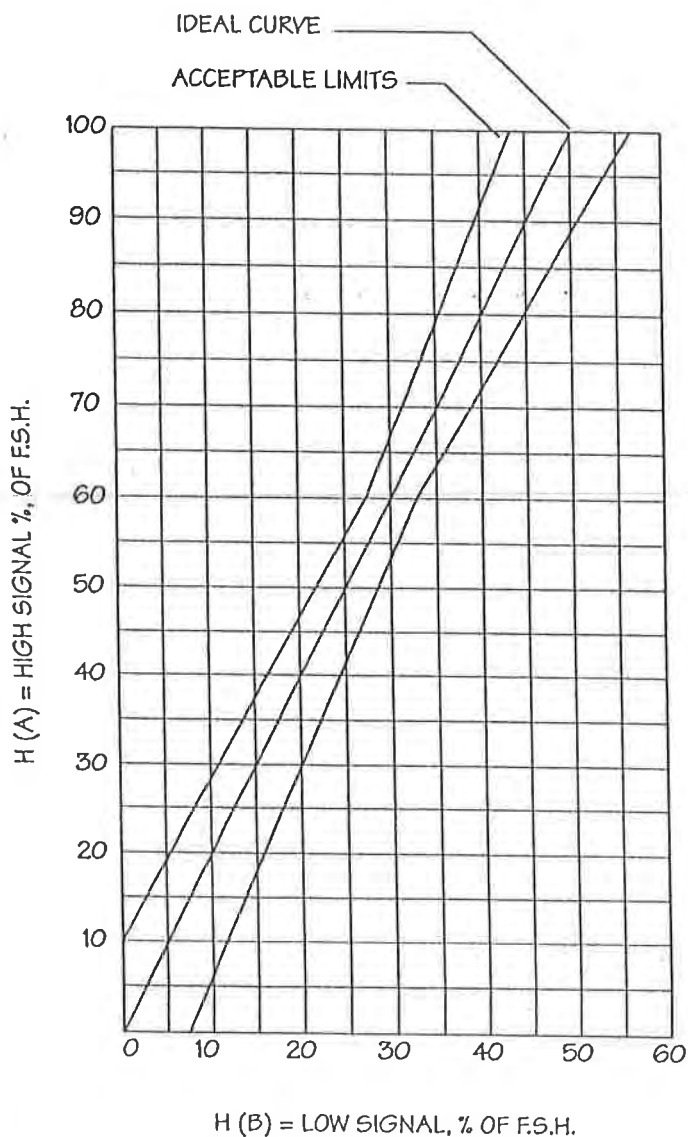
EQUIPMENT CALIBRATION DOCUMENT

Instrument (make and model):	Serial number:
------------------------------	----------------

Qualification of Instrument functions:

Vertical Limit and Linearity Check carried out in accordance with ASTM E317-85

VERTICAL LINEARITY GRAPH



ALTERNATE METHODS

SET H (A)	LIMITS H (B)	ACTUAL VALUES
100	47 - 53	
90	42 - 48	
80	40	set this value
70	32 - 38	
60	27 - 33	
50	22 - 28	
40	17 - 23	
30	12 - 18	
20	7 - 13	
10	2 - 8	

Form QS3.1	Date	Verified By	Level
---------------	------	-------------	-------



SPECTRUM NDT LTD

EQUIPMENT CALIBRATION DOCUMENT

Search Unit (make, model and size):		Serial number:	
Qualification of Instrument functions: Ultrasonic Beam Profile in the vertical and horizontal planes in accordance with ASTM Section III 1991 E164-90 A2.9			
Ultrasonic Unit:		Couplant:	
Calibration Blocks:			
TEST IN THE VERTICAL PLANE: Indication from side drilled hole 80% FSH; 1/2 amplitude 6 dB drop off: <u>Full Beam Spread</u> = _____ 1/10 amplitude 20 dB drop off: <u>Full Beam Spread</u> = _____			
TEST IN THE HORIZONTAL PLANE: Indication from side drilled hole 80% FSH; 1/2 amplitude 6 dB drop off: <u>Full Beam Spread</u> = _____ 1/10 amplitude 20 dB drop off: <u>Full Beam Spread</u> = _____			
REMARKS:			
Form QS3.3	Date	Verified By	Level



SPECTRUM NDT LTD

PERIODICAL EQUIPMENT CHECK LOG

Equipment I.D.	Date	Accept/Reject	Action Taken	Signed	Next Check Due
Form QS4					

SPECTRUM NDT LTD

NEAR - VISION ACUITY









JAEGER NUMBER 2 AT NOT LESS THAN 12 INCHES DISTANCE IN AT LEAST ONE EYE

TECHNICIAN	RESULT	EXAMINER	LEVEL III	DATE

FORM #
V1

SPECTRUM NDT LTD

COLOR CONTRAST / SHADES EYE EXAMINATION

	SHAPE	COLOR
		_____
		_____
		_____
		_____
		_____
		_____
		_____
		_____

TECHNICIAN	RESULT	EXAMINER	DATE

FORM #
V2



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Tech name here

ORIGINAL CERTIFICATION						
LEVEL	BASIC	METHOD	SPECIFIC	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 3						
SNT TC 1A MT 3						
SNT TC 1A PT 3						
HT 1						
PM1						
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT/MT/PT LEVEL 3						
HT 1						
PMI 1						

LEVEL 3 EXAMINER

SPECTRUM NDT LTD

**Certification Of Proficiency
Nondestructive Testing Personnel**

This certifies that _____ has qualified
in accordance with the requirements of SNT-TC-1A

METHODS: _____ LEVEL: _____

LEVEL III EXAMINER: _____

DATE: _____

SPECTRUM NDT LTD

Certification Of Proficiency Hardness Testing Personnel

This certifies that _____ has qualified
in accordance with the requirements of Spectrum
N.D.T. Ltd Procedures Manual. N.D.T. P1.

DATE: _____ LEVEL: HT 1

LEVEL III EXAMINER: _____



SPECTRUM N.D.T. LTD

ULTRASONIC TEST REPORT

Client		Job #		Report #		
		Req # or PO #		Work Sheet #		
Address		Requested by		Demo #		
				Procedure#		
Work Description			Acceptance Criteria		Code	
Material		Surface		Scanning Surface		
Instrument		Model		Serial #		
Sensitivity		Couplant		Inspector		
Search Unit	Serial Number	Size	Ref Sensitivity		Scan Sensitivity	
Identification		Description		Remarks		
Ind #	Depth (Inch)	Length (Inch)	Amplitude (dB's)	Probe(s)	Remarks	Classification
A = Acceptable minor non reportable indication B = Acceptable reportable indication C = Rejectable indication CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.						
CLIENT		INSPECTOR		LEVEL		DATE



SPECTRUM N.D.T. LTD

MAGNETIC PARTICLE TEST REPORT

Client	Job #	Report #	
	Req # or PO #		Work Sheet #
Address	Requested by	Demo #	
		Procedure #	
Work Description		Material	Surface
Code	Acceptance Criteria	Ambient Temp	Background / Batch
Technique	Equipment/Serial #	Power	Lifting Capability Check
Particle type	Batch #	Particle Size	Particle Manufacture
Light Source	Light intensity	Inspection surface	Inspector

Identification	Description	Comments

Ind No	Position	Length	Remarks

CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR	LEVEL	DATE
--------	-----------	-------	------



SPECTRUM N.D.T. LTD

HARDNESS TEST REPORT

Client		Job #	Report #
		Req # or P/O #	Work Sheet #
Address		Requested by	Procedure No
Work Description			
Code	Equipment	Material	Surface
Load	Hardness of Test Bar	Rejection Level	Inspector

W=WELD H=HEAT AFFECTED ZONE P=PARENT MATERIAL

Point #	Description	Weld Location				
		P	H	W	H	P
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

NOTE: Each recorded value is an average over three shots.
 CHANGES, MODIFICATIONS, ALTERATIONS OR ADDITIONAL WELDING WITHOUT RE-INSPECTION VOIDS REPORT.

CLIENT	INSPECTOR	LEVEL HT1	DATE
--------	-----------	--------------	------

SPECTRUM

May 1st 2007

Spectrum NDT Ltd Certifying Authority/Level III Examiner Appointment.

This statement formally states that on this date, Mark Edwards has been appointed as the certifying authority and level III examiner for Spectrum NDT Ltd. He is duly authorized to carry out all the functions as outlined in our Ultrasonic, Magnetic Particle and Liquid Penetrant examination procedures, qualifications and techniques manual, as well as administer examinations for all levels of personnel in accordance with SNT-TC-1A current mandatory edition.

Clint Magdee



Officer Of The Company

Mark Edwards,



President.

SPECTRUM

May 1st 2007

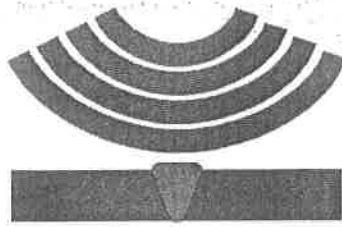
Re: Senior Management Authorization

I hereby verify that this N.D.T. Procedures Manual describes the system in use within Spectrum NDT Ltd, of 40 – 3170 114 AVE S.E. Calgary, Alberta T2Z 3V6 Tel 403 262 9958 Fax 403 262 0049

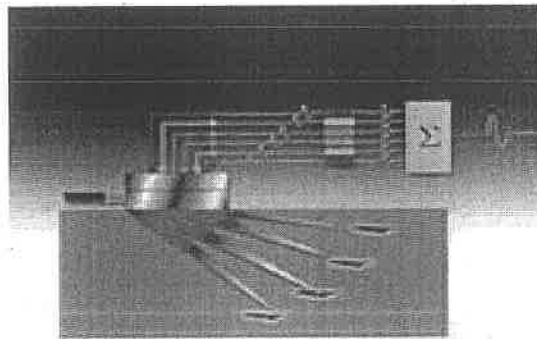
Mark Edwards,



President



SPECTRUM N.D.T. LTD



NON-DESTRUCTIVE TESTING PROCEDURES MANUAL NDT.P2 REV 1 MAR. 10/10

(RADIOGRAPHIC PROCEDURES AND STANDARDS)



CERTIFYING STATEMENT

FOREMOST UNIVERSAL LP
8825 Shepard Road S.E.
Calgary, Alberta Canada T2C 4N9
(403) 279-5000 Tel.
(403) 279-2088 Fax

I have reviewed the:

Written Practice:	Personnel Qualifying and Certification Procedure, no edition or revision status
	(Edition Number and or Revision Number of Written Practice)
NDE Procedures:	Radiographic Technique (RT1) Pressure Vessels
	Radiographic Technique (RT1) Pressure Piping
	NDT P2, Rev. 1 March 10, 2010
	(Method and Edition Number and or Revision Number of Procedures)
Personnel certification records and eye examination records of all examiners that will perform NDE at FOREMOST UNIVERSAL LP	

For

Spectrum NDT LTD, Bay 40, 3170, 114 Avenue S.E., Calgary, Alberta, T2Z 3V6
(Name and Address of NDE Company)

Based upon my review of the above referenced procedures, it is my opinion that they are in accordance with ASME Section V requirements as referenced by the applicable construction Code, and that the written practice complies in all respects with the requirements of SNT-TC-1A.

In addition I hereby certify that the demonstration of procedure(s) to the satisfaction of the AI, as required by the ASME Code, Section V, paragraph T-150, has been completed as specified within the (Name Of Company) written quality system.

Therefore:

Spectrum NDT LTD.
(Name of NDE Company)

are hereby appointed to perform:

RT
(RT, UT, PT, MT, ET, VT, and/or LT)

for:

Foremost Universal LP
(Name of Manufacturer)

APPOINTMENT OF LEVEL III EXAMINER

Tim Griggs

(Name of Level III Examiner)

is by this statement appointed to act as the Level III examiner for:

in the following methods:

FOREMOST UNIVERSAL LP
(Name of Manufacturer)

RT
(RT, UT, PT, MT, ET, VT, and/or LT)

P. Griggs

(Signature of QC Supervisor)

FEB 26 2013
(Date)

FEB 26 2014
(Appointment Expiry Date)

LEVEL III EXAMINER ACCEPTANCE OF APPOINTMENT

I hereby accept the appointment as indicated above.

Timothy Griggs
(Signature of Level III Examiner)



Maloney Industries

8825 Shepard Road SE
Calgary, Alberta T2C 4N9
Ph: (403) 279-5000
Fax: (403) 279-2068

July 18, 2007

To Whom It May Concern:

This letter states that Maloney Industries is aware that Spectrum NDT Ltd will operate and store a radiation device in our facility.

Proper use and storage of this device is the sole responsibility of Spectrum NDT and Maloney cannot verify that this is being carried out in accordance with all the current regulations that are applicable for the use, handling and storage of Nuclear Substances & Radiation Devices."

Yours truly,

Mike McCarthy
General Manager



WILCO



FORCE
COMPRESSION SYSTEMS



SPECTRUM

July 18 2007

Attn: Mr. A Krupich

Dear Sir

"This letter confirms that the radiation device owned and operated by Spectrum NDT and stored at the Maloney facility at 8825 Shepard Rd. S.E. is used and stored in accordance with all the current regulations that are applicable for the use, handling and storage of Nuclear Substances & Radiation Devices."

Yours truly,



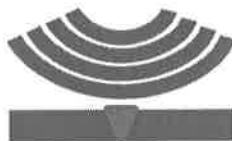
Mark Edwards
President Spectrum NDT

Spectrum N.D.T. Ltd.
Bay 40, 3170 114 Avenue S.E.
Calgary, Alberta
T2Z 3V6

The following written practice of Spectrum N.D.T. Ltd. Quality Control Manual has been reviewed and is found to be acceptable to the SNT-TC-1A document, current edition and addendums.



Tim Griggs
SNT Level III Radiography
Spectrum N.D.T. Ltd.
Dec 2nd 2008



SPECTRUM NDT LTD

Certificate Statement (Ref. SNT-TC-1A)

Employee: Tim Griggs

Test Method: RT

Location: Calgary

Restrictions to Certification (if any): None

Certification: III

Certification Date: Oct 14 2008

Expiry Date: Oct 14 2013

1. Education and Experience

Meets the requirements for applicable test methods, in accordance with SNT-TC-1A by virtue of written examination through outside agency.

2. Training

Training completed as per Spectrum NDT Ltd written procedures

3. Technical Examination Record

Examination Type	Date	Score (%)	Weight	Score	Examiner
Basic	Oct 14 2008	98	55	54	Ian Chizmazia, Level III
Specific	Oct 14 2008	100	20	20	Ian Chizmazia, Level III
Method	Oct 14 2008	95	65	62	Ian Chizmazia, Level III

A combined composite score of 97% (136/140) was achieved. This satisfies the Requirements of Certification for RT SNT III.

Tim Griggs CGSB Registration Number; 1270

3. Examiners Comments

Certification based on CGSB Level 2 certification, experience, educational background, as well As examination in three areas of RT as listed above, in accordance with SNT-TC-1A.

Mr. Ian Chizmazia, Level III Examiner CGSB Reg # 997

GAMMATECH INSPECTION SERVICES LTD.

Box 7 Site 20 RR 2
Strathmore, Alberta
T1P 1K5
(403) 934-3131

To Whom It May Concern:

Dear Sirs:

Please be advised that **TIM GRIGGS** S.I.N. _____ has been examined in the Radiographic Level III Test Method and has achieved the following grades:

General: 98 %

Specific: 100 %

Practical: 95 %

Final Grade: 97 %

Training requirements meet the recommended total hours in accordance with this procedure:

Yes X

No _____

Total Hours 80 hours

Level III examination supervised by: **Gammatech Inspection Services Ltd.**

Pass X

Fail _____

This certifies that **TIM GRIGGS** has demonstrated his knowledge and proficiency in the Radiographic Level III Test Method, according to the American Society For Non-destructive Testing Recommended Practice No. SNT-TC-1A (2001 Edition)(2006 EDITION) .

This certificate shall be valid from **OCTOBER 14, 2008.**

This certificate shall expiry **OCTOBER 14, 2013**

Tim Griggs CGSB Registration Number: ~~9999~~ 1270

Ian Chizmazia, Level III Examiner
CGSB Registration Number: 997
A.S.N.T. Level III
Gammatech Inspection Services Ltd.



Spectrum N.D.T. Ltd.

Year of Acceptable Edition of Referenced Standards

ASME Section I Recommended Practice for Nondestructive Personnel
Qualification and Certification

ASME Section VIII Recommended Practice for Nondestructive Personnel
Division 1 Qualification and Certification

ASME Section VIII Recommended Practice for Nondestructive Personnel
Division 2 Qualification and Certification

ASME B31.3 Recommended Practice for Nondestructive Personnel
Qualification and Certification

SNT-TC-1A Latest Edition

Spectrum N.D.T. Ltd.

Quality Control Manual

Table of Contents

Section One:	Personnel Qualifying and Certification Procedures
Section Two:	Training Programs
Section Three:	Examination Questions
Section Four:	Personnel and Company Certification
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Section Six:	Radiographic Technique (RT 1) Pressure Vessels
Section Seven:	Radiographic Technique (RT 1) Pressure Piping

Section One

Personnel Qualifying and Certification Procedures

- 1.0 Scope
- 2.0 Testing Method
- 3.0 Levels of Qualification
- 4.0 Requirements for Initial Certification
- 5.0 Training Programs
- 6.0 Examinations
- 7.0 Certification
- 8.0 Technical Evaluations
- 9.0 Recertification
- 10.0 Termination and Reinstatement

1.0 Scope

- 1.1 This manual establishes the practices of Spectrum N.D.T Ltd. will follow

In certifying and qualifying nondestructive personnel whose specific jobs require appropriate knowledge of the nondestructive tests they perform witness, monitor or evaluate. This procedure references and is in accordance with the American Society for Non Destructive Testing Recommended Practice SNT-TC-1A Latest Edition.

2.0 Nondestructive Testing Method

- 2.1 Qualification and certification of nondestructive test personnel in accordance with this procedure is applicable to Radiographic Testing (RT) only.

3.0 Levels of Qualification

- 3.1 There are three Levels of qualification, Level I, Level II and Level III.
- 3.2 While in the process of being initially trained, qualified and certified, an individual will be considered a trainee. A trainee will work only with certified individuals and shall not independently conduct any tests, interpret or evaluate the results of a test or report the test results.
- 3.3 Level I: A Level I employee is qualified to properly perform specific calibrations, specific tests and specific evaluations for acceptance or rejection determination, according to written instruction and to record the results. A Level I will receive the necessary instruction from a certified Level II or Level III.
- 3.4 Level II: A Level II employee is qualified to set up and calibrate equipment and to evaluate results with respect to the applicable codes, standards and specifications. The Level II will be familiar with scope and limitations of the methods for which they are qualified and will accept responsibility for on the job training and guidance of Level I personnel. The Level II can prepare written instructions, organize and report the results of the nondestructive tests.

- 3.5 Level III: A Level III will be capable of establishing techniques and procedures, interpreting codes, standards and specifications and designing the particular test methods, techniques and procedures to be used. The Level III will be responsible for the operations for which qualified and which assigned, and will be capable of interpreting and evaluating results in terms of existing codes, standards and specifications. The Level III will have sufficient practical background in applicable materials, fabrication and product technology to establish techniques and assist in establishing acceptance criteria where none are otherwise available. The Level III will have general familiarity with other appropriate NDT methods as demonstrated by an ASNT Level III Basic examination. The Level III should be capable of training and examining NDT Level I and II personnel for certification.

4.0 Requirements for Initial Certification

- 4.1 Personnel considered for certification in nondestructive testing will have sufficient education, training and experience to ensure the understanding of the principals and procedures of those areas of testing which they are being certified.
- 4.2 To be considered for certification, a candidate will satisfy one of the following criteria for the applicable level.
- 4.3 Level I and Level II
- 4.3.1 Table 1 lists the minimum training and experience factors to be considered for Level I and Level II certification.
- 4.3.2 Table 2 lists alternate training and experience factors which may be used for Level I and Level II certification.
- 4.4 Level III
- 4.4.1 Having graduated from a minimum four years college or university with a degree in engineering or science plus one year of experience beyond Level II requirements in NDT in an assignment comparable to that of an NDT Level II in Radiography.
- 4.4.2 Having completed with passing grades at least two years of engineering or science study at a university, college or technical school plus two years experience beyond the Level II requirements in NDT in an assignment at least comparable to that of a Level II in Radiography.

- 4.4.3 Having four years experience beyond the Level II requirements in NDT in an assignment at least comparable to that of an NDT Level II in Radiography.
 - 4.4.4 When the employee is qualified by examination, the above requirements may be partially replaced by experience as a certified Level II or in assignments comparable to Level II.
- 4.5 Level I, II, or III candidates may be certified by the President of Spectrum N.D.T. Ltd. if they meet the requirements of Section 4.3 and 4.4. This certification may be based on the minimum experience and training and shall be documented and have Substantiation in the form of affidavits, certificates, transcripts and resumes.

5.0 Training Programs

- 5.1 Personnel being considered for initial certification will complete sufficient training to become familiar with the principals and practices related to the level of certification being desired.
- 5.2 Personnel may receive such training from a recognized industrial course or program pertinent to radiography, or a company held training program which follows the guide lines as set out under the SNT-TC-1A document latest edition and Spectrum NDT Ltd. written practice.
- 5.3 Training programs will include sufficient examinations to assure that the necessary information has been understood.

6.0 Examinations

- 6.1 Administration and Grading
 - 6.1.1 A Level III will administer and grade all examinations. The administration and grading of examinations may be delegated to a designated representative of the Level III and be so recorded. The President of Spectrum N.D.T Ltd. or a designated representative will be responsible for administering and grading Level III personnel.
 - 6.1.2 A composite grade should be determined for Level I and II candidates by simple averaging of the general, specific and practical test results. Level III candidates will have composite

Grades determined by simple averaging of the basic, method and specific examinations.

- 6.1.3 A minimum passing grade of 80% is required to obtain certification with no one examination grade falling below 70%.
- 6.1.4 When examinations are administered and graded for Spectrum N.D.T. Ltd. an outside agency and that outside agency issues on a certified report, a grade of pass or fail only, then the employer may accept the pass grade as 80% for that particular examination.
- 6.1.5 Spectrum N.D.T. Ltd. shall ensure that all outside agencies employed for examination services meet the requirements of this manual.

6.2 Vision Requirements

- 6.2.1 Near Vision Acuity: An examination shall be given yearly to assure natural or corrected near distance acuity in at least one eye, such that the employee is capable of reading a minimum of Jaeger Number 2 or equivalent type and size letter at a distance of 12 inches on a standard Jaeger eye test chart. The ability to perceive an Orto-Rater minimum of 8 or similar test pattern is also acceptable
- 6.2.2 Color Contrast Differentiation: The examination should demonstrate the capabilities of distinguishing and differentiating contrast among colors and or shades of gray used in Radiography. This examination should be conducted upon initial certification and every three years thereafter.

6.3 Written Examination Level I and Level II

- 6.3.1 General Examination
 - 6.3.1.1 The General Examination will address the basic principals of Radiography
 - 6.3.1.2 The NDT Level III will select or devise a minimum of forty questions.
- 6.3.2 Specific Examination
 - 6.3.2.1 The Specific Examination shall address the equipment, operating procedures and techniques that an individual may encounter during specific operations. Codes, specifications and acceptance criteria used during the performance of testing are also covered in this examination.
 - 6.3.2.2 The NDT Level III will select or devise a minimum of twenty questions.

- 6.3.3 Written examinations will be closed book except that necessary data, such as graphs, table, specifications, procedures, etc. may be provided.
- 6.4 **Written Examination Level III (Basic Method and Specific)**
 - 6.4.1 **Basic Examination:** The Basic Examination has three separate parts. Part "A" has fifteen questions relating to the understanding of the SNT-TC-1A document. Part "B" has twenty questions related to applicable materials, fabrication and product technology. Part "C" have twenty questions that are similar to published Level II questions for other appropriate NDT methods.
 - 6.4.2 **Method Examination:** The Method Examination has three separate parts. Part "A" has thirty questions relating to fundamentals and principals that are similar to published ASNT Level III questions for Radiography. Part "B" has fifteen questions relating to applications and establishment of techniques and procedures that are similar to the published ASNT Level III questions for Radiography. Part "C" has twenty questions relating to the capability for interpreting codes, standards and specification relating to Radiography.
 - 6.4.3 **Specific Examination:** The Specific Examination will have twenty questions relating to specifications, equipment, techniques and procedures applicable to the products and methods employed by Spectrum N.D.T. Ltd.
 - 6.4.4 On the basis of demonstrated ability, achievement, experience and education as defined in Section 4.4, Spectrum N.D.T. Ltd. may waive the Specific Examination. Written certification will be provided and evidence supporting the certification will be held on file and made available when required.
 - 6.4.5 Written Examinations will be closed book except that necessary data such as graphs, tables, specification, procedures etc. may be provided as needed.
- 6.5 **Practical Examinations: Level I and Level II**
 - 6.5.1 The candidate should demonstrate familiarity with and ability to operate the necessary NDT equipment, record and analyze the resultant information to the degree required.
 - 6.5.2 One flawed specimen will be inspected and the results of the test analyzed by the candidate.
 - 6.5.3 The description of the specimen, the test procedure including all checkpoints and results of the examination will be documented.

6.5.4 Proficiency will be demonstrated in performing the Radiographic

Test on at least one sample approved by the Level III. At a minimum, at least ten different checkpoints requiring an understanding of the test variables and procedural requirements will be included in the examination.

6.6 Re-Examination

6.6.1 Personnel failing to attain the required grades shall wait at last thirty days before reexaminations are allowed. Prior to reexamination the candidate shall receive additional training as determined by the Level III.

7.0 Certification

7.1 Certification for all levels of NDT personnel is the responsibility of Spectrum N.D.T. Ltd.

7.2 Certification of all NDT personnel shall be based on demonstration of satisfactory qualification in accordance with Section 4, 5 and 6 of this manual.

7.3 An outside agency may be engaged to provide Level III services, but in all cases, the responsibility of certification shall remain with Spectrum N.D.T. Ltd.

7.4 Personnel certification records shall be maintained on file by Spectrum N.D.T. Ltd. and shall include the following:

7.4.1 Name of certified employee

7.4.2 Level of certification

7.4.3 Education and experience of employee

7.4.4 Verification of satisfactory completion of training in accordance with Spectrum N.D.T. Ltd. written practice.

7.4.5 Compliance of vision requirements

7.4.6 Proof of composite grades and examinations

7.4.7 Current examinations or evidence of successful completion of examination

7.4.8 Ate of certification or re-certification

7.4.9 Certification expiry date.

7.4.10 Signature of employer's certifying authority

8.0 Technical Performance Evaluation

- 8.1 Annually, an NDT Level III shall evaluate and document the technical performance of Level I and II personnel.
- 8.2 Random evaluations may be performed at any time by the NDT Level III. The Technical Performance Evaluation Log is located in APPENDIX B.

9.0 Recertification

- 9.1 Level I and Level II personnel shall be recertified once every three years.
- 9.2 Level III personnel shall be recertified once every five years.
- 9.3 All Levels of personnel being recertified shall show evidence of continuing satisfactory performance or be reexamined in those portions deemed necessary by Spectrum N.D.T. Ltd.
- 9.4 Spectrum N.D.T. Ltd. employees shall have at minimum twelve months of uninterrupted service for reexamined and recertified in accordance with Sections 4, 5 and 6 of this manual.

10.0 Termination and Reinstatement

- 10.1 Spectrum N.D.T. Ltd. certification shall be revoked when it employee has been terminated.
- 10.2 A Level I, II or III may be recertified to their former Level by examination providing all the following are met:
 - 10.2.1 The employee is being recertified within six months of termination
 - 10.2.2 The employee was working in the capacity to which he or she was certified within six months of termination.
 - 10.2.3 The employee has proof of prior certification.
- 10.3 An employee may be reinstated to their former NDT Level without examination providing all the following are met:
 - 10.3.1 The employee is being reinstated within six months of termination
 - 10.3.2 The employee's certification did not expire during termination
 - 10.3.3 Spectrum N.D.T. Ltd. has maintained the employee certification records.
- 10.4 All employees not meeting the above requirements shall receive training which the company Level III deems necessary.

Initial Training and Experience Levels for Radiography

Table 1

Level	Hours Req'd Training		Min. Work Req'd Hours		Permitted Time Frame Months	
	I	II	I	II	I	II
High School Graduate or equivalent	40	40	210	630	1.5-9	4.5-27
Completion with a passing grade of at least 2 yrs of eng. or science at a college.	30	35	210	630	1.5-9	4.5-27

- 1.0 For Level II certification, the experience shall consist of time at Level I or equivalent. If a person is being qualified directly to Level II with no time at Level I, the required experience shall consist of the sum of the times required for Level I and Level II and the required raining shall consist of the sum of the fours required for Level I and Level II.

Section Two
Training Programs

One Level One and Level Two
Two Level Three

TABLE II

COURSE OUTLINE – RADIOGRAPHIC TESTING METHOD

SUBJECT	Instruction Period		
	Hours		
	<u>Level I</u>	<u>Level II</u>	
1. Introduction	.9 1.5 6.0	1.0 1.0 5.0	
1.1 History of industrial radiography			
1.2 General principles of examination of Materials with penetrating radiation			
1.3 Relationship of penetrating radiation, radiography and radiometry			
1.4 Comparison with other methods:			
1. Imaging			
2. Metrological			
3. Product			
 2. Physical Principles	 1.2 2.0 8.0	 5.0 5.0 15.0	
2.1 Nature of penetrating radiation (all Types briefly, X-ray and gamma Detailed).			
1. Particles			
2. Wave properties			
3. Electromagnetic waves			
4. Electrical theory of matter			
5. Fundamentals of radiation physics			
6. Sources of radiation:			
a. Electronic			
b. Isotopic			
c. Other			
 2.2 Interaction between penetrating radiation and matter			
1. Absorption			
2. Scatter			
3. Pair production			
4. Photoelectric effect			
5. Other secondary emission			

TABLE II

RADIOGRAPHIC TESTING METHOD

SUBJECT	Instruction Period Hours		
	Level I	Level II	
2.3	Radiography	. . . . .	. . . . .
	1. Imaging by file		
	2. Imaging by fluorescent materials		
	3. Imaging by electronic devices		
2.4	Radiometry		
	1. Physics of detection devices		
2.5	Glossary of terms and units of measure		
3. Radiation Sources		1.8 3.0 12.0	3.0 3.0 5.0
3.1	Electronic Sources		
	1. X-ray sources		
	a. Generators and tubes as an integrated system		
	b. Electron sources:		
	Cold cathode		
	Hot cathode		
	Beam focusing		
	Field emission		
	Other		
	c. Accelerating potential:		
	General		
	Tesla coils		
	Mechanical rectifiers		
	Metal core transformers		
	Resonant coil transformers		
	Electrostatic		
	d. Targets:		
	Material		
	Configuration		
	Heat dissipation		
	e. Equipment design considerations:		
	Generating wave shape		
	Window design		
	Duty cycle		
	Roentgen output		
	Tube shielding		
	Installation – fixed, mobile, etc.		

TABLE II

RADIOGRAPHIC TESTING METHOD

SUBJECT	Instruction Period		
	Hours		
	<u>Level I</u>	<u>Level II</u>	
	* .. *	* .. *	
2. Particulate radiation sources			
a. Electrons			
b. Neutrons			
c. Other (alpha, deuterons, etc)			
3.2 Isotopic Sources			
1. Gamma			
a. Types			
b. Spectra			
c. Activity including self-absorption			
d. Handling			
2. Beta			
3. Bremsstrahlung			
4. Neutron			
4. Radiation Detection	1.8	3.0	12.0
4.1 Imaging		3.0	5.0
1. Film-principles-properties			
a. Material examination			
b. Monitoring			
2. Fluoroscopy			
a. Fluorescent screen			
b. Image amplification			
c. Cine techniques			
3. Direct TV viewing			
4. Solid state devices			
a. Xeroradiography			
b. Ionography			
c. Solid state viewer			
d. Other			
5. Special Instrumentation associated with above			
4.2 Nonimaging Devices			
1. Solid state			
a. Scintillometers			
b. Photoresistive			
c. Other			

TABLE II

RADIOGRAPHIC TESTING METHOD

SUBJECT	Instruction Period Hours		
	Level I	Level II	Level III
2. Gaseous			
a. Proportional counters			
b. Geiger counters			
c. Ionization chambers			
d. Ohmart cells			
e. Other			
3. Instrumentation			
a. Rate meters			
b. Counters			
c. Amplifiers and pre-amplifiers			
d. Recording readouts			
e. Other			
5. Personnel Safety and Radiation Protection	1.5	2.5	10.0
5.1 Hazard of excessive exposure			
5.2 Methods of controlling radiation dose			
1. Time			
2. Distance			
3. Shielding			
5.3 Specific equipment requirements			
1. X-ray			
2. Gamma handling			
3. Survey			
4. Recording			
5. Exposure shields and/or rooms			
a. Operation			
b. Alarms			
5.4 Operation and emergency procedures			
5.5 Federal, State, and Local Regulations			
6. The Radiographic Process			
6.1 Basic imaging considerations			
1. Definition of sensitivity (including penetrameters)			
2. Contrast and Definition			
a. Relation of kilovoltage or wave-length to contrast and definition			

TABLE II

RADIOGRAPHIC TESTING METHOD

SUBJECT	Instruction Period	
	Hours	Hours
	<u>Level I</u>	<u>Level II</u>
3. Geometric principles
4. Intensifying screens		
a. Fluorescent		
b. Metallic		
5. Generation and control scatter		
6. Choice of source		
7. Choice of film		
8. Use of exposure curves and how to make them		
9. Fluoroscopic inspection		
a. Theory of operations		
b. Applications		
c. Limitations		
10. Film Processing		
a. Darkroom procedures		
b. Darkroom equipment and chemicals		
c. Film processing do's and don'ts		
11. Viewing of radiographs		
a. Illuminator requirements		
b. Background lighting		
c. Judging quality of radiograph		
12. Causes and correction of unsatisfactory radiographs		
a. High film density		
b. Insufficient film density		
c. High contrast		
d. Low contrast		
e. Poor definition		
f. Fog		
g. Light leaks		
h. Artifacts		
13. Arithmetic of exposure and of other factors affecting test		
6.2 Miscellaneous applications		
1. Blocking and Filtering		
2. Multifilm techniques		
3. Enlargement and projection		
4. Stereo radiography		

TABLE II

RADIOGRAPHIC TESTING METHOD

SUBJECT	Instruction Period					
	Hours					
	<u>Level I</u>		<u>Level II</u>			
	1	2	3	4	5	6
5. Triangulation methods	.	..	...	.	..	...
6. Autoradiography						
7. Neutron radiography						
8. Flash radiography						
9. "In Motion" radiography and Fluoroscopy						
10. Backscatter radiography						
11. Micro radiography						
12. Causes of "diffraction" effects and minimization of interference with test						
13. Determination of focal spot size						
14. Panoramic techniques						
15. Altering film for contrast and for density						
16. Gauging and control processes						
7. Test Result Interpretation	1.8	3.0	12.0	13.0	13.0	25.0
7.1 Basic factors						
1. General aspects						
2. Effects on measurement and inter- pretation of test						
3. Administrative control of test quality by interpreter						
4. Familiarization with image						
7.2 Material considerations						
1. Metallurgy or other material discipline as it affects use of item and test results						
2. Material processing effects on use of item and test results						
3. Discontinuities, their causes and effects						
4. Radiographic appearance of discontinuities						

TABLE II

RADIOGRAPHIC TESTING METHOD

SUBJECT	Instruction Period Hours					
	Level I			Level II		
	·	·
7.3 Codes, standards, specifications, and procedures	·	..	...	·	..	...
Total Minimum Hours	12.0	20.0	80.0	40.0	40.0	80.0

- Completion with a passing grade of at least 2 years of engineering or science study at a university, college, or technical school.
- .. High school graduation, diploma or its equivalent.
- ... Grammar school graduation, or demonstrated proficiency or additional training.

Basic Examination

General Level III Requirements

The Basic Examination will cover three (3) main topical areas:

1. Personnel Qualification and Certification Programs
 - SNT-TC-1A
 - ANSI/ASNT-CP-189
 - ASNT Level III Program
2. General familiarity with other NDT Methods,
3. General knowledge of materials, fabrication and product technology.

Separate Method examinations will be given to cover each of the following NDT Methods:

- Acoustic Emission Testing
- Electromagnetic Testing
- Leak Testing
- Liquid Penetrant Testing
- Magnetic Particle Testing
- Neutron Radiographic Testing
- Radiographic Testing
- Thermal/Infrared Testing
- Ultrasonic Testing
- Visual Testing

Each of the ten Method examinations are divided into three main topical areas:

1. Method fundamentals and principles
2. General knowledge of techniques within the Methods
3. General interpretation of codes, standards and specifications relating to the Method.

The Basic examination and one or more Method examinations must be taken and passed to qualify for an ASNT Level III Certificate. The endorsements on the ASNT Certificate will list the various Methods which the applicant passed.

The following topical outlines further subdivide the main topical areas of both Basic and Method examinations, cite literature references and have sample questions typical of those in the examinations.

Recommended Practice No. SNT-TC-1A

- 1.0 Scope
- 2.0 Definitions
- 3.0 Nondestructive Testing Methods
- 4.0 Levels of Qualification

- 5.0 Written Practice
- 6.0 Education, Training and Experience
- 7.0 Training Programs
- 8.0 Examinations
- 9.0 Certification
- 10.0 Termination

ASNT Standard ANSI/ASNT-CP-189

- 1.0 Scope
- 2.0 Definitions
- 3.0 Levels of Qualification
- 4.0 Qualification Requirements
- 5.0 Qualification and Certification
- 6.0 Examinations
- 7.0 Expiration, Suspension, Revocation and Reinstatement of Employee's Certification
- 8.0 Employer Recertification
- 9.0 Records
- 10.0 Referenced Publications

ASNT Level III Certification Program

ASNT Document Numbers

- CP-3-89
- CP-4-86
- CP-5-87
- CP-6-86

Radiographic Testing Method

Level III Topical Outline

1.0 Principles/Theory

- 1.1 Nature of penetrating radiation
- 1.2 Interaction between penetrating radiation and matter
- 1.3 Radiography
 - 1.3.1 Imaging by film
 - 1.3.2 Imaging by fluorescent materials
 - 1.3.3 Imaging by electronic devices

2.0 Radiometry

- 2.1 Equipment/Materials
 - 2.1.1 X-ray sources
 - a. Generators and tubes as an integrated system
 - b. Sources of electrons
 - c. Electron accelerating methods
 - d. Target materials and characteristics
 - e. Equipment design considerations
- 2.2 Particulate radiation sources
- 2.3 Radiation detectors
 - 2.3.1 Imaging
 - a. Film-principles-properties
 - b. Fluoroscopy
 - c. TV and optical systems
 - d. Other nonfilm devices
 - 2.3.2 Nonimaging devices
 - a. Solid state detectors
 - b. Gaseous ionization detectors
 - c. Instrumentation
 - d. Gaging and control processes

3.0 Techniques/Calibration

- 3.1 Imaging considerations
 - 3.1.1 Sensitivity
 - 3.1.2 Contrast and definition
 - 3.1.3 Geometric factors
 - 3.1.4 Intensifying screens
 - 3.1.5 Scattered radiation
 - 3.1.6 Source factors
 - 3.1.7 Detection media
 - 3.1.8 Exposure curves

- 3.2 Film Processing
 - 3.2.1 Darkroom procedures
 - 3.2.2 Darkroom equipment and chemicals
 - 3.2.3 Film processing
- 3.3 Viewing of radiographs
 - 3.3.1 Illuminator requirements
 - 3.3.2 Background lighting
 - 3.3.3 Optical aids
- 3.4 Judging radiographic quality
 - 3.4.1 Density
 - 3.4.2 Contrast
 - 3.4.3 Definition
 - 3.4.4 Artifacts
 - 3.4.5 IQIs
 - 3.4.6 Causes and correction of unsatisfactory radiographs
- 3.5 Exposure calculations
- 3.6 Radiographic Techniques
 - 3.6.1 Blocking and filtering
 - 3.6.2 Multifilm techniques
 - 3.6.3 Enlargement and projection
 - 3.6.4 Stereoradiography
 - 3.6.5 Triangulation methods
 - 3.6.6 Autoradiography
 - 3.6.7 Flash radiography
 - 3.6.8 In-motion radiography
 - 3.6.9 Fluoroscopy
 - 3.6.10 Electron emission radiography
 - 3.6.11 Micro radiography
 - 3.6.12 Neutron radiography
 - 3.6.13 Laminography (tomography)
 - 3.6.14 Control of diffraction effects
 - 3.6.15 Panoramic exposures
 - 3.6.16 Gaging
 - 3.6.17 Real-time imaging
 - 3.6.18 Image Analysis techniques
 - 3.6.19 Image-object relationship

4.0 Interpretation/Evaluation

- 4.1 Material considerations
 - 4.1.1 Materials processing as it affects use of item and test results
 - 4.1.2 Discontinuities, their cause and effects
 - 4.1.3 Radiographic appearance of discontinuities
 - 4.1.4 Nonrelevant indications
 - 4.1.5 Film artifacts

5.0 Procedures

6.0 Safety and Health

- 6.1 Exposure Hazards
- 6.2 Methods of controlling radiation exposure
- 6.3 Operational and emergency procedures
- 6.4 Dosimetry and Film Badges

Section Three

Examination Questions

One	Level One Specific Exam Questions
Two	Level One General Exam Questions
Three	Level Two Specific Exam Questions
Four	Level Two General Exam Questions
Five	Level One and Level Two Practical Examination

SPECIFIC EXAMINATION

NDT LEVEL I

RADIOGRAPHY

Note: The bracketed numbers are the point values of the questions.

1. What radiation sources may Spectrum N.D.T. Ltd. use?

(4)

2. Explain why lead screens are used. What foil thicknesses are used?

(4)

3. Where multiple films are required, how much overlap is required?

(4)

4. Where not density is specified, what film density shall be used?

Single film viewing:

(6)

Double film viewing:

5. (a) What penetrometer shall be used if none is specified?

(6) **(b) When 2 – 2T is specified, what does the first number refer to?**

(c) When 2 – 2T is specified, what does the second number refer to?

6. (a) Which side of the object should the penetrometer be placed on?

(6) **(b) What do you do if inaccessibility prevents this?**

7. Are you permitted to interpret radiographs with Level I qualifications?

(4)

8. (a) Explain how to reduce back scattered radiation.
- (6)
- (b) Explain how you determine back scatter is occurring.
9. Explain the radiograph identification system Spectrum N.D.T. Ltd. uses.
- (4)
10. Explain how to determine the proper film exposure for items of unknown radiation absorption.
- (6)
11. How much separation between hangers is required when processing film?
- (4)
12. What is the purpose of tapping the cross bars of hangers when they are in the developer?
- (4)
13. (a) What determines the developing time?
- (2)
- (b) What are the manufacturers' recommendations?
14. How long is the film left in the stop bath?
- (2)
15. Explain the Inverse Square Law as it is applied to Radiation Safety.
- (6)

16. Describe how and where you would set up barricades before starting the exposure.
- (4)
17. (a) What is minimum recommended thickness for steel when Iridium 192 is used as the source of radiation?
- (4)
- (b) What is the minimum recommended thickness for steel when Cobalt 60 is used as the source of radiation?
18. If no film type is specified in the procedure, name four types that can be used.
- 1.
- 2.
- (4)
- 3.
- 4.
19. Name the four manufacturers of cameras permitted on Spectrum N.D.T. Ltd. Radioactive Material License. Which are cable drive and which are air controlled?
- 1.
- 2.
- (8)
- 3.
- 4.
20. Give one advantage and one disadvantage for air controlled cameras and cable controlled cameras.

NDT LEVEL I – RADIOGRAPHIC TESTING

1. **An excellent radiograph is obtained under given conditions of exposure with the film located at a distance of 36 inches from the target of the x-ray tube. If the film is now placed only 18 inches from the target, and all exposure conditions except time are held constant, the new exposure time will be:**
 - a. unchanged.
 - b. longer by approximately 80 per cent.
 - c. shorter by approximately 55 per cent.
 - d. only about 25 per cent as long as the original exposure time.

2. **An excellent radiograph is obtained under given exposure conditions with a tube current of five milliamperes and an exposure time of twelve minutes. If other conditions are not changed, what exposure time would be required if the x-ray tube current could be raised to ten milliamperes?**
 - a. 24 minutes
 - b. 12 minutes
 - c. 6 minutes
 - d. 3 minutes

3. **In film radiography, penetrameters are usually placed:**
 - a. between the intensifying screen and the film.
 - b. on the source side of the test object.
 - c. on the film side of the test object.
 - d. between the operator and the radiation source.

4. **When radiographing to the 2-2T quality level, an ASTM penetrometer for one-half inch thick 2024 aluminum alloy has a thickness of :**
 - a. one-half inch
 - b. 2 mils.
 - c. 5 mils.
 - d. 10 mils.

5. **Lead is frequently employed in shielding against radiation from x-ray and gamma ray sources because of its:**
 - a. extremely low cost.
 - b. high absorption for a given thickness and weight.
 - c. ability to emit electrons when irradiated.
 - d. ability to diffract alpha particles.

6. **The penetrating ability of an x-ray beam is governed by:**
 - a. kilovoltage or wavelength.
 - b. time.
 - c. milliamperage.
 - d. source-to-film distance.

7. **Upon completing an x-ray exposure and turning the equipment off:**
- personnel should wait for a few minutes before entering the exposure area.
 - personnel should wear a lead-lined apron before entering the exposure area.
 - personnel may enter the exposure area without fear of radiation exposure.
 - personnel should take a reading with a Geiger counter before entering the exposure area.
8. **The most widely used unit of measurement for measuring the rate at which the output of a gamma ray source decreases is that:**
- curie
 - roentgen
 - half life
 - NEV
9. **Small amounts of exposure to x-ray or gamma rays:**
- will have a cumulative effect which must be considered when monitoring for maximum permissible dose.
 - will be beneficial since they build up an immunity to radiation poisoning
 - will have no effect on human beings.
 - will have only a short-term effect on human tissues.
10. **If a film is laced in a developer solution and allowed to develop without any agitation:**
- the radiograph will not show proper contrast.
 - it will be impossible to fix the radiograph permanently.
 - there will be a general "fogging" condition over the entire radiograph.
 - there will be a tendency for each area of the film to affect the development of the areas immediately below it.
11. **The two most common causes for excessively high density radiographs are:**
- insufficient washing and overdevelopment.
 - contaminated fixer and insufficient washing.
 - overexposure and contaminated fixer.
 - overexposure and overdevelopment.
12. **A cobalt 60 capsule will have a half-life of:**
- 1.2 years
 - 6 months
 - 5.3 years
 - 75 days

13. **Lead foil in direct contact with x-ray film:**
- intensifies the scatter radiation more than the primary radiation.
 - decreases the contrast of the radiographic image.
 - intensifies the primary radiation more than the scatter radiation.
 - should not be used when gamma rays are emitted by the source of radiation.
14. **Primary radiation which strikes a film holder or cassette through a thin portion of the specimen will cause scattering into the shadows of the adjacent thicker portions producing an effect called:**
- radiation imaging
 - spotting
 - undercut
 - unsharpness
15. **Overexposure to x-rays or gamma rays may cause damage to human:**
- blood tissue
 - skin
 - internal organs
 - all of the above
16. **A general rule used to define the amount of radiation exposure that is excessive is:**
- Although small amounts of radiation (0.4 r per week or less) are beneficial since they build up an immunity to these rays. Anything above 0.4 r per week is excessive.
 - Any dose over 5 r per week is excessive.
 - Any dose which causes a mid-range reading on a Geiger counter is excessive
 - Any unnecessary exposure to radiation is excessive.
17. **If a piece of lead $\frac{1}{2}$ inch thick is placed in the path of a beam of radiation emanating from cobalt 60, it will reduce the dose rate at a given location by:**
- $\frac{1}{3}$
 - $\frac{1}{4}$
 - $\frac{1}{2}$
 - $\frac{3}{4}$
18. **Materials which are exposed to gamma radiation or to x-ray below a few million volts:**
- should not be handled for at least 3 minutes after exposure has ceased.
 - should be stored in a lead lined room.
 - will not be dangerous to handle after exposure to radiation has ceased.
 - should be monitored by means of a Geiger counter.

19. **White crescent shaped marks on an exposed x-ray film are most likely caused by:**
- crimping film after exposure.
 - crimping film before exposure.
 - sudden extreme temperature change while processing.
 - warm or exhausted fixer.
20. **Frilling or loosening of the emulsion from the base of the film is most likely caused by :**
- water or developer on unprocessed film.
 - low temperature of processing solutions.
 - developer solution contamination.
 - warm or exhausted fixer solutions.
21. **If an exposure time of 60 seconds was necessary using a 4-foot source-to=film distance for a particular exposure, what time would be necessary if a 2 foot source-to-film distance is used and all other variables remain the same?**
- 120 seconds
 - 30 seconds
 - 15 seconds
 - 240 seconds
22. **As a check on the adequacy of the radiographic technique, it is customary to place a standard test piece on the source side of the specimen. This standard test piece is called a:**
- reference plate
 - lead screen
 - penetrameter
 - illuminator
23. **The purpose of agitating an x-ray film during development is to:**
- protect the film from excessive pressure.
 - renew the developer at the surface of the film.
 - disperse unexposed silver grains on the film surface.
 - prevent reticulation.
24. **The activity of the developer solution is maintained stable by:**
- constant agitation.
 - maintaining processing solutions within the recommended temperature range.
 - avoiding contamination from the wash bath.
 - addition of replenisher.

25. **For best results when manually processing film, solutions should be maintained within a temperature range of:**
- 64 degrees F and 75 degrees F
 - 65 degrees C and 75 degrees C
 - 75 degrees F and 85 degrees F
 - 75 degrees C and 85 degrees C
26. **The radiation quality of a gamma ray source is:**
- determined by the size of the focal spot.
 - determined by the isotope involved.
 - can be varied by the operator.
 - is greater in iridium 192 than in Cobalt 60.
27. **Very short wavelength electromagnetic radiation produced when electrons traveling at high speeds collide with matter is called:**
- X-radiation
 - beta radiation
 - gamma radiation
 - none of the above
28. **A graph showing the relation between material thickness, kilovoltage and exposure is called:**
- a bar chart
 - an exposure chart
 - a characteristic curve
 - an H and D curve
29. **A graph which expresses the relationship between the logarithm of the exposure applied to a photographic material and the resulting photographic density is called:**
- a bar chart
 - an exposure chart
 - the characteristic curve
 - a logarithmic chart
30. **In order to achieve uniformity of development over the area of an x-ray film during manual processing:**
- the film should be placed in a dryer after being developed.
 - the developer should be agitated by means of mechanical stirrers or circulating pumps.
 - the film should be agitated while in the developer.
 - the film should be transferred directly from the developer to the fixer.

- 31. An advantage of the fountain pen type of ionization chamber used to monitor radiation received by personnel is:**
- a. it provides a permanent record of accumulated dosage.
 - b. it provides an immediate indication of dosage.
 - c. it is the most sensitive detector available.
 - d. all of the above are advantages.
- 32. The density difference between two selected portions of a radiograph is know as:**
- a. unsharpness
 - b. radiographic contrast
 - c. specific activity
 - d. subject density

SPECIFIC EXAMINATION

NDT LEVEL II

RADIOGRAPHY

Note: The bracketed numbers are the point values of the questions.

1. **What radiation sources may Spectrum N.D.T. Ltd. use?**

(4)

2. **Explain why lead screens are used. What foil thicknesses are used?**

(4)

3. **Where multiple films are required, how much overlap is required?**

(4)

4. **Where no density is specified, what film density shall be used?**

Single film viewing:

(6)

Double film viewing:

5. (a) **What penetrometer shall be used if none is specified?**

(6) (b) **When 2 – 2T is specified, what does the first number refer to?**

(c) **When 2 – 4T is specified, what does the second number refer to?**

6. (a) **Which side of the object should the penetrometer be placed on?**

(6) (b) **What do you do if inaccessibility prevents this?**

7. **Final acceptance of the radiographs shall be based on what?**
(4)
8. (a) **Explain how to reduce back-scattered radiation.**
(6)
(b) **Explain how you determine back-scatter is occurring.**
9. **Give two reasons for identification markers.**
(4)
10. **Explain how to determine the proper film exposure for items of unknown radiation absorption.**
(6)
11. **How much separation between hangers is required when processing film?**
(4)
12. **What is the purpose of tapping the cross bars of hangers when they are in the developer?**
(4)
13. (a) **What determines the developing time?**
(2)
(b) **What are the manufacturers recommendations?**
14. **How long is the film left in the stop bath?**
(2)

NDT LEVEL II – RADIOGRAPHIC TESTING

1. **A Cobalt 60 gamma ray source has an approximate practical thickness limit of:**
 - a. 2 1/2 inches of steel or its equivalent.
 - b. 4 inches of steel or its equivalent.
 - c. 7 1/2 inches of steel or its equivalent.
 - d. 11 inches of steel or its equivalent.

2. **The uneven distribution of developed grains within the emulsion of a processed x-ray film causes the subjective impression of:**
 - a. graininess
 - b. streaks
 - c. spots
 - d. white scum

3. **Cobalt 60 is reported to have a half life of 5.3 years. By how much should exposure time be increased (over that used initially to produce excellent radiographs when the cobalt 60 source was used) when the source is two years old?**
 - a. No change in exposure time is needed.
 - b. Exposure time should be about 11 per cent longer.
 - c. Exposure time should be about 37 per cent longer.
 - d. Exposure time should be from 62 to 100 per cent longer.

4. **A source of iridium 192, whose half life is 75 days, provides an optimum exposure of a given test object today in a period of twenty minutes. Five months from now, what exposure time would be required for the same radiographic density, under similar exposure conditions?**
 - a. 10 minutes
 - b. 20 minutes
 - c. 1 hour and 20 minutes
 - d. 6 hours

5. **Of the following, the source providing the most penetrating radiation is:**
 - a. cobalt 60
 - b. 220 kvp x-ray tube
 - c. 15 megavolt betatron
 - d. electrons from iridium 192

6. **The gamma ray intensity at one foot from a one curie source of radioactive cobalt 60 is nearest:**
- 15 roentgens per hour
 - 1,000 roentgens per hour
 - 1 roentgen per minute
 - 10 milliroentgens per day
7. **The focal spot in an x-ray tube:**
- is inclined at an angle of 30 degrees from the normal to the tube axis.
 - is maintained at a high negative voltage during operations.
 - should be as large as possible to ensure a narrow beam of primary radiation.
 - should be as small as possible without unduly shortening the life of the tube.
8. **The specific activity of an isotopic source is usually measured in:**
- Mev (million-electron-volts)
 - c/gr (curies per gram)
 - R/hr (roentgens per hour)
 - c/min (counts per minute)
9. **Which of the following isotope has the longest half-life?**
- thulium 170
 - cobalt 60
 - iridium 192
 - cesium 139
10. **The slope of a straight line joining two points of specific densities on a characteristic curve of a film is known as the:**
- speed of the curve
 - latitude
 - average gradient
 - density
11. **An x-ray film having wide latitude also has, by definition:**
- poor definition
 - low contrast
 - high speed
 - none of the above
12. **The purpose for circulating oil in some types of x-ray tubes is:**
- to lubricate moving parts.
 - to absorb secondary radiation.
 - to decrease the need for high current.
 - to dissipate heat.

13. **Thin sheets of lead foil in intimate contact with x-ray film during exposure increase film density because:**
- a. they fluoresce and emit visible light which helps expose the film.
 - b. they absorb the scattered radiation.
 - c. they prevent back scattered radiation from fogging the film.
 - d. they emit electrons when exposed to X- and gamma radiation which help darken the film.
14. **An x-ray tube is rated for maximum of 250 kv. This tube may be operated at a maximum of:**
- a. 250,000 volts peak voltage
 - b. 250 kv effective voltage
 - c. 250,000,000 volts RMS voltage
 - d. 250 kv average voltage
15. **An x-ray radiography, alternating current must be changed to pulsating direct current in order to satisfy the need for unidirectional current. This change may be accomplished by:**
- a. transformers
 - b. rectifiers
 - c. anodes
 - d. cathodes
16. **When radiographing to the 2-2T quality level, an ASTM penetrameter for 2.5 inch steel has a thickness of:**
- a. one half inch
 - b. 2.5 mils
 - c. 5 mils
 - d. 50 mils
17. **A good cobalt 60 shot is made on a 3" steel casting using a exposure time of 10 minutes and a source to film distance of 36 inches. If it is necessary to change the source to film to 24", what exposure time would produce a similar radiograph if all other conditions remain the same?**
- a. 1.6 min.
 - b. 4.4 min.
 - c. 6.4 min.
 - d. 8.8 min.
18. **When sharp, black bird-foot shaped marks which are know not to correspond with any discontinuities appear at random on radiographs, they are probably caused by:**
- a. prolonged development in old developer.
 - b. exposure of the film by natural cosmic ray showers during storage.
 - c. static charges caused by friction.
 - d. inadequate rinsing after fixing.

19. **An ASTM penetrometer for use when inspecting a one-half inch thick steel plate to the 2-2T quality level using a 15 inch source to film distance would be made of:**
- 5 mil thick aluminum
 - 50 mil thick aluminum or steel
 - 10 mil thick steel
 - 2 mil strip of any metallic material
20. **Besides serving as a filter, screens of high atomic number, such as lead and lead antimony, also:**
- decrease the source to film distance needed for a proper radiograph.
 - provide some image intensifying action.
 - permit the use of higher speed film.
 - decrease the graininess in a radiograph.
21. **The range of thickness over which densities are obtained that are satisfactory for interpretation is a measure of this:**
- subject contrast of a radiograph.
 - sensitivity of a radiograph
 - latitude of a radiograph
 - definition of a radiograph
22. **X-ray films with large grain size:**
- grain
- will produce radiographs with better definition than film with small size.
 - have slower speeds than those with a relatively small grain size.
 - have higher speeds than those with a relatively small grain size.
 - will take longer to expose properly than film with relatively small size.
- grain
23. **The purpose for including a disc-shaped target that rotates rapidly during operation in some x-ray tubes is to:**
- increase the intensity of x-radiation.
 - decrease the voltage needed for a specific quality of radiation.
 - increase the permissible load.
 - none of the above answers is correct.

24. **A general rule governing the application of the geometric principles of shadow formation states that:**
- a. the x-ray should proceed from as large a focal spot as other considerations will allow.
 - b. the distance between the radiation source and the material examined should be as small as practical.
 - c. the film should be as far as possible from the object being radiographed the central ray should be as nearly perpendicular to the film as possible, the preserve spatial relationships.
25. **X-ray exposure holders and cassettes often incorporate a sheet of lead foil in the back which is not in intimate contact with the film. The purpose of this sheet of lead foil is:**
- a. to act as an intensifying screen.
 - b. to protect the film from back scatter.
 - c. both "a" and "b" above.
 - d. neither "a" or "b" above.

GRADING SYSTEM FOR PRACTICAL EXAMINATIONS

LEVEL I AND LEVEL II CANDIDATES

Level I and Level II candidates will be graded on a point system, ranging from 0 to 10, for each of the following nondestructive test elements.

1. Did the candidate obtain or attempt to obtain proper sample information prior to conducting the test?
2. Did the candidate select the proper test procedure?
3. Did the candidate handle the equipment in a workmanship like manner?
4. Did the candidate comply with Company Safety Procedures?
5. Was the test specimen properly prepared for the test?
6. Did the candidate interpret the test results correctly?
7. Does the candidate exhibit adequate knowledge of the Codes?
8. Were the test results properly recorded and reported?
9. Were defects found marked correctly?
10. A subjective evaluation of the candidate's attitude will be made and evaluated.

Spectrum N.D.T. Ltd

Eye Examination Report

Applicants Name:

Registration No:

Examination Date:

Part A Near Vision

Near vision acuity shall permit reading a minimum of Jaeger Number 1 or Times Roman N4, 5 or equivalent letters at not less than 30 cm with one or both eyes, either corrected or uncorrected.

Part B Color Vision

Normal

I certify the above mentioned applicant can distinguish and differentiate contrast between the colours or shades of gray used in the NDT methods concerned.

Examiners Name





Examiners Signature

Title

Examination Date

SPECTRUM NDT LTD

NEAR - VISION ACUITY

TECHNICIAN	RESULT	EXAMINER	Signed	DATE OF TEST
T. Griggs	OK	M. Edwards Level III		Jun 1 st , 2013
K. Gowler	OK	T. Griggs Level III		Dec 4, 2013
D. Titmus	OK	T. Griggs Level III		Nov 12, 2012
L. Wiens	OK	T. Griggs Level III		June 1, 2013

JAEGER NUMBER 2 AT NOT LESS THAN 12 INCHES DISTANCE IN AT LEAST ONE EYE. TEST CONDUCTED ANUALLY

FORM #
V1

Section Four

Personnel and Company Certification

One	Level Three Examination Results
Two	Company Letter of Certification
Three	Letter of Level Three Acceptance
Four	Level Three Resume



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Timothy D. Griggs

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A UT 2	82	84	90	85	CGSB 2 REG # 1270	16/12/10
SNT TC 1A RT 2	NA	NA	NA	NA	CGSB 2 REG # 1270	29/10/07
SNT TC 1A MT 2	NA	NA	NA	NA	CGSB 2 REG # 1259	29/10/07
SNT TC 1A PT 2	NA	NA	NA	NA	CGSB 2 REG # 1270	29/10/07
HT 1	NA	NA	100	NA		29/10/07
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A UT 2	24/10/13	CGSB EQUIVALENCY			OCT. 24 2016	
SNT TC 1A RT 2	24/10/13	CGSB EQUIVALENCY			OCT. 24 2016	
SNT TC 1A MT 2	24/10/13	CGSB EQUIVALENCY			OCT. 24 2016	
SNT TC 1A PT 2	24/10/13	CGSB EQUIVALENCY			OCT. 24 2016	
HT 1	24/10/13	LEVEL 3 PERFORMANCE REVIEW			OCT. 24 2016	

LEVEL 3 EXAMINER



Natural Resources
Canada

Ressources naturelles
Canada



Name/ Nom: **Timothy D. Griggs**
 Reg. No./ No. matricule: **1270**
 Issue Date/ Date d'émission: **2012/12/06**

This card does not identify the stated individual to be an employee or representative of Natural Resources Canada, Government of Canada.
 Cette carte n'identifie pas l'individu d'être un employé ou un représentant de Ressources naturelles Canada, Gouvernement du Canada

Corrective lenses for [X] near [X] far vision.
 Verres correctifs pour la vision de [X] près [X] distance.

Signature:  C-02150c III



Natural Resources
Canada

Ressources naturelles
Canada

Certified to/Certifié selon: CAN/CDSB 48 9711

1270

Method Méthode	Level Niveau	Sector Secteur	Cert. Date Date cert.	Date recert. Date recert.	Expires Expiration
MT	2	EMC	1979/10/01		2015/12/31
PT	2	EMC	1979/10/01		2015/12/31
RT	2	WW	1979/01/01		2015/12/31
UT	2	EMC	2010/12/16		2015/12/31

For verification of certification status, policies and definitions, visit website:
<https://nrc.can.ca/22/> Pour la vérification de la certification, les politiques, et les définitions,
 visitez le site web: <https://nrc.can.ca/>

Manager, Certifying Agency
 Gestionnaire Organisme de certification

Spectrum N.D.T. Ltd

Eye Examination Report

Applicants Name: Tim Griggs
Registration No: 1270
Examination Date: June 1st, 2013

Part A **Near Vision**

Near vision acuity shall permit reading a minimum of Jaeger Number 1 or Times Roman N4, 5 or equivalent letters at not less than 30 cm with one or both eyes, either corrected or uncorrected.

Part B **Colour Vision**

Normal

I certify the above mentioned applicant can distinguish and differentiate contrast between the colours or shades of gray used in the NDT methods concerned.

Examiners Name

Examiners Signature

Ken Gowler



Title
Level II

Examination Date
June 1st 2013

SPECTRUM NDT LTD

COLOR CONTRAST / SHADES EYE EXAMINATION



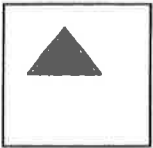
Dark grey oval against
Lighter grey



Grey octagon
Grey background



Dark grey pentagon
in light grey background



Light grey triangle
In white background



Dark grey crescent
in black background




Green diamond
red background



blue cross in red
Background



blue triangle in
Yellow background

TECHNICIAN	RESULT	EXAMINER	DATE
Tim Griggs	OK		Sept 02nd 2011

FORM #
V2

RESUME OF
Timothy Griggs

CAREER HISTORY:

2007 – Present

**Spectrum NDT Ltd, Calgary, Alberta
NDT inspections in local Fabrication Shops**

1991 - 2007

**Canspec Group Inc / Acuren Group Inc
Sr. NDT Tech / Project Supervisor
Assistant RSO Calgary 2005 – 2007**

Major Projects:

- Encana – Palliser Area, Pipeline & Facility installations,
- B.C. Gas – 24" Lower Mainland Pipeline Project
- Maritimes & Northeast Pipeline Project – 30" NG pipeline
- PanCanadian Res. – Palliser Area Gathering Systems
- Foster Wheeler Overseas 1995, Maraven Refinery, PARC Project, Venezuela
- Nova, Farrell Lake Compression Station
- Shell, Caroline Project
- Nicles – Radke, TCPL, Union Gas, Prefab Pipe Project

1988 – 1991

**Senior Mining Engineer / Owner
SCYLLA ENGINEERING LTD., Milton, Ontario / Calgary, Alberta
Conducted field evaluations of various exploration projects
across the country**

1984 – 1988

Self-employed / Contract Basis

Quality Assurance Engineer / Senior Radiographer

Responsible for all quality aspects of project supervision of the North Shore Lateral for the Northern and Central gas Corp. Ltd. Also supervised 360 km of 20" pipeline for IPL from Brandon, Manitoba to Regina, Sask. Managed a variety of other contracts, details available upon request.

1975 – 1984

Self-employed/ Contract Basis

Senior Radiographer

During this period, worked on a contract basis for a number of major firms involved in large diameter pipeline construction. On these projects, supervised up to 30 personnel and looked after all aspects of report writing, personnel scheduling, equipment control, and monitoring staff performance to ensure testing procedures adhered to client requirements.

Junior Radiographer

Employed on various pipeline projects across Canada. Responsible for shop construction of vessels, piping and high pressure components. Stationed for eight months on lay-barges in the Gulf of Mexico doing radiography on large diameter sub-sea pipelines.

TECHNICAL QUALIFICATIONS:

CGSB – Level II Radiography

CGSB - Level II Magnetic Particle

CGSB - Level II Liquid Penetrant

CGSB - Level I Ultrasonics

CWB - Level II Visual

EDUCATION:

1983 - Graduated South Dakota School of
Mines and Technology, Rapid City, South Dakota:
BSc Mining Engineering

1974 – Haileybury School of Mines, Haileybury, Ontario
Mining Technology Diploma

1968 – Hudson High School, Hudson, Quebec
Grade 11 High School Matriculation

PERSONAL DATA:

Birthdate: December 21, 1950

Marital status: Married with 1 son at home

Interests: Skiing, Hockey, Golf, Fishing, Camping, Reading

Passport: Valid to February 2013

REFERENCES:

Available upon request



SPECTRUM NDT LTD

Certificate of Proficiency for NDT Personnel

Mike Whitely

ORIGINAL CERTIFICATION						
LEVEL	GENERAL	SPECIFIC	PRACTICAL	WEIGHTED	EQUIVALENCY	DATE
SNT TC 1A RT 2	77.5	90	100	88.5	NA	08/11/07
SNT TC 1A MT 2	NA	NA	NA	NA	NA	
SNT TC 1A PT 2	NA	NA	NA	NA	NA	
HT 1	NA	NA	NA	NA	NA	
PM1	NA	NA	NA	NA	NA	NA
CURRENT CERTIFICATION						
LEVEL	DATES RECERTIFIED	BASIS OF RECERTIFICATION			CURRENT CERT EXPIRES	
SNT TC 1A RT 2	08/11/10	ORIGINAL			08/11/13	
SNT TC 1A MT 2	NA	NA			NA	
SNT TC 1A PT 2	NA	NA			NA	
HT 1	NA	NA			NA	
PMI 1	NA	NA			NA	

LEVEL 3 EXAMINER Tim Griggs

Michael Whitely
8447

Registration Number
Numéro de matricule

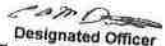



is certified by the Canadian
Nuclear Safety Commission
as an Exposure Device
Operator.

est accrédité par la Commission
canadienne de sûreté nucléaire
à titre d'opérateur d'appareil
d'exposition.

2013/02/01
Issue Date
Date d'émission

2018/06/01
Expiry Date
Date d'expiration


Designated Officer
Fonctionnaire désigné

 Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire



Spectrum N.D.T. Ltd

Eye Examination Report

Applicants Name: Mike Whitely
Registration No: 000007
Examination Date: September 12, 2013

Part A **Near Vision**

Near vision acuity shall permit reading a minimum of Jaeger Number 1 or Times Roman N4, 5 or equivalent letters at not less than 30 cm with one or both eyes, either corrected or uncorrected.

Part B **Colour Vision**


Normal

I certify the above mentioned applicant can distinguish and differentiate contrast between the colours or shades of gray used in the NDT methods concerned.

Examiners Name

__Tim Griggs__

Examiners Signature



Title

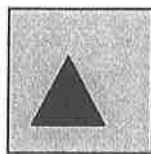
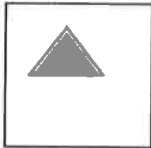
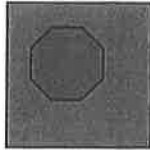
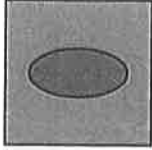
__Level III__

Examination Date

__September 12, 2013__

SPECTRUM NDT LTD

COLOR CONTRAST / SHADES EYE EXAMINATION



TECHNICIAN	RESULT	EXAMINER	DATE
Mike Whitely	OK		February 1, 2013

FORM #
V2

Section Five

Radiographic Procedure and Standards

- 5.1 Scope**
- 5.2 Procedure Requirements**
- 5.3 Qualification of Personnel**
- 5.4 Visual Examination**
- 5.5 Sources of Radiation**
- 5.6 Intensifying Screens**
- 5.7 Geometric Unsharpness**
- 5.8 Back-Scattered Radiation**
- 5.9 Film Density**
- 5.10 Identification and Traceability**
- 5.11 Penetrameters (1Q1)**
- 5.12 Film**
- 5.13 Film Processing**
- 5.14 Viewing of Radiographs**
- 5.15 Interpretation of Radiographs**
- 5.16 Record and Reporting**

Spectrum N.D.T. Ltd.

Year of Acceptable Edition of Referenced Standards

ASME Section 1	Recommended Practice for Nondestructive Personnel Qualification and Certification
ASME Section VIII Division 1	Recommended Practice for Nondestructive Personnel Qualification and Certification
SSME Section VIII Division 2	Recommended Practice for Nondestructive Personnel Qualification and Certification
ASME B31.3	Recommended Practice for Nondestructive Personnel Qualification and Certification
	SNT-TC-1A Latest Edition

5.0 Radiographic Procedures and Standards

5.1 Scope

5.1.1 These procedures are to be used for the radiographic inspection of pressure vessels and pressure piping fabricated under ASME Section I and VIII Div. 1, Div. 2, ASME IX, ASME B31.1 and ASME B31.3 current edition and addenda.

This procedure shall be used for the radiographic examination of weldments of steel plate up to 80mm in thickness and the examination of pressure piping weldments up to and including double extra heavy grade.

5.2 Procedure Requirements

5.2.1 Compliance with density and penetrometer image requirements on production radiographs shall be considered evidence of qualification and the procedure used when there is no written procedure, as per T-221.2 of Article 2. AMSE Section V

5.2.2 When required by the referencing Code Section, or client, a written procedure shall contain, as a minimum, the following information, and with the required density limitations and penetrometer image requirements, shall be considered as complying with that procedure.

Material and thickness range

Isotope type

Minimum source to object distance

Maximum source size

Film brand and type

Distance from source side of object to the film at the minimum source to object distance.

Type and thickness of screens used

5.3 Qualification of Personnel

5.3.1 All personnel employed by Spectrum N.D.T. Ltd. shall be in accordance with the Recommended Practice SNT-TC-1A. Latest Edition

5.3.2 Personnel interpreting film shall be certified to a minimum of ASNT Level II or III. Final interpretation and acceptance of radiographs shall be the responsibility of the customer.

5.4 Visual Examination

- 5.4.1 The radiographer shall visually examine the welds to ensure that no surface artifacts exist which will mask or confuse the interpretation of the radiograph. Surface artifacts shall be removed prior to radiographic examination by a suitable process such as buffing or grinding.

5.5 Sources of Radiation

- 5.5.1 Gamma rays from the isotope Iridium 192 shall be used as the radiation source.
- 5.5.2 Limitation on the thickness range for Iridium 192 shall be based on the applicable referencing code section.
- 5.5.3 Documentation from supplier of sources shall be evidence of the actual size or focal spot size and shall be considered acceptable, as per T-261.1 of Article 2.

5.6 Intensifying Screens

- 5.6.1 Front and back intensifying screens shall be used with Iridium 192. Screen thickness shall be .25 mm
- 5.6.2 Scratched, dented, dirty or greasy screens shall be discarded and all film showing poor quality due to screen contact shall not be interpreted. Dirty or greasy screens may be restored to service after cleaning.

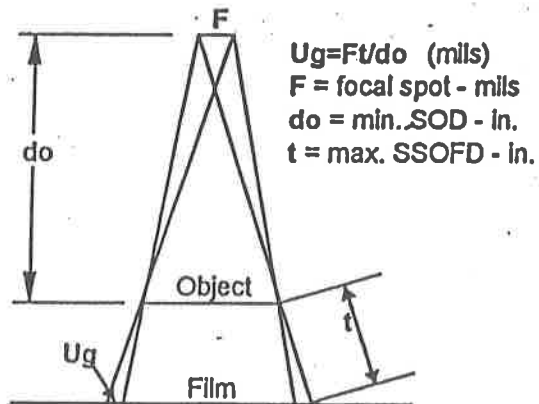
5.7 Geometric Unsharpness

- 5.7.1 Geometric Unsharpness of the radiographs shall be determined by the following variables:
- $U_g = Fd/D$
- U_g = geometric unsharpness
- F = source size or the effective focal spot size measured in inches
- D = source to the object distance measured in inches
- d = distance from source side of object being radiographed to the film measured in inches

5.7.2 The geometric Unsharpness of all radiographs shall not exceed the required values as specified in the referencing code.

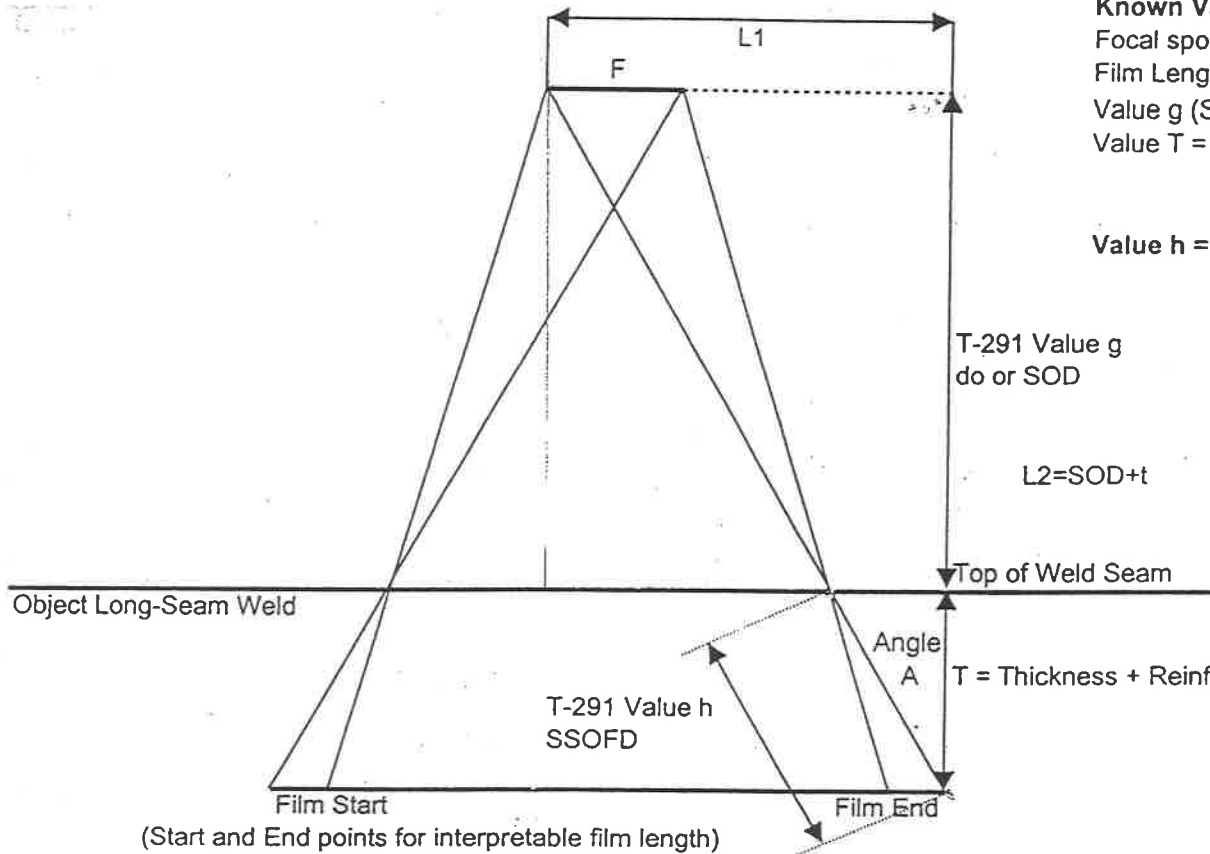
5.7.3

$U_g = Ft/d_o$ (mils)
 F = focal spot - mils
 D_o = min. SOD - in
 T = max. SSOFD - in



ASME Section V, Paragraph T-291 Requirements for Dimension g and h

As applied to a typical Longitudinal Weld Seam



Known Values

Focal spot size = F =
 Film Length = FL =
 Value g (SOD) =
 Value T =

Inches Paragraph T-285 Limitations

Material Thickness (Including Reinforcement)	Max. Ug
Under 2 in.	0.02
2 in. through 3 in.	0.03
Over 3 in. through 4 in.	0.04
Greater than 4 in.	0.07

Value h =

1.831167

Calculated

Geometric Unsharpness (Ug)
 Ug = 0.019904

T-291 Value g
 do or SOD

L2 = SOD + t

Top of Weld Seam

Angle
 A

T = Thickness + Reinforcement (both sides) + ((Loaded Cassette Thickness)/2)

T-291 Value h
 SSOFD

Film Start

Film End

(Start and End points for interpretable film length)

Intermediate Calculated Values

L1 = Film Length(FL)/2 + Focal Spot Size(F)/2 = 7.625
 L2 = Min. Source to Object Dist.(SOD) + T = 24.75
 Beam Path Distance = SQRT((L1*L1)+(L2*L2)) = 25.89794

Degrees Radians

Angle A = ATAN(L1/L2) = 17.12306 0.298854
 Check Angle A = ACOS(L2/BPD) = 17.12306 0.298854

5.8 Back-Scattered Radiation

- 5.8.1 All cassettes shall have a lead letter "B", 13mm in height and 1.6 mm in thickness attached to its back, as per T-223 of Article 2.
- 5.8.2 If a light of the "B" appears on a darker background of the radiograph, protection from backscatter radiation is insufficient and the radiograph shall be unacceptable. A darker image of the "B" on a lighter background shall not be cause for rejection of the radiograph, as per T-284 of Article 2.

5.9 Densitometers, Step Wedge Comparison Film and Film Density

- 5.9.1 A densitometer or a calibrated film comparator strip shall be used for judging the film density requirements. The density for the comparison films and the densitometer calibration shall be traceable to a national standard. In all cases the requirements of Article 2, sections T-262.1, T-262.2 and T-262.3 shall be adhered to.
- 5.9.2 Calibration shall be completed once every 90 days and recorded in the calibration log.
- 5.9.3 Transmitted film density through the radiographic image of the area of interest shall be in accordance with the specified code or standard.
- 5.9.4 In all cases the transmitted density shall be a 2.0 minimum and a 4.0 maximum, and shall conform to the requirements of T-282.1 and T-282.2 of Article 2.

5.10 Identification and Traceability

- 5.10.1 All radiographs shall contain as a minimum the following information, flashed either on the film or by the use of lead letters; to appear permanently. In all cases the requirements of T-224 of Article 2 shall be met.
 - Client identification
 - Date of inspection
 - Client work order
 - Vessel or Pipe number
- 5.10.2 Location markers which are to appear as radiographic images on the film, shall be placed on the part being radiographed, not the cassette, and their location marked on the surface of the part, in a manner permitting the area of interest of the radiograph to be accurately traceable to the part.
- 5.10.3 Location markers shall provide evidence that 100% coverage of the area being radiographed has been obtained on the radiograph.
Examples of location marker placement. See Diagrams

5.11 Penetrators (IQI)

- 5.11.1 All radiographs shall show the required sensitivity by displaying the penetrator image and the required wire thickness and or hole size.
- 5.11.2 Penetrators shall be manufactured and identified in accordance with ASME SE-142, SE-1025 or SE-747 and certification attesting to this is required.
- 5.11.3 Selection of penetrator will be based on the nominal wall thickness plus the allowable weld reinforcement as per the applicable code. For double wall radiography, the penetrator selection shall be based on the thickness of the weld next to the film. Selection shall be based on Table T-276 as per T-276.1 of Article 2.
- 5.11.4 Penetrator will be hand placed on the source side of the object being radiographed. Where inaccessibility prevents hand placement, the penetrator may be placed on the film side of the part being radiographed but a lead letter "F" shall be placed adjacent to the penetrator.
- 5.11.5 The number of penetrators used shall be determined by the type of exposure being conducted. In all cases the requirements of Article 2, T-277.2 shall be adhered to.
- 5.11.6 The selection of penetrator will be based on the following:
 - ASME Code, Section V, Article 2
 - ASME Code, Section VIII, Paragraph UW 51
 - ASME Code, B31.3 Paragraph 344.5.1
 - ASME Code, B31.1 Paragraph 136.4.5
 - And / Or as specified in the applicable code or specification

5.12 Film

- 5.12.1 All film shall be AGFA brand. The film used shall be either of the following types in accordance with T-231.1
 - Type I Low speed, extremely high contrast
 - Type II Moderate speed, high contrast
- 5.12.2 The film type used will be as required by client or as specified in the governing code. In all cases a type I film will be used when the required penetrator image cannot be obtained using a Type II film.
- 5.12.3 The only film to be used shall be with – in the film manufactures expiration date. Film will be stored in a clean area where the temperature shall remain between 60 and 80 degrees Fahrenheit.

5.13 Film Processing

5.13.1 Film handling is to be done on a clean, oil or grease free surface. Ensure that all chemicals have been mixed as per the manufacturer's instructions. All chemicals shall be stored as per the manufacturer's instructions.

Manual processing tanks will be topped up with properly mixed developer, top bath and fixer. The processing chemicals will be stirred vigorously to ensure proper mixing and uniform temperature. Processing chemistry will be heated or cooled, to maintain a temperature range between 68 and 80 degrees Fahrenheit. Developing time will be temperature based on the manufacturers published recommendations. During the processing period ensure that film is agitated as per those recommended by the chemical manufacture. Film shall be washed in fresh water for at least 15 minutes. Prior to drying, film shall be immersed in a wetting agent to aid in the uniform drying of radiographs.

5.14 Viewing the Radiographs

5.14.1 Viewing facilities shall provide subdued background lighting of an intensity that will not cause troublesome reflections, shadows or glare on the radiographs.

5.14.2 Equipment used to view film shall produce sufficient light for the essential pentrameter hole to be visible for the specific density range without damaging film. Unwanted light from around viewer will be masked when viewing radiographs.

5.15 Interpretation of Radiographs

5.15.1 Film artifacts such as water marks, chemical stains, scratches, fogging etc., which appear in the area of interest and may cause defects to be masked are to be considered unacceptable and that area to be re-radiographed. The area, which will be interpreted on the radiograph, shall be limited to that which the pentrameter has shown to be of a suitable technique.

5.15.2 Acceptance or rejection variables will be specified in the governing code or will be supplied by the customer.

Spectrum NDT Ltd.

Densitometer & Step Wedge Comparison Film Calibration Certification

This is to certify that Konica densitometer PDA-100 Serial #06014633 is within the acceptable limits as set out in Article 22, SE-1079 and Article 2, T262.1, T262.2, T262.3 and T262.4.

The Radiographic density strip has been calibrated using the above certified densitometer prior to being placed in service.



Timothy Griggs
ASNT Level III
Spectrum NDT Ltd.

Spectrum NDT Ltd.

Density Strip Calibration

Step Tablet Identification

030612-15

Densitometer

Konica PDA-100 S/N 06014633

Calibrated 2013-06-14

Maloney Industries

Calibration Date

Calibrated Strip Density

Recorded Density

July 2013

Step 8 1.56

1.51

Step 12 2.39

2.33

Step 16 3.20

2.95

Step 20 4.27

4.10

October 2013

1.56

1.52

2.39

2.35

3.20

2.98

4.27

3.15

January 2014

1.56

2.39

3.20

4.27

April 2014

1.56

2.39

3.20

4.27

July 2014

1.56

2.39

3.20

4.27

October 2014

1.56

2.39

3.20

4.27

Konica PDA-100 Densitometer, SN 06014633, is calibrated to step wedge tablet, SN. 030612-15 prior to each of the quarterly calibrations of the density strip.

Spectrum NDT Ltd.

Step Tablet Identification **Density Strip Calibration**
030612-15

Densitometer **Konica PDA-100 S/N 06014633**
Calibrated 2012-07-06
Maloney Industries

<u>Calibration Date</u>	<u>Calibrated Strip Density</u>	<u>Recorded Density</u>
October 2012	Step 8 1.56	1.50
	Step 12 2.39	2.33
	Step 16 3.20	3.12
	Step 20 4.27	3.89
January 2013	1.56	1.60
	2.39	2.40
	3.20	3.29
	4.27	4.16
April 2013	1.56	1.50
	2.39	2.45
	3.20	3.19
	4.27	4.26
July 2013	1.56	
	2.39	
	3.20	
	4.27	
October 2013	1.56	
	2.39	
	3.20	
	4.27	
January 2014	1.56	
	2.39	
	3.20	
	4.27	

Konica PDA-100 Densitometer, SN 06014633, is calibrated to step wedge tablet, SN.030612-15 prior to each of the quarterly calibrations of the density strip.

Spectrum NDT Ltd.

Density Strip Calibration

Step Tablet Identification **7113070**

Densitometer **Konica PDA-100 S/N 06014633**
Calibrated 2012-07-06
Maloney Industries

<u>Calibration Date</u>	<u>Calibrated Strip Density</u>	<u>Recorded Density</u>
July 2012	Step 4 1.180	1.17
	Step 8 2.390	2.36
	Step 10 2.980	2.90
	Step 13 3.900	3.59
October 2012	1.180	
	2.390	
	2.980	
	3.900	
January 2013	1.180	
	2.390	
	2.980	
	3.900	
April 2013	1.180	
	2.390	
	2.980	
	3.900	
July 2013	1.180	
	2.390	
	2.980	
	3.900	
October 2013	1.180	
	2.390	
	2.980	
	3.900	

Konica PDA-100 Densitometer, SN 06014633, is calibrated to step wedge tablet, SN. 7113070 prior to each of the quarterly calibrations of the density strip.



8045 CORONET ROAD N.W.
EDMONTON ALBERTA T6E 4N7
PHONE (780) 469-4619
FAX (780) 469-4642

GAMMA-RAY EQUIPMENT & SUPPLIES

CNSC License #: 08561-2-16.0
Document #: C.F.022-2011A

Work Order ID. #: EWO-04895
Calibration ID. #: CS017379

DENSITOMETER CALIBRATION CERTIFICATE

Licensee Name : Spectrum NDT Ltd.

Telephone : (403) 262-9958 CNSC License #: 14023-1-17.0

Densitometer Make : Konica Minolta Model : PDA-100

Serial # : 06014633

Method of Calibration : Eseco Speedmaster Calibrated 21-Step Density Strip Tablet

Serial # : 102212-10

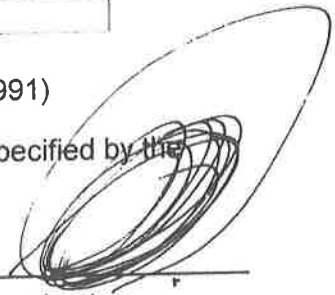
#	Actual Density	Measured Density	Error in Difference	Maximum Allowable Error (+/-)
01	0.14	0.18	0.04	0.05
02	0.29	0.32	0.03	0.05
03	0.52	0.54	0.02	0.05
04	0.70	0.72	0.02	0.05
05	0.89	0.91	0.02	0.05
06	1.14	1.16	0.02	0.05
07	1.33	1.35	0.02	0.05
08	1.62	1.64	0.02	0.05
09	1.88	1.89	0.01	0.05
10	2.07	2.09	0.02	0.05
11	2.31	2.33	0.02	0.05
12	2.55	2.56	0.01	0.05
13	2.79	2.8	0.01	0.05
14	2.97	2.99	0.02	0.05
15	3.27	3.26	-0.01	0.05
16	3.52	3.53	0.01	0.05
17	3.75	3.74	-0.01	0.05
18	3.91	3.89	-0.02	0.05
19	4.16	4.12	-0.04	0.05
20	4.60	N/A		0.05
21	5.24	N/A		0.05

*Allowable error is based upon standards set by ASME SE-1079 and ASTM 1079-85(1991)

Summary of Findings : Measured density was less than the maximum allowable error specified by the manufacturer and ASME/ASTM standards for all values.

Calibrated on : June 14, 2013

by Tom Rosiecki
print name


signature



Spectrum NDT Ltd.

Densitometer & Step Wedge Comparison Film Calibration Certification

This is to certify that Esecos densitometer Serial #40109 is within the acceptable limits as set out in Article 22, SE-1079 and Article 2, T262.1, T262.2, T262.3 and T262.4.

The Radiographic density strip has been calibrated using the above certified densitometer prior to being placed in service.

A handwritten signature in black ink, appearing to read "Timothy Griggs".

Timothy Griggs
ASNT Level III
Spectrum NDT Ltd.



8045 CORONET ROAD N.W.
EDMONTON ALBERTA T6E 4N7
PHONE (780) 469-4619
FAX (780) 469-4642

GAMMA-RAY EQUIPMENT & SUPPLIES

CNSC License #: 08561-2-16.0

Document #: C.F.022-2011A

Work Order ID #: EWO-05099

Calibration ID #: CS018180

DENSITOMETER CALIBRATION CERTIFICATE

Licensee Name : Spectrum NDT Ltd.

Telephone : (403) 262-9958 CNSC License # : 14023-1-17.0

Densitometer Make : Eseco Model : SM-14

Serial # : 40109

Method of Calibration : Eseco Speedmaster Calibrated 21-Step Density Strip Tablet

Serial # : 102212-10

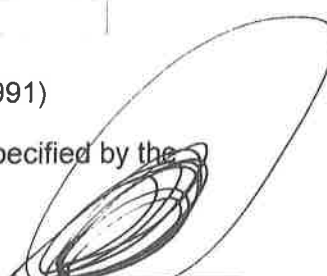
#	Actual Density	Measured Density	Error in Difference	Maximum Allowable Error (+/-)
01	0.14	0.14	0.00	0.05
02	0.29	0.29	0.00	0.05
03	0.52	0.54	0.02	0.05
04	0.70	0.73	0.03	0.05
05	0.89	0.92	0.03	0.05
06	1.14	1.16	0.02	0.05
07	1.33	1.35	0.02	0.05
08	1.62	1.65	0.03	0.05
09	1.88	1.89	0.01	0.05
10	2.07	2.08	0.01	0.05
11	2.31	2.32	0.01	0.05
12	2.55	2.55	0.00	0.05
13	2.79	2.8	0.01	0.05
14	2.97	2.98	0.01	0.05
15	3.27	3.26	-0.01	0.05
16	3.52	3.51	-0.01	0.05
17	3.75	3.72	-0.03	0.05
18	3.91	3.88	-0.03	0.05
19	4.16	N/A		0.05
20	4.60	N/A		0.05
21	5.24	N/A		0.05

*Allowable error is based upon standards set by ASME SE-1079 and ASTM 1079-85(1991)

Summary of Findings : Measured density was less than the maximum allowable error specified by the manufacturer and ASME/ASTM standards for all values.

Calibrated on : September 12, 2013 by Tom Rosiecki

print name



signature



ESECO
Speedmaster[®]

Certification of Conformance & Calibration

ESECO Speedmaster[®] hereby certifies that the following listed product has been manufactured and inspected and tested and found in conformance with the specifications and standards herein cited and/or set forth in **ESECO** marketing and operating documents. The enclosed Density Tablet has been calibrated for its specific application using calibration standards that are traceable to **NIST** (the U.S. National Institute of Standards and Technology). Any warranty is limited to that shown on the **ESECO** standard product warranty and general terms and conditions of sale.

David Offutt, Quality Control Manager

ESECO Product: *Speedmaster*[®] Calibrated 21-Step Density Tablet

Model Number: **ST-21**

Serial Number: **030612-15**

Geometric Conditions:

ISO 5-2 / ANSI PH2.19 Opal Glass Diffused

Spectral Conditions:

ISO 5-3 / ANSI PH2.18 Visual Density

Step

#	Den	#	Den	#	Den	#	Den	#	Den	#	Den
1	<u>0.15</u>	5	<u>0.89</u>	9	<u>1.75</u>	13	<u>2.62</u>	17	<u>3.35</u>	21	<u>5.05</u>
2	<u>0.39</u>	6	<u>1.11</u>	10	<u>2.01</u>	14	<u>2.73</u>	18	<u>3.54</u>		
3	<u>0.54</u>	7	<u>1.33</u>	11	<u>2.20</u>	15	<u>2.99</u>	19	<u>3.82</u>		
4	<u>0.72</u>	8	<u>1.56</u>	12	<u>2.39</u>	16	<u>3.20</u>	20	<u>4.27</u>		

Certification Date:

March 6, 2012

Date of First Use:

July 31, 2012 (to be completed by user)

Expiration Date:

Two years from date of first use. (Earlier if stored in or exposed to adverse conditions)

ESECO Speedmaster[®]
One ESECO Road
Cushing, OK 74023

Phone: 918 225 1266

FAX: 918-225-1284

E-mail: Info@ese-co-speedmaster.com

Calibration Certificate

STRUCTURIX CERTIFIED DENSTEP

X-Ray Film Step Tablet

Step Tablet identification number:

7113070

Calibration date: november 2008

The density values reported, cross referenced by serial number to the enclosed table, are traceable to NIST (the United States National Institute of Standards and Technology) through traceable calibrations of the instrumentation in accordance with ISO 9001 approved Q.A. system.

The calibration process is additionally verified by measurement of a NIST X-Ray Film Step Tablet, S.R.M. 1001: ID **0401014** (certificate in attachment)



I. Daneels
Quality Management & Application
Application Assistant Film Systems
Agfa Business Group NDT



K. Marstboom
Quality Management & Application
Manager Film Systems
Agfa Business Group NDT

To be completed by the user:

Date of first use: 2009 / 10 / 30 (date package opened)
(fill in: Y/M/D)

Name: T. GRIGES

Signature: 

The Step Tablet might be replaced two years from date of first use or earlier if it show signs of deleterious wear.



GE Inspection
Technologies

Instructions for use

1. Use:

The STRUCTURIX CERTIFIED DENSTEP is a X-ray film step tablet for the calibration of optical transmission densitometers which are used in the NDT industrial X-ray field.

2. Description:

The standard STRUCTURIX CERTIFIED DENSTEP is produced on a STRUCTURIX D7 industrial X-ray film, processed using a standard industrial X-ray film processing system: G 135/G 335; developer temperature: 28° C (82° F) and 100 seconds (\pm 5 sec.) immersion time.

The dimensions are 35 x 230 mm (1 3/8" x 9 1/16"). The film has a blue base and emulsion on both sides.

The STRUCTURIX CERTIFIED DENSTEP covers the optical density range from 0 to 4.0, it has 15 steps with approximate intervals of 0.30 optical density (lowest O.D. < 0.3, highest O.D. > 3.9).

3. Density measurement and certification:

The diffuse optical transmission densities of the enclosed STRUCTURIX CERTIFIED DENSTEP were measured using a calibrated Macbeth TR924 densitometer with 3 mm diameter circular aperture. The densities were calibrated by methods that conform to conditions specified for ISO Standard Diffuse Visual Diffuse Transmission Density, $D_T(\leq 10^\circ; S_H:opal; V_T)$, in ANSI PH2.19-1990 and ISO 5-2:1991 "Density Measurements - Geometric Conditions for Transmission Density," and in ANSI PH2.18 and ISO 5-3:1984 "Density Measurements - Spectral Conditions." Measurements were performed at the center of each step. The estimated overall uncertainty (combined accuracy and precision at 95 % confidence) of the values given with the Step Tablet is \pm 0.022 or 2.2 % of the reported density, whichever is greater.

4. Shelf life:

Archiving of this strip is monitored according to ANSI PH 4.8-1985, ANSI IT 9.1-1989 and ISO 10602 with "life time expectancies" of more than 500 years. As mentioned in the NIST certificate, also the shelf life of the STRUCTURIX CERTIFIED DENSTEP is dependent on storage and handling. Agfa has packed this DENSTEP in a light-tight waterproof package which protects it against fumes, dust, etc. Therefore, until opening the package, the DENSTEP is totally protected against scratching and abrasion.

Agfa guarantees a shelf life of at least 4 years for sealed package, starting from the certification date mentioned on the front page (in agreement with Agfa and NIST shelf life studies).

In the Agfa Q.A. system, records are kept for the identification numbers, certification and calibration dates of the STRUCTURIX CERTIFIED DENSTEP, during the guaranteed shelf life time.

5. Life during use:

The life time could be 24 months or as stipulated by user contract, starting from "date in use" after opening of package.

After opening the packaging, the life time of the STRUCTURIX CERTIFIED DENSTEP is mainly dependent on abrasion, dust, handling etc. The DENSTEP should always be stored in a dark, cool and dry place.



National Institute of Standards & Technology

Certificate

Standard Reference Material 1001

X-ray Film Step Tablet

This Standard Reference Material (SRM) is intended for use in the calibration of optical densitometers and similar equipment used in the photographic, graphic arts, and X-ray fields. SRM 1001 is a double emulsion X-ray film step tablet 25.4 cm (10 in) long by 3.5 cm (1.375 in) wide. The tablet has 17 steps 1.3 cm (0.5 in) wide perpendicular to the long edge of the film with certified transmission densities ranging from less than 0.200 to greater than 4.000. The serial number is located at one end of the step tablet.

Determination of Certified Transmission Density: The transmission density of each step of the tablet was measured using the NIST Diffuse Transmittance Densitometer [1]. The instrument and measurements conform to the conditions specified for ISO Standard Diffuse Visual Transmission Density, $D_T(90^\circ \text{ Opal}; S_H: 10^\circ; V_T)$ [2,3]. The certified transmission densities listed in Table 2 were measured on a 3 mm diameter circle at the center of each step, and apply only to that area. When measured, the side of the tablet with the serial number was in contact with the diffuser of the densitometer.

Expiration of Certification: The certification of this SRM is deemed to be valid, within the uncertainties specified, for a period of three years from the calibration date given in Table 2, provided the SRM is stored and handled in accordance with the "Instructions for Use" and "Storage and Handling" sections of this certificate. However, certification will be nullified if the SRM is damaged or contaminated. Registration (see attached sheet) will facilitate notification.

Discussion of Uncertainties: Uncertainties were calculated according to the procedures outlined in reference 4. Measured (Type A) uncertainties were assumed to be Gaussian-distributed, and were calculated from the standard deviations. Estimated or inferred (Type B) uncertainties were also assumed to be Gaussian-distributed, and were calculated from the measurement equation. The uncertainties were combined by adding their variances in quadrature. Table 1 is a list of all identifiable sources of uncertainty. The measured standard deviations are listed in (a), the inferred standard deviations are listed in (b).

Source¹: Film step tablets were produced by GE Inspection Technologies, AGFA division, Goose Creek, SC.

The technical direction and physical measurements leading to certification were provided by E.A. Early with assistance from C.L. Cromer, D. Dummer, T.R. O'Brian, X. Xiong, and R.D. Saunders of the NIST Optical Technology Division and P.F. Wychorski of the Eastman Kodak Co.

Albert C. Parr, Chief
Optical Technology Division

Robert L. Watters, Jr., Acting Chief
Measurement Services Division

Gaithersburg, MD 20899
Certificate Issue Date: 20 May 2004
See Certificate Revision History on Page 3

¹Certain commercial equipment, instruments, or materials are identified in this certificate in order to specify adequately the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

The support aspects involved in the issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by C.S. Davis of the NIST Measurement Services Division.

INSTRUCTIONS FOR USE

Remove the film from its protective sleeve and place the center of a step on the diffuser of the densitometer to be calibrated with the side of the step tablet with the serial number in contact with the diffuser. Calibrate the densitometer using the transmission density of that step, and repeat this procedure with other steps of the step tablet.

Storage and Handling: The densities of this X-ray film step tablet may change with time. To minimize such changes, the film should be stored in a cool, dry place where it will not be exposed to light or other radiant energy or to chemical fumes, or to dust in the air. Scratches, abrasion marks, or foreign matter on the film can change the density. Fingerprints are a common source of contamination. Fingerprints on the film surfaces can be avoided by handling the step tablet only by the edges and by wearing clean cloth gloves available from photographic film dealers for this purpose. Any attempt to clean a film step tablet, other than to remove dust with a soft camel-hair brush, is not recommended as it is likely to alter the certified values.

Table 1. Tabulation of Uncertainties	
Source of Uncertainty	Uncertainty in Transmission Density
(a) Measured (Type A) Uncertainties	
Source Stability	± 0.001
Signal Noise	± 0.001
Amplifier Gain	<< 0.001
Detector Linearity	± 0.001
Step Uniformity	± 0.001
(b) Inferred (Type B) Uncertainties	
Voltmeter Accuracy	<< 0.001
Diffusion Coefficient	< 0.001
Opal Reflectance	< 0.001
Spectral Product	< 0.001
Combined Uncertainty (1)	± 0.002
Expanded Uncertainty (3)	± 0.006

REFERENCES *

- [1] Early, E.A.; O'Brian, T.R.; Saunders, R.D.; Parr, A.C.; *Standard Reference Materials: Film Step Tablet Standards of Diffuse Visual Transmission Density - SRM 1001 and SRM 1008*; Natl. Inst. Stand. Technol. Spec. Publ. 260-135, U.S. Government Printing Office: Washington, DC (1998).
- [2] ISO 5-2: 2001, Photography - Density Measurements - Part 2: Geometric Conditions for Transmission Density; *International Organization for Standardization*: Geneva, Switzerland (2001).
- [3] ISO 5-3: 1995, Photography - Density Measurements - Part 3: Spectral Conditions; *International Organization for Standardization*: Geneva, Switzerland (1995).
- [4] ISO; *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10183-9, 1st ed. ISO, Geneva, Switzerland (1993); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297, U.S. Government Printing Office: Washington, DC (1994).

APPENDIX

Table 2. Transmission Densities of SRM 1001	
Serial No.: 0401014	Calibration Date: 13 July 2004
Step Number	Transmission Density ^{a)}
1	0.155
2	0.237
3	0.480
4	0.720
5	0.950
6	1.207
7	1.449
8	1.708
9	1.948
10	2.217
11	2.480
12	2.753
13	2.989
14	3.261
15	3.485
16	3.723
17	4.111

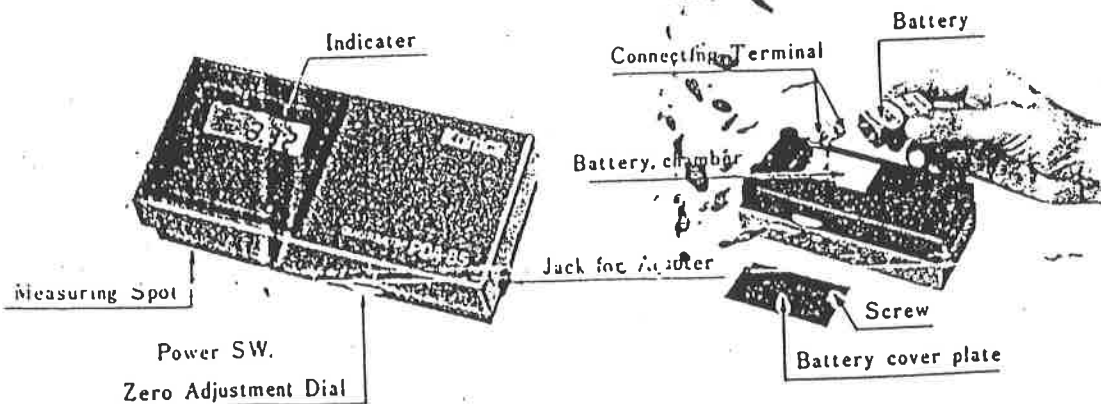
^{a)} Expanded uncertainty ($k = 3$) of the transmission density of each step is ± 0.006 (see Table 1).

Certificate Revision History: 20 May 2004 (This technical revision reports an extension of the certification period.); 14 October 1997 (Original certificate date).

Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-6776; fax (301) 926-4751; email srminfo@nist.gov; or via the Internet at <http://www.nist.gov/srm>.

Konica densitometer PDA-85 is a handy portable type densitometer for transmission density of black and white silver halide images, and is unique with its direct reading of density. Place the unit over a specimen on a light table after zero adjustment. The density value is then displayed in numerals and easily measured. The light source is confined to a fluorescent lamp or tungsten lamp with intensity of measuring surface between 2,000 and 50,000 lux. Power source is 9v dry battery or adapter for DC 9v.

Components



Operation

Preparation:

for battery use.

- 1) Turn screw and remove battery cover plate at the bottom
 - 2) Connect battery to terminal.
 - 3) Place battery into battery chamber and tighten screw.
- for commercially available adapter use. Insert phone plug into jack in densitometer.

Measurement:

- 1) Place densitometer on a light table.
- 2) Adjust indication to 0.00 after turning power switch ON.
- 3) Place measuring area of specimen under the measuring spot with emulsion-side up.
- 4) Digital reading shows density of a specimen.
- 5) Turn switch to OFF after use.

Maintenance:

When BATT sign appears, replace battery (Type 006P,9V) after turning switch to OFF.

Note:

- 1) Light intensity varies from place to place on a light table.
- 2) To get an accurate density reading, place a specimen on the spot where the zero-adjustment is made.
- 3) Please note that use of other light table than designated and measurement of other specimen than black and white image of silver halide may cause inaccurate indication of density.
- 4) This densitometer is of high accuracy using LSI. Handle with care and avoid shock and falling.

Specifications

Measuring Object	: Transmission density of black and white images.
Density Range	: 0.00 - 4.00 D.
Measuring Area	: 3mm in diameter.
Density Indication	: 3-digit indication (by liquid crystal, reflecting type)
Measuring Accuracy	: $\pm 0.05D$.
Detector	: Photocell.

STANDARD PRACTICE FOR CALIBRATION OF TRANSMISSION DENSITOMETERS¹

A99



SE-1079



(Identical with ASTM Specification E 1079-97)

1. Scope

1.1 This practice² covers the calibration of transmission densitometers used to perform radiographic film density measurements (see Note).

1.2 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

NOTE — For further information on the design and use of densitometers, the following literature is suggested as additional background information: Guide E 94 and ANSI documents PH2.19 and PH2.36.

2. Referenced Documents

- 2.1 *ASTM Standards:*
E 94 Guide for Radiographic Testing³
E 1316 Terminology for Nondestructive Examinations³

¹This practice is under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.01 on Radiology (X and Gamma) Method.

Current edition approved Aug. 10, 1997. Published February 1998. Originally published as E 1079-85. Last previous edition E 1079-95.

²For ASME Boiler and Pressure Vessel Code applications, see related Practice SE-1079 in Section V of that Code.

³Annual Book of ASTM Standards, Vol 03.03.

2.2 *ANSI Documents:*

ANSI/NAPM IT2.19-1994, Photography — Density Measurements — Part 2: Geometric Conditions for Transmission Density⁴

ANSI/NAPM IT2.16-1996, Photography — Density Measurements — Part 1: Terms, Symbols, and Notations⁴

3. Terminology

3.1 *Definitions* — For definitions of terms used in this practice, see Terminology E 1316.

4. Significance and Use

4.1 This practice provides a means for calibrating transmission densitometers used for the measurement of radiographic film density. A transmission densitometer calibrated in accordance with this practice provides the assurance that accurate density values of radiographs are obtained.

5. Apparatus

5.1 Apparatus should consist of the following:

5.1.1 A calibrated step tablet shall be used. The step tablet may be a NIST X-ray Step Tablet (Standard

⁴Available from American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.

Reference Material SRM 1001)⁵ or alternately a step tablet from another supplier, which is traceable to the NIST SRM 1001 X-ray Step Tablet. The step tablet shall have at least five step densities ranging from 0.3 through 3.9. The step tablet may have additional step densities less than 0.3 and greater than 3.9. A calibration certificate shall be provided with the step tablet indicating the tablet ID and recorded values for each step density. For suppliers of step tablets other than NIST, the certificate shall indicate conformance of traceability to NIST instrumentation used in the calibration process, applicable ANSI standards used, verification of measurement on a NIST SRM 1001 step tablet, the ID number of the SRM 1001 step tablet, and calibration date of the step tablet. Precautions should be taken in the storage, handling, and use of the step tablet. In the event it becomes scratched, blemished, or exhibits other signs of deleterious wear, it should be replaced immediately. The step tablet shall be replaced four years from date of first use.

5.1.2 *Transmission Densitometers*, with either direct-scale readout or digital readout displays specifically manufactured for the purpose of measuring the range of film densities described in 5.1.1 may be used.

5.1.3 *Manufacturer's Operating Instructions for Appropriate Transmission Densitometer*.

6. Calibration

6.1 Full-scale linearity calibration should be performed at least every 90 days during use as follows:

6.1.1 Allow a minimum of 30-min "warm-up" time (or the manufacturer's recommended warm-up time) to stabilize circuitry before starting the calibration procedure or the periodic verification checks described in Section 8. Adjust the "0" reading of the densitometer after the warm-up period.

6.1.2 Select and position for reading the neutral density closest to 0.3, 3.0, and 3.9 on the calibrated step tablet. Read and record the density for each step.

6.1.3 Compare the densities recorded with the actual density values on the calibrated step tablet or the density values listed on the calibration certificate. If the densitometer has been calibrated properly, the

densities at 0.3, 3.0, and 3.9 steps should not vary more than ± 0.05 density units. If any of the recorded density values vary more than ± 0.05 density units from the density values on the calibrated step tablet, the linearity of the densitometer is out of tolerance and should be corrected.

7. Records and Associated Documentation

7.1 Note and record the calibrated readings, required by 6.1.2 in an appropriate calibration log. A pressure-sensitive label or tag that indicates the date the calibration was performed, and the identification of the individual performing the calibration, may be applied to the densitometer to verify the calibration reference check recorded in the calibration log.

7.2 An alternative calibration documentation system may be used provided the calibration traceability requirements identified in 7.1 can be satisfied and documented properly.

8. Periodic Verification

8.1 Periodic calibration verification checks using the procedure described in Section 6 should be performed at the beginning of each shift, after 8 h of continuous operation, or change of apertures, whichever occurs first.

8.1.1 If the verification reading is within ± 0.05 of the density values recorded in the calibration log required by 7.1, the densitometer is ready for continued use. It is not necessary to record density values when they are within the acceptable tolerance. If the density values are not within the tolerance, recalibration is required and it shall be performed in accordance with Section 6.

8.1.2 If the calibration verification check shows a variation greater than ± 0.05 , then all radiographs examined since the last acceptable daily density check should be subject to a reverification for density after the densitometer has been recalibrated.

8.2 Consult the Manufacturer's Technical Manual for troubleshooting information.

9. Keywords

9.1 calibration; densitometer; density; periodic verification; radiographic film

⁵ Standard Reference Material 1001 is available from the National Institute of Standards and Technology, Gaithersburg, MD.

SPECTRUM N.D.T. LTD

Section Six

Radiographic Technique Number One (RT1)

Pressure Vessels

- 1. Scope**
- 2. Preliminary Consideration**
- 3. Specific Job Requirements**
- 4. Radiation Control**
- 5. Set Up Procedures**
- 6. Exposure**
- 7. Film Processing**
- 8. Film Interpretation and Reporting**
- 9. Diagrams**

1. Radiographic Technique Number One Part 1:

- 1.1 This portion of Technique No. 1 applies to pressure vessels manufactured Under ASME Section 1 & Section VIII, Divisions 1 and 2. These procedures shall also be used for non-code vessels or structures of similar configuration.
- 1.2 **Definition of a Pressure Vessel:**
A pressure vessel includes the shell, heads, manways, and attached piping including flanges or threaded fittings. Piping extending beyond the first flange or threaded fitting may also come under the jurisdiction of Section VIII but usually comes under the jurisdiction of Power Piping Codes. Jurisdiction changes will always occur at a flange or threaded fitting.

2. Preliminary Considerations:

- 2.1 Personally inspect the vessel both inside and outside to determine that there are no surface artifacts, on or adjacent to, the weld whose image may mask an internal defect and that the weld reinforcement does not exceed the limits specified by Code. Surface artifacts may include bars across the weld, excessive weld ripple, stray tools, welding rods, flux, etc.
- 2.2 Inform the manufacturer of these defects and request that they be removed. If cooperation cannot be obtained, record existing artifacts on the report form. Remove loose slag and welding rod from the inspection area personally.
- 2.3 Determine what code applies. The manufacturer's representative should have this information available but it commonly is shown on "Approved for Construction" shop drawings. It may also be obtained from the Contract Specifications.
- 2.4 Request that a construction drawing of the vessel be made available for marking by yourself. Your markings will show the weld identification scheme used, source location, and reference will be made to Figures and Exposure Arrangements shown in Section II of this manual. If a shop drawing is unavailable, prepare your own using Figures 1 and 2 as a guide. This need not be an engineering quality drawing, a neat sketch will suffice. The marked drawing or sketch will be submitted to the manufacturer with the film.
- 2.5 Determine that the identification system we propose to use is satisfactory to the manufacturer. He may have a different standard than ours and every effort should be made to work, within his system, as it should not be confusing to his employees.

2. Preliminary Considerations: (Cont'd)

- 2.6 Determine the plate thickness, head thickness and schedule of pipe used for fitting attachments. If a beveled transition occurs between the head and shell, pay particular attention to penetrometer and shim selection.
- 2.7 Discuss the Radiation Protection Boundaries you must set up with the manufacturer. Although we have legal requirements which must be met, our operations can be very disruptive and satisfactory arrangements must be worked out between our customer and ourselves.

3. Specific Job Instructions:

- 3.1 Mark the vessel following the system shown in Figure 1 & 2, if approved by the manufacturer. Circumferential seam C₁ will always join the top head to the top course (can) of a vertical vessel, or the head farthest removed from the manway of a horizontal vessel. In cases where the opposing end is flanged, C₁ is the circ furthest removed from the flange. An example of this last case is a heat exchanger shell.

Longitudinal Seam L₁ occurs on course (can) one between circ, welds C₁ And C₂. Similarly L₂ occurs between C₂ and C₃. Very large diameter vessels (or penstock cans) may have more than one longitudinal seam. Designate these seams as L₁(a), L₁(b), L₁(c), etc.

3.2 Marker Orientation:

3.2.1 Circumferential Seams:

The direction of travel for marker identification is CLOCKWISE when the seam is viewed from inside the vessel with your back to C₁. Starting at the junction of the longitudinal weld, mark the circumferential weld at 28 cm intervals if 100% radiography is required. (A cassette should be centered on the 'T' intersection for 'spot shots' and should be numbered similarly, 0 to 14 cm.)

When the source is centrally located on the axis of the vessel, placing the markers on the film side is permitted, hence it may be convenient to attach a "clock tape" marked in 28 cm intervals on the film side of the weld.

The marker locations shall be permanently marked by stamping with the number 0 at the starting point followed at 28 and 55 cm intervals.

3. Specific Job Instructions (Cont'd)

Following the foregoing procedure will ensure that the identification specified in paragraph 8.1 of this manual appears correctly on the radiograph with 'clock tape' numbers increasing in value reading from left to right.

3.2.2 Longitudinal Seams:

The foregoing instructions apply to radiography of longitudinal weld seams with the 0 mark placed at the junction between the circumferential and longitudinal seams. Referring to Figure 1 and 2, note that the 0 starting point occurs adjacent C² with markers increasing in number toward C₁. When viewed as though the eye were at the source of radiation, the markers read correctly from left to right.

3.3 Back Scatter Control:

Place a letter "B" on the back of each cassette used for Code work. Ensure that there is at least 50 cm clearance between weld seams and other objects, such as rolls, structural steel, concrete shop floors or walls. Use sheets of plumbers lead to absorb the primary beam impinging on the aforementioned objects.

3.4 Film Type: AGFA Brand Film shall be used.

Type 1 films will be used on thicknesses 10 mm and below. Type II films will be used on thicknesses above 10 mm.

3.5 Film Identification:

Each film will show Contract No., Vessel No., Seam No. and other markings required by the manufacturer.

Observe and conform to the requirements for source side markers and film side markers.

3.6 Image Quality Indicators (Penetrameters) & Shims:

3.6.1 Use penetrameters that conform to the configuration specified in ASME SE-142.

3.6.2 Select penetrameter designation, thickness and hole diameter appropriate to the plate thickness, crown reinforcement and backing strip if used.

3.6.3 Place the penetrameter on the source side of the plate. When radiographing longitudinal seams, the penetrameter is to be placed between, but adjacent, to the marker numbers. When radiographing circumferential seams with markers placed on the outside of the can, care must be taken to ensure that the image of the source side penetrameter is not superimposed on the marker.

- 3.6.4 Place the penetrometer on the film side of the material when the source side is not accessible. In this case, a lead letter "F" is to be placed adjacent to the penetrometer to indicate the film side placement.

4.0 Radiation Control Considerations:

- 4.1 If using a gamma ray source, calculate the distance from the proposed source location which meets the legal boundary requirement of our license.

If an x-ray source is used, the R/hr output of the machine should be known. This number can be used directly in the aforementioned calculation; however, the equivalent voltage is likely to be much less than that of an isotope and the source to boundary distance will be significantly less.

- 4.2 Expose the source and measure the radiation level at the boundary and warning signs. If necessary extend the boundary.

5.0 Set up Procedures:

- 5.1 The instruction of 4.2 above, presumes that you have set up for the exposure following the appropriate exposure arrangements shown in the following drawings.

- 5.2 These exposure arrangements show all radiography set ups authorized for use by Level I and II personnel. These exposure arrangements apply to radiography of pressure vessels and/or pressure piping.

Figures 1 and 2 will be recognized as expansions of exposure arrangement "A". When this arrangement is used, determine that the source is centered correctly by taking four measurements of the source to plate distance. Each measurement shall be taken at 90° intervals.

6.0 Exposure Calculations:

- 6.1 At this point in time, the source (if a gamma ray exposure) should be removed from its storage container, placed in its proper position and the controls attached.
- 6.2 The exposure time should be calculated with a slide 'rule' exposure calculator. Refer to the exposure chart for the specific tube if an x-ray machine is used.

7.0 Film Processing

- 7.1 Film handling is to be done on clean, oil or grease free surfaces. The technician's hands will also be clean and free from grease and oil.
- 7.2 Manual processing tanks will be topped up with properly mixed developer, refresher and fixer. The processing chemicals will be stirred vigorously to ensure proper mixing and uniform temperature. Processing chemistry, particularly the developer, will be heated or cooled to maintain a temperature range between 68° F and 80° F.
- 7.3 Developer will be replenished until four times the original volume has been added, at which time new chemistry shall be mixed. Fixer may be used with refreshing until the clearing time reaches twice the new fixer clearing time. Indicating short stop will be used and replaced when exhausted.
- 7.4 Developing time will be time-temperature based on the manufacturers published recommendations.
- 7.5 Film will be washed in fresh 68° F running water and dried in hot air dryers.
- 7.6 Automatic processing may be used. The recommended procedures supplied by the machine and chemistry manufacturers will be followed.

8.0 Film Interpretation & Reporting:

- 8.1 Radiographs will be checked to ensure compliance with the density requirements of Section II. A portable densitometer will be used to compare radiograph density to densities of a Standard Test strip.
- 8.2 Radiographs will be interpreted by a Certified ASNT or CGSB Level II or Level III personnel.
- 8.3 Interpretation shall be to ASME Section I, VIII Divisions 1 and 2 or to ANSI B31.1, B31.3 or B31.5 as appropriate.
- 8.4 The result of the film interpretation shall be recorded on the company's Radiographic Report Form.
- 8.5 The radiographs shall be packaged, with dividers separating each seam, and turned over to the manufacturer along with the report.

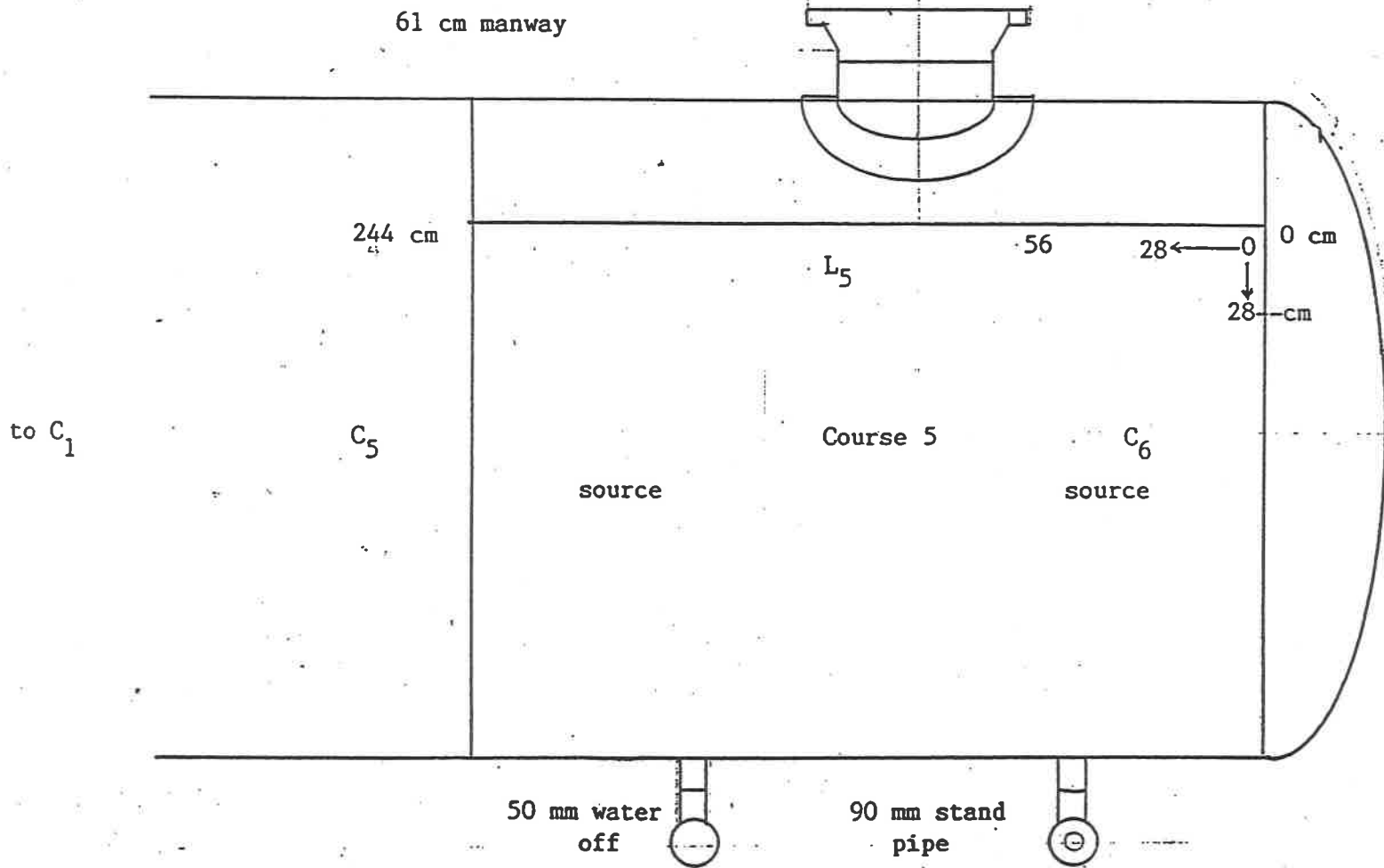


Figure - 1 Source and film placement for Semi Elliptical Head Pressure Vessel

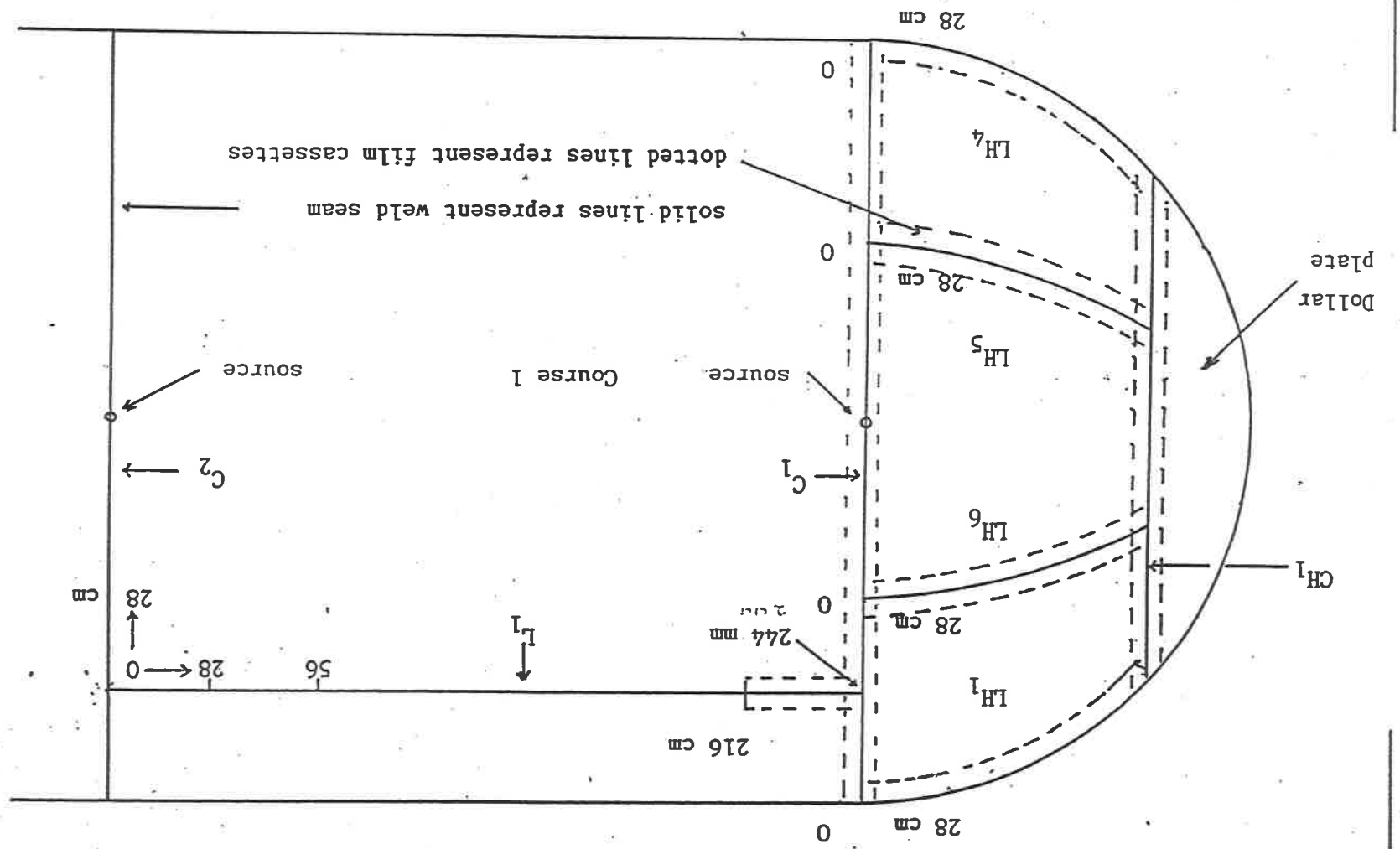


Figure 1 - Source and Film Placement for Hemispherical Head Pressure Vessel

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Section Seven

Radiographic Technique Number Two (RT2)

Pressure Piping

- 9. Scope**
- 10. Radiographic Identification**
- 11. Marker Orientation**
- 12. Image Quality Indicators**
- 13. Standard Setup Procedures**
- 14. Radiation Control**
- 15. Exposure Calculations**
- 16. Film Processing**
- 17. Film Interpretation and Reporting**
- 18. Diagrams**

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Section Seven

Radiographic Technique Number One (RT2)

Pressure Piping

- 9. Scope**
- 10. Radiographic Identification**
- 11. Marker Orientation**
- 12. Image Quality Indicators**
- 13. Standard Setup Procedures**
- 14. Radiation Control**
- 15. Exposure Calculations**
- 16. Film Processing**
- 17. Film Interpretation and Reporting**
- 18. Diagrams**

9.0 Radiographic Technique Number One Part 2:

- 9.1 Part 2 of Radiographic Technique Number One applies to pressure piping manufactured under ASME Section B31.1, B31.3 and B31.5. These procedures shall also be used for radiography of non Code piping or structures of similar configuration.
- 9.2 Preliminary considerations listed in Part 2, Article 2, paragraphs 2.1 through 2.7 apply equally to radiography of Pressure Piping.

10.0 Radiograph Identification:

- 10.1 Radiographs will be identified as required by the manufacturer. If no specific instructions are given, show the manufacturers Job Number and Name, Line Number, Mark Number, Spool Number, Welders Stamp and the Weld Number.

Radiographs of small diameter pipe may be to show the above as a radiographic image. Other identifying methods may be used, but it is essential to show the manufacturers Job Number, Spool Number and the Weld Number as radiographic images.

11.0 Marker Orientation:

- 11.1 All markers or 'clock tapes' will be placed on the film side of the pipe, and will read from left to right on the radiograph.

12.0 Image Quality Indicators:

- 12.1 The provisions of Section 2, Article 3, Paragraph 3.6.1 through 3.6 apply to penetrameters and shims for pressure piping radiographs.

'Film side' placement of the penetrameter will be used. A lead letter "F" will show adjacent the penetrameter to confirm 'film side'.

When the weld joins pipe to a fitting, the penetrameter shall be placed on the pipe.

13.0 Standard Set up Procedures:

13.1 Exposure Arrangements / Set-ups:

Either 'exposure arrangement' A, D or E will be followed as Standard Practice. Arrangements B, C and F will not be used without specific approval by the Company Level III.

Note the pipe diameter limitations above and below 89mm. Note also, that these technique charts refer to specific sections of Section V, Article 1, and reference is made to specific paragraphs which give Code requirements for penetrometer selection and placement, and marker placement. A copy of Article 1 of Section V is attached for reference by Radiographers employed by this Company.

14.0 Radiation Control Procedures:

14.1 The requirements of Article 4, Paragraphs 4.1 and 4.2 will be followed explicitly.

15.0 Exposure Calculations:

15.1 Follow the procedure described in 6.1 and 6.2.

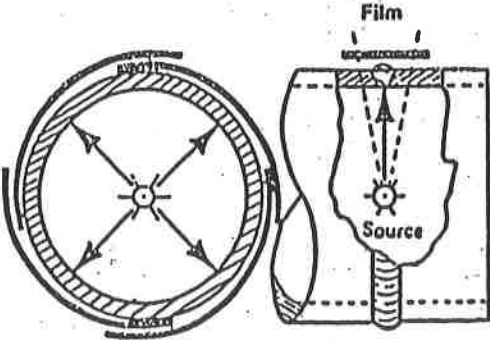
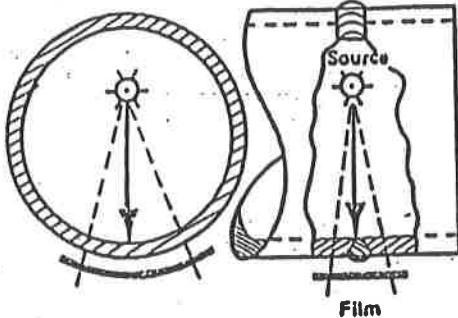
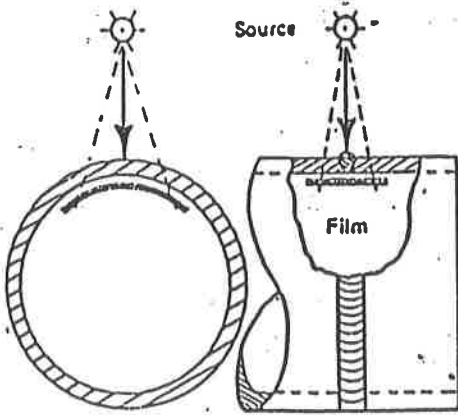
16.0 Film Processing:

16.1 Follow the procedures described in 7.1 through 7.6.

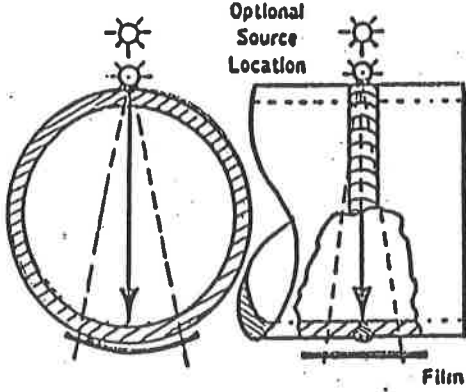
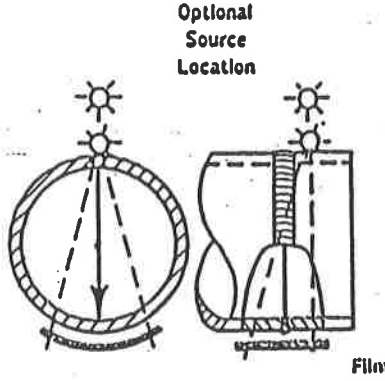
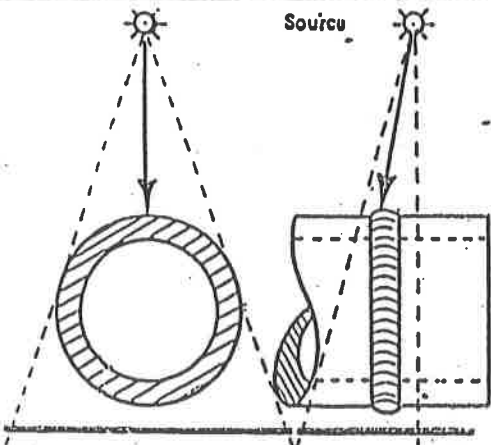
17.0 Film Interpretation & Reporting:

17.1 Follow the procedures described in 8.1 through 8.5.

SINGLE-WALL RADIOGRAPHIC TECHNIQUES

Pipe O.D.	Exposure Technique	Radio-graph Viewing	Source-Weld-Film Arrangement		IQI Penetrameter		Location Marker Placement
			End View	Side View	Selection	Place-ment	
Any	Single-Wall T-271.1	Single-Wall	 <p>Exposure Arrangement — A</p>		T-276 and Table T-276	Source Side T-277.1(a)	Either Side T-275.3 T-275.1(c)
				Film Side T-277.1(b)			
Any	Single-Wall T-271.1	Single-Wall	 <p>Exposure Arrangement — B</p>		T-276 and Table T-276	Source Side T-277.1(a)	Film Side T-275.1 (b)(1)
				Film Side T-277.1(b)			
Any	Single-Wall T-271.1	Single-Wall	 <p>Exposure Arrangement — C</p>		T-276 and Table T-276	Source Side T-277.1(a)	Source Side T-275.1 (a)(3)
				Film Side T-277.1(b)			

DOUBLE-WALL RADIOGRAPHIC TECHNIQUES

Pipe O.D.	Exposure Technique	Radiograph Viewing	Source-Weld-Film Arrangement		IQI Penetrator		Location Marker Placement
			End View	Side View	Selection	Placement	
Any	Double-Wall: T-271.2(a) at Least 3 Exposures 120 deg. to Each Other for Complete Coverage	Single-Wall	 <p style="text-align: center;">Exposure Arrangement — D</p>		T-276 and Table T-276	Source Side T-277.1(a)	Film Side T-275.1 (b)(1)
Any	Double-Wall: T-271.2(a) at least 3 Exposures 120 deg. to Each Other for Complete Coverage	Single-Wall	 <p style="text-align: center;">Exposure Arrangement — E</p>		T-276 and Table T-276	Source Side T-277.1(a)	Film Side T-275.1 (b)(1)
3/8 in. or Less	Double-Wall T-271.2 (b)(1) at Least 2 Exposures at 90 deg. to Each Other for Complete Coverage	Double-Wall (Ellipse): Read Offset Source Side and Film Side Images	 <p style="text-align: center;">Exposure Arrangement — F</p>		T-276 and Table T-276	Source Side T-277.1(b)	Either Side T-275.2

DOUBLE-WALL RADIOGRAPHIC TECHNIQUES (CONT'D)

Pipe O.D.	Exposure Technique	Radio-graph Viewing	Source-Weld-Film Arrangement		IQI Penetrameter		Location Marker Placement
			End View	Side View	Selection	Place-ment	
3/4 In. or Less	Double-Wall: T-271.2 (b)(2) at Least 3 Exposures at 60 deg. or 120 deg. to Each Other for Complete Coverage	Double-Wall: Read Super-Imposed Source Side and Film Side Images	<p style="text-align: center;">Exposure Arrangement — G</p>		T-276 and Table T-276	Source Side T-277.1(b)	Either Side T-275.2

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Bay 40, 3170 114 Avenue SE, Calgary AB T2Z3V6

HYDROSTATIC PROCEDURES



Revision Date: 11/28/07	Maloney Industries Safe Work Standard	Standard #: MI-SWS-12-07
HAA Ref #: MI.08	Pressure Vessel Hydrostatic Testing	Date of Activation: 12/18/05
Authored by: D.Hawkins	Title: Loss Prevention Manager	Date: 11/28/07
Approved by: A. Krupich	Title: Quality Manager	Date: 11/28/07

PURPOSE

This standard is in place to ensure that workers understand the steps needed to carry out hydrostatic testing on pressure vessels safely and within quality control parameters.

SCOPE

This standard applies to all workers who are required to perform hydrostatic testing on pressure vessels that are fabricated at Maloney Industries Inc.

RESPONSIBILITY MATRIX

Operations Manager-	Is responsible for ensuring that this standard is supported on the worksite.
Plant Supervisors-	Are responsible for ensuring that only those workers who are trained and verified as being competent by the Quality Department can perform the hydrostatic testing of pressure vessels.
Quality Manager-	Is responsible for ensuring that workers for Maloney Industries Inc. who are selected to perform hydrostatic testing on pressure vessels are adequately trained, and certified internally to perform the testing.
Quality Control Workers-	Are responsible for ensuring that the Vessel Hydrostatic Checklist is accurately completed and verified before pressure is applied to the vessel for testing.
Workers-	Are responsible for ensuring that this standard is followed to support the health and safety initiative set by Foremost Universal LP for reducing the potential for injuries and other losses through the processes we carry out.
Safety Coordinator-	Is responsible for ensuring that the hazard assessment applicable to this standard is periodically assessed to ensure that the information is current with the trends within the corporation and/ or through the changes and trends recognized in the industry that we are a part of.

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Approved by: A. Krupich	Title: Quality Manager	Date: 11/28/07

STANDARD

General Information

All pressure vessels fabricated in accordance with ASME Section VIII, Division 1 and 2 or other Codes of construction, will be hydrostatically tested following the completion of all fabrication. The test pressure will be as stated on the fabrication drawing and verified by the Quality Control Department.

- 1.1 Hydrostatic testing shall be carried out on all vessels and piping after all fabrication is completed, except for operations which could not be performed prior to the test, such as cosmetic grinding on the base materials which does not affect the required thickness of the vessel or piping.
- 1.2 All vessels will receive a complete visual inspection of all components prior to the installation of blinds, plugs and filling of the vessel with water. Any repairs which may be required will be completed before testing of the vessel. Using faulting equipment could result in a failure that could lead to serious injury and/ or property damage.
- 1.3 Blind flanges, plugs, gaskets, studs and other components that will sustain pressure during the test will be examined prior to use to ensure that defective components are not used *and that the components can withstand the required hydro test pressure*. Prior to installation, blind flanges, plugs valves, etc. will be checked to ensure that the correct rating is used on the vessel being tested.
- 1.4 Potable water will be used in all hydrostatic pressure tests. Where specified, a corrosion inhibitor will be added to the water. The water will be at least 30°F above the vessels Minimum Design Metal Temperature for Division 1 vessels and 60°F for Division 2 vessels, where practical. The metal temperature will be allowed to stabilize with the water temperature before pressure is applied.
- 1.5 All filling and drain lines will be blocked to prevent inadvertent pressurizing. Air pockets will be vented while the vessel is being filled.
- 1.6 Pressure gauges used to measure the test pressure will be checked prior to use to ensure that they have been properly calibrated. Each gauge used will have a calibration label which bears a current calibration date attached to the lens. The gauge will also be checked for visual damage and for proper zeroing. At minimum, two gauges will be used for each hydrostatic test. The gauges will be of a suitable range that is not less than 1.5 times nor greater than 4 times the test pressure.

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- One gauge shall be mounted directly without intervening valves on the items being tested.
- Vessels and heater bundles will not require a chart unless specified by the customer. All vessels being shipped internationally will be charted regardless of size.
- Remember to ensure that before pressurizing that the test equipment shall be examined to ensure it is tight and secure, and that all low pressure filling lines, and other items that should not be subjected to pressure are disconnected or isolated. Place barrier tape around the area where the connections are located to warn workers of the hazard that hydrostatic testing is being performed.
- 1.7 Pressure will be applied in the presence of a Quality Control Inspector, where possible. The vessel will be checked by the Quality Control inspector prior to contacting the Authorized Inspector to ensure that the vessel is ready for his inspection.
- For Division 2 vessels, the pressure will be applied gradually to not more than one-half of the test pressure, after which the test pressure will be increased in steps of approximately one-tenth of the test pressure until the required test pressure has been reached.
- All hydrostatic tests as defined in the Maloney Industries Inc. Quality Control Program will be witnessed by the Authorized Inspector. The Customer Inspector will also be contacted to witness the hydrostatic test, where applicable.
- 1.8 All joints, connections and areas of high stress will be examined for leakage. Vessels fabricated to ASME Section VIII, Division 1 will be examined at the specified test pressure. Vessels fabricated to ASME Section VIII, Division 2 will be examined at a pressure lower than the test pressure, but not lower than the design pressure.
- 1.9 For Division 1 vessels, the hydrostatic test pressure, once applied, will be maintained for as long as required by the Authorized Inspector or as stated in customer specifications. For Division 2 vessels, the hydrostatic test pressure will be maintained for as long as required by the Authorized Inspector.
- 1.10 Any leaks detected where it is not necessary to remove the test pressure to correct the deficiency will be considered a normal construction practice. Leaks requiring the removal of the test pressure will be treated as a non-conformance.
- 1.11 Once the hydrostatic test is complete and approved, the vents are to be opened and the unit is to be drained. Remember to ensure that you release the pressure. Once complete, disassemble the equipment, inspect its condition, and return to storage. Should there



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be any hydrostatic equipment that is questionable, ensure that it is properly tagged for maintenance and/ or calibration.

Safe Work Precautions

- 2.1 Workers are to be aware of the following hazards that are present in carrying out hydro testing:
- Strains from awkward positions or over-exerting on lifting or torquing;
 - Flying debris while cleaning the parts or if there is a leak;
 - Pinch points when handling the tools and equipment;
 - Equipment failure should the equipment not be properly inspected before, during, and after the performance of the hydrostatic test; and
 - Slips/ trips/ falls when working around the unit that is being tested. Remember to keep the area clean.
- 2.2 When setting up and/ or storing parts that are and/ or were a part of the hydrostatic testing, use the mechanical lifting devices such as cranes and hoists to reduce the amount of lifting and/ or carrying.
- 2.3 Workers in the area of the hydrostatic testing need to be made aware of the test. Using a barrier tape and/ or strobe light stand to alert workers that the area is under pressure is a consideration.
- 2.4 Workers who are working in the area of the hydrostatic testing i.e. quality control inspectors, should not turn their back on the hoses and connections to ensure that if there is warning of a potential failure, the worker can act on it immediately to minimize the potential loss.

Associated Reports with Hydrostatic Testing

- 3.1 Note the following reports as a part of tracking and verifying the hydrostatic testing process:
- Maloney Industries Inc. Vessel Travel Sheet
 - Maloney Industries Inc. Heater Bundle Travel Sheet
 - Maloney Industries Hydrostatic Test Affidavit

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3.2 All final testing reports will be kept on file for a period no less than 3-years. These reports will be filed in the archives for the vessel.

Approvals and Revisions

4.1 The Quality Manager and the Loss Prevention Manager are the only ones authorized to make any revisions to this standard once reviewed and approved for revision by management. This revision will be noted in the revision summary listed in the Standard Index.

4.2 All reviews and/ or revisions will include senior workers, where practical, who are certified for conducting and/ or supervising a hydrostatic test. Part of this review and/ or revision will also include the following information as a minimum:

- Hazard Assessment and Analysis for Hydrostatic Testing;
- Quality Reports;
- Incident Investigations;
- Any hazard Identifications by workers.

4.3 All reviews and/ or revisions will be carried out as per the identified risk that is assigned to the task of carrying out hydrostatic testing as noted in the hazard assessment and analysis. However, this process can be accelerated based on events and/ or request to review/ revise by the management group and/ or outside agency.

Revision Index

5.1 The following revisions have been tracked for this standard to date:

- April 25, 1996- Revision 1- Minor editorial changes
- June 4, 1996- Revision 2- General revision to procedure, revised format
- March 5, 1997- Revision 3- Revised charting requirements in paragraph 5.5
- May 5, 1998- Revision 4- Moved to new procedure format.
- June 8, 2000- Revision 5- Revised 5.8 Division 1 vessels hold time to suit the AI and customer requirements

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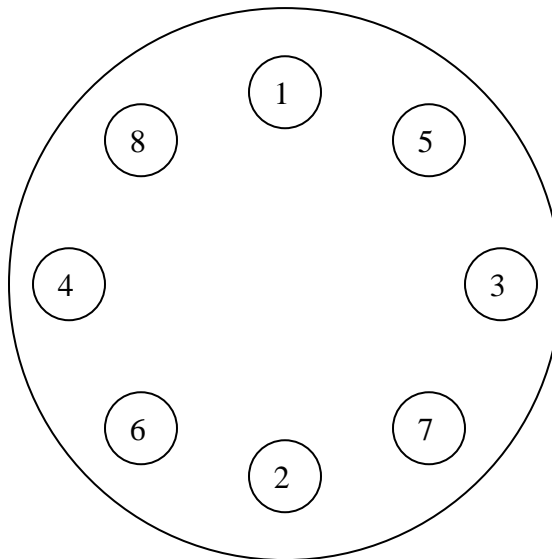
- April 12, 2007 - Revision 6 - Revised the current procedure to include the information noted in the Hazard Assessment and Analysis and the Safe Work Practice to unify the standard.
- November 28, 2007- Revision 7- Revision to the format of the quality procedure into the Safe Work Standard Template. Furthermore, a review was carried out due to the Incident; MI.087, involving a hydrostatic test.

Bolting Pattern

6.1

It is recommended that a 4-stage tightening method be used as follows:

- Tighten the bolts at 30% of the final loading using the diametrical sequence;
- 60% of the final load following diametrical sequence;
- 100% of the final load following diametrical sequence;
- 100% of the final torque on adjacent bolts.



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REFERENCE

- 2.1 Hazard Assessment and Analysis- M.04- Hydrostatic Testing
- 2.2 Section 12; Occupational Health and Safety Regulation of Alberta- Equipment
- 2.3 Section 14; Occupational Health and Safety Regulation of Alberta- Duties of Workers
- 2.4 Part 2; Occupational Health and Safety Code of Alberta- Hazard Assessment, Elimination, and Control
- 2.5 ASME Section VIII, Division 1 and 2
- 2.6 Maloney Industries Inc. Quality Control Manual
- 2.7 Vessel General Arrangement Drawing
- 2.8 Maloney Industries Inc. Pressure Gauge Calibration Procedure-MII-GCP-01-1

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PAINT PROCEDURE

Procedures for Internal/External Coating

1). Purpose

The purpose of this procedure is to define the minimum requirements for the application of protective coating systems to be used on equipment, platforms, steel structures, skids, vessels, piping, valves and any/all additional instruments.

2). Codes and standards

Paint application shall follow the guidelines and standards as set by NACE.
Paint application and safety standards shall follow the regulations from the Occupational Safety and Health Act and local regulations in the strictest manner.

3). Procedure

A). Daily Tests

The following tests will be performed before internal and external coating application begins. These tests will be performed once a day and recorded in the Coating Log Book. The specified tests will be performed as per industry standards.

- Relative Humidity
- Material Surface Temperature
- Ambient Temperature
- Dew Point
- Dry film thickness readings

B). Pre-Coat Inspection

Before the application of the first coat of paint, the blasted surfaces will be inspected to ensure that the specified surface preparation has been obtained. The results of this inspection will be recorded in the Coating Inspection Report that is specific to the job being worked on.

C). Painting

- Coating shall be done in accordance with the paint manufacturer's recommendations with respect to mixing, weather conditions, applications and drying times.
- Coating material shall be in accordance with the paint schedule
- Coating shall not be applied during fog, mist, rain, when the relative humidity is above 85%, or when the surfaces are less than 5° F above dew point nor when the surfaces are wet. Surfaces must be clean, free from dust and be dry before priming or application of any coat of paint.

Painting Procedures cont'd.

- Epoxies shall not be applied at less than 50° F, unless approved by Foremost Universal LP.
- A minimum of two inches around the edges of blast cleaned surfaces shall be left uncoated, unless joining a coated surface. No coating shall be placed on edges prepared for field welds within two inches of these edges. Painting will not be allowed closer than six inches from these un-blasted areas.
- Stainless steel items such as instrument fittings, and galvanized items such as handrails, grating and ladders; and cadmium plated items such as ring joint gaskets and bolting; and electrical equipment and equipment tags shall be protected from damage by blasting abrasives and shall not be painted unless noted.
- Repair of painted areas damaged by fabrication shall include cleaning the damaged areas to bare metal as specified for the primer to be used. Organic zinc primer shall be applied and shall overlap previously coated areas by 1-1/2 inches. Remaining paint coats shall follow the appropriate paint schedule.
- Any portion of a fabrication to be coated shall be completed and in final condition. Corners and edges shall be rounded to 1/8inch radius; slag metal spatter and silvers, heat oxides and other foreign matter shall be removed from weld areas.
- 7 Over Lazy A shall furnish all coating materials and thinners in original unopened containers bearing manufacturer's label and instructions.
- For painting materials which have a limited shelf life, the date of manufacturer and length of life shall be shown,
- Coating materials shall be stirred with a power mixer to remix the pigments and vehicles prior to application
- Only thinners specified by the coating manufacturer shall be used. Manufacturer's mixing and thinning directions shall be followed.
- Blast cleaned surfaces shall be coated with the specified primer with four hours of blasting before rusting can occur.

D). Inspection and Testing

- 7 Over Lazy A and Foremost Universal LP. shall be responsible for maintaining an inspection program to ensure compliance with all surface preparation and coating application codes, standards and specifications
- Each coat shall be inspected for dry film thickness, colour, appearance, etc. and be free from pinholes, runs, sags, over spray, holidays, foreign debris or any other sign of improper application
- 7 Over Lazy A shall make necessary repairs on coating prior to application of the next coat
- Where coating thickness fall below the specified minimum, an additional top coat shall be applied to achieve the total thickness requirement

PACKING LIST

DESIGNERS AND FABRICATORS OF OIL AND GAS PRODUCTION EQUIPMENT

FOREMOST CALGARY SOUTH

8825 SHEPARD ROAD S.E., CALGARY, ALBERTA T2C 4N9

TELEPHONE (403) 279-5000 - FAX (403) 279-2068

Business Registration GST# 811949874 RT0001



PACKING LIST FOR WO-030625

DATE: January 24, 2013

CUSTOMER: Suncor Energy c/o Equinox Engineering
Box 2844, 150 - 6th Ave. SW
Calgary, Alberta
T2P3E3

SHIP TO: Kobes North Liquids Handling Upgrades/Kobes
c-97-G/94-B-9 (exact LSD - TBD)

Contacts:

Derek Tuppen: 780-882-0503

dtuppen@telus.net

Raj Dhaliwal: 403-296-8013

rdhaliwal@suncor.com

Ravash Yazdi: 403-298-9252

ryazdi@equinox-eng.com

DATE SHIPPED: January 27, 2013

PURCHASE ORDER: P383121-KN-001

PROJECT: Kobes North Liquids Handling Upgrades/Kobes

SHIPPED VIA: Zedcor Trucking

SHIPPED FROM: FOREMOST (Calgary South), 8825 Shepard Road SE Calgary AB T2C 4N9

FREIGHT: FOB

MI WORK ORDER NO.: WO-030789

ID # Tag #	Quantity	Description- (Truck Load 1)	Shipping Dimensions (LxWxH)	Weight
030789-D101	1	Slug Finger 72"ID x 30' S/S	34'9"x7'0"x9'9" [10586mm x 2134mm x 2952mm]	49,604 lbs [22,500 kgs]
	1	Data book (Mud Copy)		

CERTIFIED TRUE AND CORRECT

Kelly Sidebottom
Project-Coordinator
Foremost

SHIPPING RELEASE

INSPECTION RELEASE CERTIFICATE (IRC)

INSPECTION RELEASE IS AN INTERNAL DOCUMENT ONLY, DO NOT ISSUE TO SUPPLIER

**THE MATERIAL/EQUIPMENT LISTED BELOW IS RELEASED BY INSPECTION.
SUPPLIER IS TO CONTACT PROJECT EXPEDITING FOR SHIPPING AUTHORIZATION.**

PROJECT NO.: P383121-KN-001	PROJECT NAME: North Kobes Liquids Handling Upgrades	RELEASE NO: 01
PO/SC No.: 2424	TYPE OF IRC: <input type="checkbox"/> INTERIM <input checked="" type="checkbox"/> FINAL <input type="checkbox"/> CONDITIONAL	REF. INSPECTION REPORT No.: Error! Reference source not found. - 07
INSPECTOR: Larry McKinley	DATE: Jan. 23, 2014	OFFICE: Intertek – Calgary, AB
SUPPLIER & LOCATION: Foremost Universal LP	CONTACT: Kelly Sidebottom	TELEPHONE No.: 403-723-3188
SUB-SUPPLIER & LOCATION: N/A	CONTACT:	TELEPHONE No.:

CONDITIONAL RELEASE AUTHORIZATION BY:	
CLOSE OUT ACCEPT / BACKCHARGE VENDOR BY:	
PURCHASE ORDER DELIVERY DATE:	

PO/SC ITEM	QTY	EQUIPMENT DESCRIPTION	TAG, MARK OR EQUIPMENT NUMBER
	1	Slug Finger Vessel	V110
	1	Slug Finger Vessel	V120

RELEASED WITH THE FOLLOWING EXEPTIONS FROM DRAWINGS, PO/SC OR SPECTIFICATIONS: (STATE THE EXCEPTION, JE PROJECT ENGINEER WHO AUTHORIZATION THE EXCEPTION AND THE DATE OF SUCH AUTHORIZATION).

LIST OF ALL CONDITIONS OF RELEASE	REF. SPEC.	REC'D INSPECTOR VERIFICATION
There are no conditions of this release.		

INSPECTOR'S SIGNATURE: _____ Larry McKinley _____
(Print Name)

_____  _____
(Signature)