PRELIMINARY

Energy Industries of Ohio

Contract # S005242-F

Modular Coil Winding Forms

A-1 Documentation Package

Part 1 – Metal Tek International
Casting Data Package

12/29/2005

Note – Documents in red (next page) not yet inserted

A-1 Documentation Package

List of Documents 12-29-2005

Doc #	Description	# Pages
1	MTR for weighted average of chemistry – 3 ladles replaced by product analysis	1
2	MTR from Wisconsion Centrifugal	1
3	MTR for C-4 Shim revised 9/24/05	1
4	Lincoln weld metal product conformance spec Lot 3018926/78309	1
5	St Louis Test Lab dated 8/9/05 mech test results at RT & CVN @ 293°k for Lincoln lot 3018926/78309 (Note – page 3 of 3 unrelated & omitted)	2
6	Westmoreland mech test & CVN @ -320°F dated 9/13/05 Lot 3018926/78309	2
7	Westmoreland Tensile test report @ -320°F dated 9-9-05	1
8	St Louis Test Lab dated 10-10-05 – incl. tensile test results @ room temp & Charpy V Notch (CVN) at 77°K & 293°K	3
9	Weld map	9
10	Radiographic Standard Shooting Sketch	1
11	MQS Radiographic Inspection Report dated 8/13/05	6
12	MTK Radiographic Interpretation Report dated 10/24	1
13	MTK Radiographic Interpretation Report A-1 Shim	2
14	C-4 Coil heat treat chart dated 7/26/05	1
15	C-4 Coil stress relief dated 10/29/05	1
16	A-1 Shim heat treat chart dated 06/02/05	1
17	MTK signed MTS A-1 Coil	12
18	MTK signed MTS A-1 Coil shim	
19	CA 1308 – shim chemistry out of spec	2
20	CA 1323 – CA for sulfur & phosphorus readings dated 7/26/05 + addendum dated 8/17/05 – 9/8/05 & 9/30/05	10
21	CA 1324 – Major weld defects	2
22	CA 1347 – Thin wall condition on areas of shell	3
23	CA 1371 Lack of fusion in welds	1
24	Final inspection report A-1 coil – dated 8/30/2005	1
25	C of C for A-1 Coil	
26	Final Inspection report A-1 Shim	
27	C of C for A-1 shim	
28	EIO shipping release for A-1 Coil	
	Thin Wall Addendum	
i	EIO Thin wall report (not written yet)	
ii	3D ScanCo explanation of tolerance shift	5
iii	3D ScanCo rescan of A-1	8
iv	3D Scanco – review of initial scan on A pattern	16
v	EIO evaluation of stocked model for A casting	1
vi	EIO discussion slides on thin wall	16
vii	Preliminary FEA analysis on A-1	4
viii	FEA analysis report from PPPL	16
12/29/05		

MetalTek INTERNATIONAL

Carondelet Division

8600 Commercial Blvd. - Pevely, MO 63070 USA
Phone: 636-479-4499 - Fax: 636-479-3399

Material Test Report

ENERGY INDUSTRIES OF OHIO

Purchase Order Number PPPL-FP-LTS-2
Pattern Number MCWF-A1
CAF Metal Designation CF8MNMnMod
Material Spec CF8MNMnMOD

Cert Number 169470-1
Pour Date 5/24/2005

Weighted average of 3 heats – 29516(39%),29517(23%),29519(38%) Total Weight 32422 lbs.

Revised 12/5/05

Element	Min	Actual	Max
C	0.04	0.04	0.07
MN	2.3	2.4	2.8
SI	0.0	0.4	0.5
CR	18.0	18.2	18.5
NI	13.0	13.3	13.5
MO	2.1	2.4	2.5
P*	0.0	0.022	0.035
S*	0.0	0.009	0.025
N	0.24	0.26	0.28

*P & S taken from cast on bar, zones 1,2,&3 and analyzed by wet chemistries, ASTM E1019-03 for sulfur and Colormetric for phosphorous.

PRODUCT ANALYSIS

Results of spectrometer analysis of cast on test bar after spectrometer preventive maintenance performed and at Wisconsin Centrifugal.
***Not analyzed on spectrograph.

Element	CAF after PM	WC Analysis
C	***	0.06
MN	1.6	1.6
SI	0.6	.06
CR	18.2	18.1
NI	13.5	13.7
MO	2.4	2.4
P	0.028	0.027
S	0.009	0.009
N	***	0.25

Respectfully Submitted,
Charles A. Ruud
Quality Assurance Manager

MetalTek INTERNATIONAL

Carondelet Division

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Material Test Report

ENERGY INDUSTRIES OF OHIO

Purchase Order Number PPPL-FP-LTS-2
Pattern Number MCWF-A1
CAF Metal Designation CF8MNMnMod
Material Spec CF8MNMnMOD
Analysis performed by Wisconsin Centrifugal

Cert Number 169470-1
Pour Date 5/24/2005

Revised 11/3/05

Element	Min	Actual	Max
C	0.04	0.06	0.07
MN*	2.3	1.6	2.8
SI	0.0	0.6	0.7
CR	18.0	18.1	18.5
NI*	13.0	13.7	13.5
MO	2.1	2.4	2.5
P	0.0	0.027	0.035
S	0.0	0.009	0.025
N	0.24	0.25	0.28

* See Corrective Action Number 1323.

Respectfully Submitted,
Charles A. Ruud
Quality Assurance Manager

Carondelet Division

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Material Test Report

ENERGY INDUSTRIES OF OHIO

Purchase Order Number	PPPL-FP-LTS-2	Heat Number 29198	Pour Date 4/28/2005
Pattern Number	SE-141-073 COIL C SHIM (-3 thru -6 Parts) Cert Number S73220-2 and		
	SE-141-033 COIL A SHIM (-1 thru -6 Parts) Cert Number S76220-1		
CAF Metal Designation	CF8MNMnMod		
Material Spec	CF8MNMN MOD		

Revised 9/24/05

Element	Min	Actual	Max
C	0.040	0.070	0.070
CR	18.000	18.100	18.500
MN	2.300	2.970	2.800
MO	2.100	2.450	2.500
N	0.240	0.255	0.280
NI	13.000	13.120	13.500
P*	0.000	0.013	0.035
S*	0.000	0.010	0.025
SI	0.000	0.700	0.700

MN & SI previously reported on CA 1308 and were accepted.

*P & S taken from test from heat parts were poured from and analyzed by wet chemistry, ASTM E1019-03 for sulfur and Gravimetric for phosphorous.

This report covers the eleven castings poured from heat 29198. Only parts listed above however will be shipped for this order. Each casting has a unique number stamped in the part adjacent to the pattern number to differentiate the part and subsequent reporting that will be traced to the casting.

Specification limits have been updated to latest specification.

Respectfully Submitted,
Charles A. Ruud
Quality Assurance Manager

.045 ER316 MN1 F 9

PRODUCT CONFORMANCE REPORT

LINCOLN ELECTRIC

Product	LNM 4455	Size(s) mm	1,2
Class.		Lot/Batch	3018926/78309
	EN 12072-99: G 20 16 3 Mn L	Item No.	692129
Customer	CK SUPPLY Contact Ernie Simpson Eureka (MISSOURI) 63025 UNITED STATES	Quantity	450,0 KG
		Customer ref.	P.O.: SL 057549
		LSW Order No.	SD424496

Chemical analysis (%) — EN10204 3.1B

C	Si	Mn	P	S	Cr	Ni	Mo	Cu	N
0,02	**0,4**	**7,3**	**0,019**	**0,001**	**20,1**	**16,3**	**2,9**	**0,1**	**0,200**

Mechanical tests, all weld metal — EN10204

Additional information — EN10204
Other tests

Remarks

The product identified above has been manufactured, tested and supplied in compliance with a Quality Assurance Programme that fulfils the requirements of EN 29000/ ISO 9000/BS 5750 or similar standard.
We herewith certify that the product complies with the above-mentioned standards.
Certified ISO 9001:2000.

Company	Issued by	Function	Date	Cert.No.
Lincoln Smitweld B.V.	**P. van Etteger**	**QS Manager**	**10/02/2005**	**3018926/7830**

Registered Office
Nieuwe Dukenburgseweg 20
6534 AD NIJMEGEN

Post address:
P.O. Box 253
6500 AG Nijmegen
NETHERLANDS

Telephone:
31 24 3522911

Fax:
31 24 3522200

QA120(v3)

3301013 rev. 00

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Chemical, Metallurgical, Mechanical, Nondestructive, Environmental Testing, Analyses and Field Service.

METALTEK INTERNATIONAL
8600 Commercial Blvd.
Pevely, MO 63070

August 8, 2005
Lab No. 05P-2334
P.O. No. 21324

Attention: CHUCK RUUD

REPORT OF MECHANICAL TESTS

SAMPLE ID:
1) STOCK# LNM 4455, LINCOLN LOT 3018926/78309
2) STOCK# LNM 4455, LINCOLN LOT 3017006/72262
3) STOCK# LNM 4455, LINCOLN LOT 3012668/82743
4) STOCK# B316NF METRODE, W021735

Sample ID	Original Area Sq. Inches	Reduced Area Sq. Inches	Reduction in Area %	Modules of Elasticity	Yield Strength PSI	Tensile Strength PSI	Elongation (2.0" Gage Length) in.	Elongation (2.0" Gage Length) %
1	0.1385	0.0897	54.3	24.5 Msi	56900	93900	0.84	42.0
2	0.1886	0.0935	50.4	24.9 Msi	54900	92100	0.85	42.5
3	0.1909	0.0951	50.2	22.6 Msi	57400	93700	0.83	41.5
4	0.1901	0.0962	49.4	23.0 Msi	54800	88200	0.75	37.5

Round, reduced section all weld tensiles

Yield taken at .2% offset

Tested in accordance with ASTM A 370-03a

Identification of tested specimens provided by the client.

Karl Schmitz, Director
Materials Testing

KS/tlv

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METALTEK INTERNATIONAL
8600 Commercial Blvd.
Pevely, MO 63070

August 8, 2005
Lab No. 05P-2334
P.O. No. 21324

Attention: Chuck Ruud

REPORT OF CHARPY IMPACT TEST

MATERIAL (SAMPLE ID): STOCK# LNM 4455, LINCOLN LOT 3018926/78309
STOCK# LNM 4455, LINCOLN LOT 3017006/72262

SPECIFICATION: ASTM A 370-03a

SPECIMEN TYPE: "A" Vee Notch

SPECIMEN SIZE: 10 mm x 10 mm (All Weld)

TEMPERATURE OF TEST: 293°K

REQUIREMENTS:

ALL WELD	FOOT LBS.	LATERAL EXPANSION	% SHEAR
78309-7	97	0.074	50
78309-8	96	0.076	50
78309-9	108	0.075	50
Average	100	0.075	50
ALL WELD	**FOOT LBS.**	**LATERAL EXPANSION**	**% SHEAR**
72262-7	126	0.098	50
72262-8	102	0.080	50
72262-9	123	0.087	50
Average	117	0.088	50

Identification of tested specimen provided by client.

Karl Schmitz, Director
Materials Testing

KS/tlv

Westmoreland Mechanical Testing & Research, Inc.
P.O. Box 388
Westmoreland Drive
Youngstown, Pa. 15696-0388 U.S.A.
Telephone: 724-537-3131 Fax: 724-537-3151
Website: www.wmtr.com
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ACCREDITED
621-01 & 621-02

Accredited Nadcap Materials Testing Laboratory

September 13, 2005

CERTIFICATION

WMT&R Report No. 5-34328
P.O. No. 19386 Rel No.18
Requisition No. 4934

MetalTek International
The Carondelet Division
8600 Commercial Blvd.
I-55 Industrial Park
Pevely, MO 63070-1528

Attention: Jim Galaske

Subject: All processes, performed upon the material as received, were conducted at WMT&R, Inc. in accordance with the WMT&R Quality Assurance Manual, Rev. 9, dated 4/1/2000.
The following tests were performed on this order: IMPACT and TENSILE

TENSILE RESULTS: ASTM E21-03a
Requirements: UTS ksi (Min 95\Max ---) 0.2% YS ksi (Min 72\Max ---) 4D Elong. % (Min 32\Max ---) Modulus Msi (Min 21\Max ---)
SOAK TIME: 5 Minutes
SPEED OF TESTING: 0.0030 in./in./min., 0.0500 in./min./in.
MATERIAL: 316 S/S

DISPOSITION: Acceptable

Reference	Lot No. | Batch No. | Specimen ID	TestLog Number	Temp. °F	UTS ksi	0.2% YS ksi	Elong %	RA %	Modulus Msi	Ult. Load lbf	0.2% YLD. lbf
Lincoln LNM4455	3018926 | 78309 | Tensile	C43938	-320	182.1	128.2	34	24	27.0	17560	12360

A\U\R: A=ACCEPTABLE, U=UNACCEPTABLE, R=REPORT

DISPOSITION: Acceptable

Reference	Lot No. | Batch No. | Specimen ID	TestLog Number	Orig. Dia. (in.)	Final Dia. (in.)	4D Orig GL (in.)	4D Final GL (in.)	Orig. Area (sq. in.)	Machine Number	A\U\R
Lincoln LNM4455	3018926 | 78309 | Tensile	C43938	0.3504	0.3048	1.40	1.87	0.09643131	M9	A

A\U\R: A=ACCEPTABLE, U=UNACCEPTABLE, R=REPORT

Requirements supplied by MetalTek International.

Roy E. Starr/Matt Wojton
Technical Services Manager / Tensile Supervisor

9-13-05
September 13, 2005

Westmoreland Mechanical Testing & Research, Inc.
P.O. Box 388
Westmoreland Drive
Youngstown, Pa. 15696-0388 U.S.A.
Telephone: 724-537-3131 Fax: 724-537-3151
Website: www.wmtr.com
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621-01 & 621-02

Accredited Nadcap Materials Testing Laboratory

11

CERTIFICATION

September 13, 2005

WMT&R Report No. 5-34328
P.O. No. 19386 Rel No.18
Requisition No. 4934

MetalTek International
The Carondelet Division
8600 Commercial Blvd.
I-55 Industrial Park
Pevely, MO 63070-1528

Attention: Jim Galaske

Subject: All processes, performed upon the material as received, were conducted at WMT&R, Inc. in accordance with the WMT&R Quality Assurance Manual, Rev. 9, dated 4/1/2000.
The following tests were performed on this order: IMPACT and TENSILE

IMPACT RESULTS: ASTM E23-02
REQUIREMENTS: Energy (Min 35\Max ---)
MATERIAL: Lincoln LNM4455
SAMPLE TYPE: Charpy V-Notch
DISPOSITION: Acceptable

Reference	Lot No. | Batch No. | Specimen ID	TestLog Number	Sample Size	Temp. °F	Energy ft-lbs	Mils Lat Exp	% Shear Fracture	A\U\R
Lincoln LNM4455	3018926 | 78309 | Cvn-1	C43939	Standard	-320	56	18	40	Acceptable
Lincoln LNM4455	3018926 | 78309 | Cvn-2	C43940	Standard	-320	52	18	40	Acceptable
Lincoln LNM4455	3018926 | 78309 | Cvn-3	C43941	Standard	-320	53	12	40	Acceptable

Requirements supplied by MetalTek International.

Roy E. Starr\Matt Wolton
Technical Services Manager\ Tensile Supervisor

9-13-05
September 13, 2005

Westmoreland Mechanical Testing & Research, Inc.
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Website: www.wmtr.com
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ACCREDITED
621-01 & 621-02

Accredited Nadcap Materials Testing Laboratory

June 17, 2005

CERTIFICATION

Section 1 of 1

WMT&R Report No. 5-29323
Req. No. 5394

MetalTek International
The Carondelet Division
8600 Commercial Blvd.
I-55 Industrial Park
Pevely, MO 63070-1528

Attention: Rick Suria

Subject: All processes, performed upon the material as received, were conducted at WMT&R, Inc. in accordance with the WMT&R Quality Assurance Manual, Rev. 9, dated 4/1/2000.
The following tests were performed on this order: TENSILE

TENSILE RESULTS: ASTM E21-03a
SOAK TIME: 5 Minutes
SPEED OF TESTING: 0.0030 in./in./min., 0.0500 in./min./in.
MATERIAL: Metaltek CF8MNMnMOD

DISPOSITION: Report

Sample	TestLog Number	Temp. °F	UTS ksi	0.2% YS ksi	Elong %	RA %	Modulus Msi	Codes	Ult. Load lbf	0.2% YLD. lbf	Orig. Dia. (in.)	Final Dia. (in.)	4D Orig GL (in.)	4D Final GL (in.)	Orig. Area (sq. in.)	Machine Number	A\U\R
A1 (Z1)	C03040	-320	165.1	95.5	51	37	25.9	—	33210	19210	0.5060	0.4002	2.00	3.02	0.20109020	M9	R
A1 (Z2)	C03041	-320	165.1	94.6	59	51	25.4	—	33120	18980	0.5054	0.3543	2.00	3.18	0.20061359	M9	R
A1 (Z3)	C03042	-320	168.7	101.8	58	57	25.2	—	33840	20420	0.5054	0.3305	2.00	3.16	0.20061359	M9	R
C2 (Z1)	C03043	-320	163.6	94.0	51	41	25.9	D	32840	18880	0.5056	0.3891	2.00	3.03	0.20077240	M9	R
C2 (Z2)	C03044	-320	162.4	91.7	61	61	25.0	—	32580	18390	0.5054	0.3163	2.00	3.21	0.20061359	M9	R
C2 (Z3)	C03045	-320	165.5	93.9	61	61	25.7	—	33230	18850	0.5056	0.3163	2.00	3.21	0.20077240	M9	R

A\U\R: A=ACCEPTABLE, U=UNACCEPTABLE, R=REPORT

D - Failed outside middle half of gage length.

Matthew Wolton 6-17-05
Roy E. Starr/Matt Wolton
Technical Services Manager / Tensile Supervisor June 17, 2005

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METALTEK INTERNATIONAL
8600 Commercial Blvd.
Pevely, MO 63070

June 14, 2005
Lab No. 05P-1741
P.O. No. 12516
Page 1 of 3

Attention: Chuck Ruud

REPORT OF CHARPY IMPACT TEST

MATERIAL (SAMPLE ID): Alloy CF8 MNMn-Mod, A-1 COIL

SPECIFICATION: ASTM A 370-03a

SPECIMEN TYPE: "A" Vee Notch

SPECIMEN SIZE: 10 mm x 10 mm

TEMPERATURE OF TEST: 293°K / 68° F

RESULTS:

BASE METAL	FOOT LBS.	LATERAL EXPANSION	% SHEAR
Z1-7	152	0.125	100
Z1-8	152	0.086	100
Z1-9	182	0.089	100
Average	162	0.100	100
BASE METAL	**FOOT LBS.**	**LATERAL EXPANSION**	**% SHEAR**
Z2-7	152	0.131	100
Z2-8	164	0.084	100
Z2-9	170	0.105	100
Average	162	0.107	100
BASE METAL	**FOOT LBS.**	**LATERAL EXPANSION**	**% SHEAR**
Z3-7	196	0.117	100
Z3-8	164	0.104	100
Z3-9	142	0.088	100
Average	167	0.103	100

Identification of tested specimen provided by client.

Karl Schmitz, Director
Materials Testing

KS/tlv

ACCREDITED
Certificate No. 0397-01
Certificate No. 0397-02

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Pevely, MO 63070

June 14, 2005
Lab No. 05P-1741
P.O. No. 12516
Page 2 of 3

Attention: Chuck Ruud

REPORT OF CHARPY IMPACT TEST

MATERIAL (SAMPLE ID): Alloy CF8 MNMn-Mod, A-1 COIL

SPECIFICATION: ASTM A 370-03a

SPECIMEN TYPE: "A" Vee Notch

SPECIMEN SIZE: 10 mm x 10 mm

TEMPERATURE OF TEST: 77°K / -320°F

RESULTS:

BASE METAL	FOOT LBS.	LATERAL EXPANSION	% SHEAR
Z1-7	82	0.040	60
Z1-8	73	0.053	60
Z1-9	78	0.045	60
Average	78	0.046	60
BASE METAL	**FOOT LBS.**	**LATERAL EXPANSION**	**% SHEAR**
Z2-7	94	0.061	70
Z2-8	90	0.053	70
Z2-9	76	0.057	70
Average	87	0.057	70
BASE METAL	**FOOT LBS.**	**LATERAL EXPANSION**	**% SHEAR**
Z3-7	59	0.028	30
Z3-8	83	0.059	40
Z3-9	72	0.043	40
Average	71	0.043	37

Identification of tested specimen provided by client.

Karl Schmitz, Director
Materials Testing

KS/tlv

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METALTEK INTERNATIONAL
8600 Commercial Blvd.
Pevely, MO 63070

June 14, 2005
Lab No. 05P-1741
P.O. No. 12516

Attention: CHUCK RUUD

REPORT OF MECHANICAL TESTS

SAMPLE ID: 3 EA., A-1 COIL, Z1, Z2, Z3

Sample ID	Original Area Sq. Inches	Reduced Area Sq. Inches	Reduction in Area %	Modules of Elasticity	Yield Strength PSI	Tensile Strength PSI	Elongation (2.0" Gage Length) in.	Elongation (2.0" Gage Length) %
Z1	0.1886	.0716	62.0	21.8 Msi	37600	85700	1.06	53.0
Z2	0.1886	0.0707	62.5	21.5 Msi	35500	79300	1.11	55.5
Z3	0.1940	0.0855	55.9	21.7 Msi	36800	82100	1.02	51.0

Round, reduced section room temperature tensiles

Yield taken at .2% offset

Tested in accordance with ASTM A 370

Identification of tested specimens provided by the client.

Karl Schmitz, Director
Materials Testing

KS/tlv

A-1 COIL WELD MAP

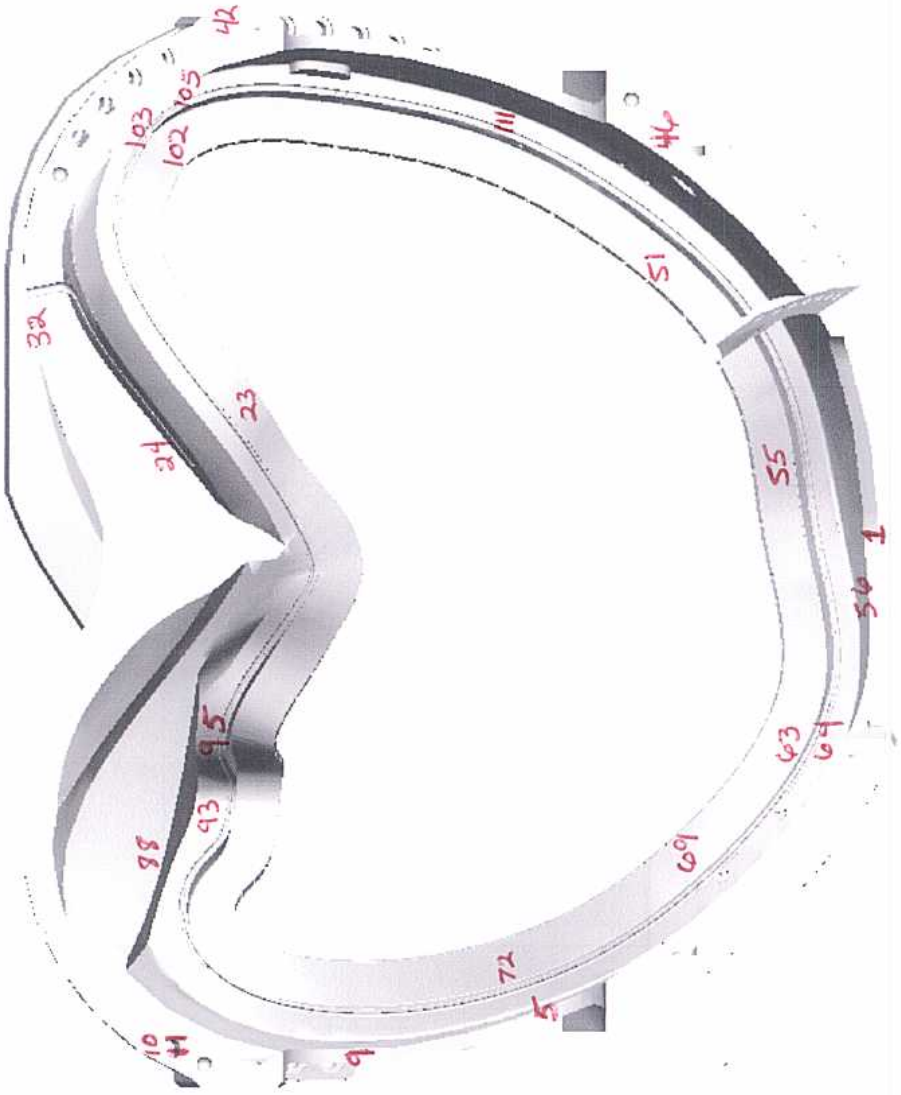
Defect Number	Drawing View	Length Inches	Width Inches	Depth Inches	Over 20% wall Over 1 inch Over 10^2 inches Yes/No
1	Front	4/8	1 1/2	1/2	Yes
5	Front	7	5 1/4	1	Yes
9	Front	3 3/4	2	1 1/8	Yes
10	Front	5 1/2	4 1/2	1 3/4	Yes
11	Front	2 1/2	2	1	Yes
23	Front	7	2 1/2	1/2	Yes
24	Front	11	2 1/2	1 1/2	Yes
32	Front	4	2 1/4	1	Yes
42	Front	5	2 1/2	2 1/4	Yes
46	Front	28 1/2	6	Through	Yes
51	Front	9	3	1/4	Yes
55	Front	10	1 1/2	1	Yes
56	Front	6	2 1/4	2	Yes
63	Front	10	8 1/2	3/4	Yes
64	Front	7	3	1/4	Yes
69	Front	5 1/4	5	1/2	Yes
72	Front	9	6 1/2	1	Yes
88	Front	13	1 1/2	2 1/2	Yes
93	Front	11	1 1/2	1 1/2	Yes
95	Front	8	4	1	Yes
102	Front	3 1/2	3 1/4	1 1/8	Yes
103	Front	13	3	1	Yes
105	Front	8	3	2	Yes
111	Front	9	4	1	Yes
116	~~Top~~	2 1/2	2	7/8	Yes
117	Top	1 1/4	1	3/4	Yes
118	Top	2	1 1/2	3/4	Yes
119	Top	2 1/2	2 1/2	1	Yes
123	Top	9 3/4	4 1/2	2	Yes
128	Top	4 1/4	4	1/4	Yes
131	Top	5	3	1	Yes
135	Top	9 1/2	2	1/4	Yes
140	Right	5 1/2	5	1	Yes
144	Right	6	3	1/4	Yes
145	Right	33	3 1/2	1 3/4	Yes
146	Right	16 3/4	1 1/4	1/4	Yes
147	Right	9	6	1/4	Yes
152	Right	5	3 3/4	Through	Yes
154	Right	8	4	Through	Yes

A-1 COIL WELD MAP

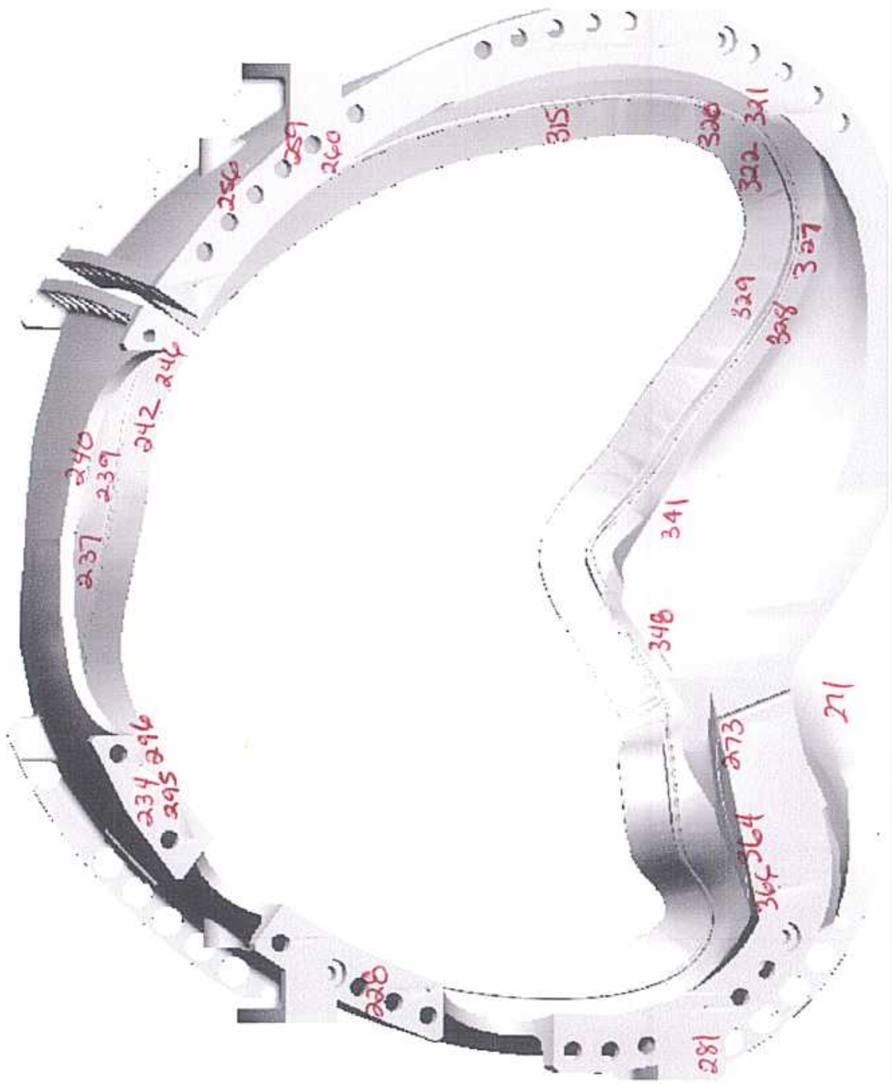
Defect Number	Drawing View	Length Inches	Width Inches	Depth Inches	Over 20% wall Over 1 inch Over 10^2 inches Yes/No
155	Right	8 1/2	7	1/4	Yes
157	Right	6 3/4	4	1/4	Yes
158	Right	7 1/2	3 1/4	1/4	Yes
162	Right	7	2	1/2	Yes
166	Right	4 3/4	2	1	Yes
168	Right	9	4 1/2	1/4	Yes
170	Right	5 3/4	2	3/4	Yes
171	Right	10	3	Through	Yes
172	Right	7 1/2	3	1/2	Yes
173	Right	9	3 1/2	1/2	Yes
176	Right	5 1/2	3	Through	Yes
177	Right	9 1/2	1 3/4	5/16	Yes
181	Right	4	3 1/2	1/4	Yes
183	Right	10	2	1/2	Yes
191	Right	3 3/4	3 1/2	2	Yes
197	Right	4	3 1/2	3/4	Yes
198	Right	5	2 3/4	Through	Yes
204	Right	16	2 1/2	5/16	Yes
205	Bottom	7 1/2	6 1/2	Through	Yes
206	Bottom	3 1/2	1 3/4	1	Yes
207	Bottom	8	2 1/2	3/16	Yes
212	Bottom	9	4	1/4	Yes
214	Bottom	8 3/4	5	3/4	Yes
216	Bottom	7	2	1	Yes
220	Left	6 3/4	4	Through	Yes
222	Left	4 1/2	2	1	Yes
228	BACK	13	8	Through	Yes
234	BACK	1 3/4	1 3/4	1 1/4	Yes
237	BACK	5	2 1/4	3/4	Yes
239	BACK	5 1/2	5	3/4	Yes
240	BACK	6 1/2	2 3/4	1	Yes
242	BACK	9	3 1/2	Through	Yes
246	BACK	5 3/4	4 1/2	3/4	Yes
256	BACK	3	2 3/4	7/8	Yes
259	BACK	6	2 1/2	1	Yes
260	BACK	6	2	3/4	Yes
271	BACK	4	2 1/2	1	Yes
273	BACK	6 1/2	4 1/2	Through	Yes
281	BACK	3 1/2	2	1	Yes

A-1 COIL WELD MAP

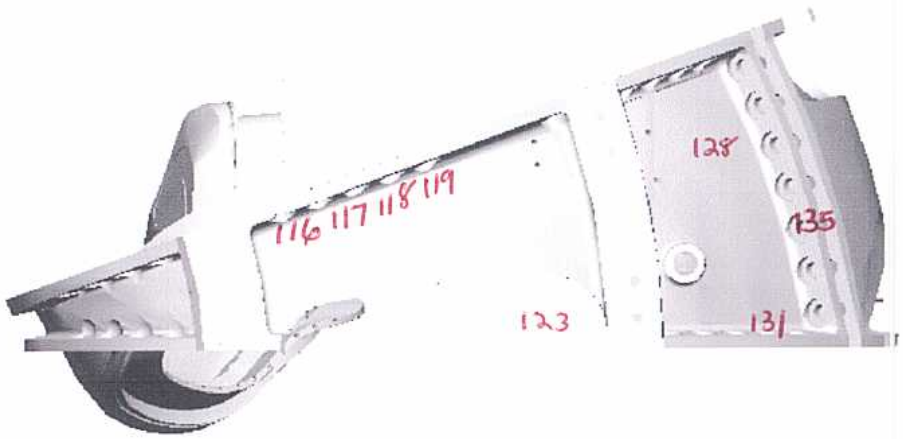
Defect Number	Drawing View	Length Inches	Width Inches	Depth Inches	Over 20% wall Over 1 inch Over 10^2 inches Yes/No
295	BACK	11 1/2	4 1/2	3/4	Yes
296	BACK	6	4	3/4	Yes
297	Left	6 1/2	2 1/2	3/4	Yes
300	Left	11	9	1	Yes
304	Left	10	1 1/2	1	Yes
306	Left	8	6	3/4	Yes
308	Left	8 1/2	4 1/2	3/4	Yes
309	Left	4 1/2	4	1/2	Yes
313	Left	7	2 3/4	2 1/4	Yes
315	BACK	9	2 1/2	1/2	Yes
320	BACK	11	11 1/2	2	Yes
321	BACK	5	3	1/4	Yes
322	BACK	8 3/4	3	3/4	Yes
327	BACK	4	2	2	Yes
328	BACK	3	2	1	Yes
329	BACK	2 3/4	2	1	Yes
341	BACK	8	8	1/2	Yes
348	BACK	6	3	1/2	Yes
364	BACK	6 1/4	2 1/2	3/4	Yes
366	BACK	3 3/4	3 3/4	1	Yes
367	Left	3 1/2	2 1/2	Through	Yes
368	Left	7 1/2	3	Through	Yes
369	Left	5	4 3/4	1/4	Yes
155R1	Right	6	4 1/2	1	Yes
162 R1	Right	8	2 1/4	1 1/4	Yes
170 R1	Right	4 3/4	3 1/2	1 1/2	Yes
145 R1	Right	5 1/2	2 1/2	1 1/2	Yes
155R2	Right	7	5	1 1/2	Yes
170R2	Right	7 1/8	2 1/4	1 1/4	Yes
370	Right	3 3/16	2 3/8	1	Yes
371	Right	5	3 7/8	1 3/4	Yes
373	Left	6 7/8	1 3/4	3/4	Yes



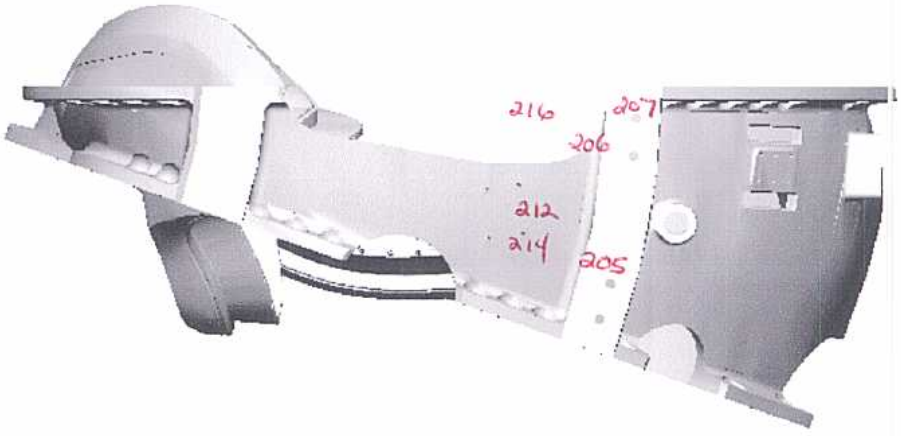
Front



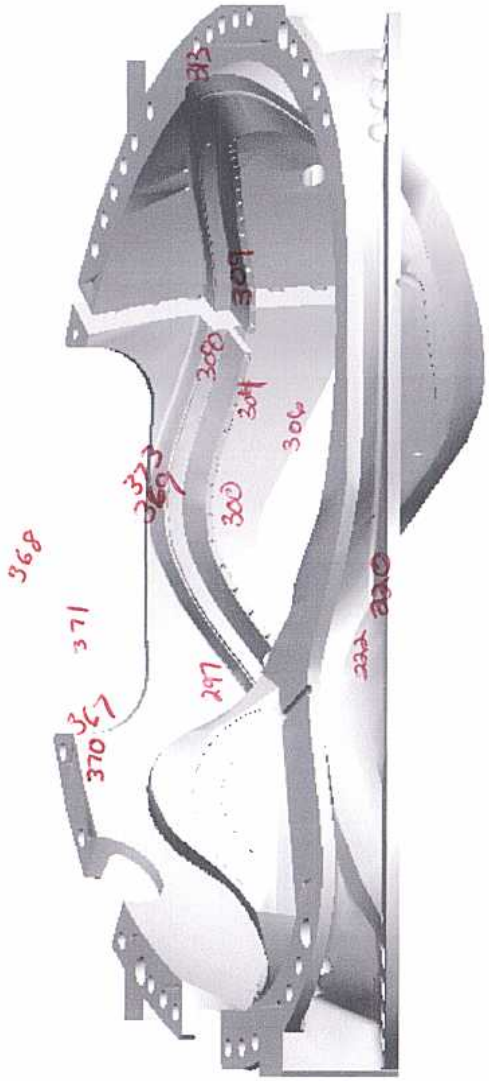
Back



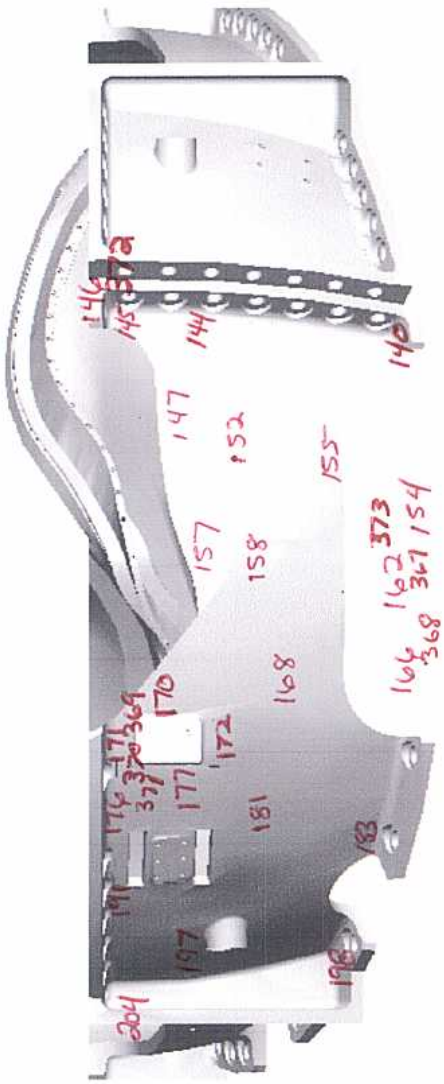
Top



Bottom



Left


146
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197
196
204

Right

TEAM COOPERHEAT-MQS, INC.

CERTIFIED RADIOGRAPHIC INSPECTION REPORT

FORM 6061-RT- 002 Rev.2

5512 W. State St. Milwaukee, WI 53208 Tel:(414)771-3060 Fax:(414)771-9481 (800)818-6403 www.cooperheat-mqs.com

CUSTOMER

NAME METAL TEK INTERNATIONAL

ADDRESS 8600 COMMERCIAL BLVD

CITY PEVELY STATE MO ZIP 63070

DATE 06/16/2005

WORK ORDER NO. 361-02341

P.O. NUMBER Rick Suria

XRAY X

GAMMA

PROCEDURE SPECIFICATION ASTM E94-93

ACCEPTANCE CRITERIA MSS-SP-54-1999

SHEET 1 OF 5

PART NUMBER	Serial No	View	No Apparent Indications: Acceptable	Rejected	Incl.	Dross or Slag	Incomplete Penetration: Porosity	Lack of Fusion	Shrinkage: Gas	Cracks	Hot Tear	Film Artifacts: Undercut	Surface	REMARKS
MCWFA-1	1	1-2	✓											
		2-3		R					4				✓	
Z103990		3-4	✓		1				1					
HT# M169470		4-5		R					4					
CO40851		5-6	✓						2					
		6-7		R					4					
		7-8	✓						1					
		8-9	✓		2								✓	
		9-10	✓		2								✓	*
		10-11	✓											
		11-12	✓		2							✓		
		12-13	✓										✓	
		13-14	✓										✓	
		V15		R	2					4				
		16-17	✓						1					
		17-18	✓						2					
		18-19	✓											
		19-20	✓									✓		
		20-21	✓		1				1					
		21-22	✓		1							✓	✓	
		22-23	✓							2			✓	
		23-24	✓						2	2				
		24-25		R							R			
		25-26	✓											
		26-27		R					4		R			

ACCEPTED Ø NO. REJECTED 1

COMMENTS

* Extra Film Shot Fore Pene Coverage.

MQS TECH. NO. 12970 SHT. REV.

CUST. RSS NO. SHT. REV.

REVIEWER John Petroske

CERTIFIED NDT LEVEL (RT)

John Petroske RT II Exp. 01/08

TEAM COOPERHEAT-MQS, INC.

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DATE 06/16/2005

WORK ORDER NO. 361-02341

P.O. NUMBER Rick Suria

XRAY X

GAMMA

PROCEDURE SPECIFICATION ASTM E94-93

ACCEPTANCE CRITERIA MSS-SP-54-1999

SHEET 2 OF 5

PART NUMBER	Serial No	View	No Apparent Indications: Acceptable	Rejected	Incomplete Penetration: Inclusion	Dross or Slag	Porosity	Lack of Fusion	Shrinkage: Gas	Cracks	Hot Tears	Film Artifacts: Undercut	Surface	REMARKS
MCWFA-1	1	27-28		R					4					
		28-29		R					2		4 R			
Z103990		29-1		R					4					
T# M169470		30-31		R							R			
CO40851		31-32		R							4			
		32-33		R					5		R			
		33-34	✓											
		34-35	✓									✓	✓	
		35-36		R							R			
		37-38		R							R			
		38-39	✓									✓		
		39-40	✓									✓		
		41-42		R							R			
		43-44	✓						1					
		44-45	✓											
		45-46	✓											
		46-47	✓											
		47-48	✓											
		48-49	✓											
		50-51		R	4									
		51-52		R	4									
		52-53		R	4						R			
		54-55	✓											
		55-56	✓											

ACCEPTED 0 NO. REJECTED 1

MENTS

MQS TECH. NO. 12970 SHT. REV.

CUST. RSS NO. SHT. REV.

REVIEWER John Petroske

CERTIFIED NDT LEVEL (RT)

John Petroske RT II Exp. 01/08

TEAM COOPERHEAT-MQS, INC.

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ADDRESS 8600 COMMERCIAL BLVD

CITY PEVELY STATE MO ZIP 63070

DATE 06/16/2005

WORK ORDER NO. 361-02341

P.O. NUMBER Rick Suria

XRAY X

GAMMA

PROCEDURE SPECIFICATION ASTM E94-93

ACCEPTANCE CRITERIA MSS-SP-54-1999

SHEET 3 OF 5

PART NUMBER	Serial No	View	No Apparent Indications: Acceptable	Rejected	Inclusion	Dross or Slag	Incomplete Penetration: Porosity	Lack of Fusion	Shrinkage: Gas	Cracks	Hot Tear	Film Artifacts: Undercut	Surface	REMARKS
MCWFA-1	1	57-58	✓											
	58-58A-59		✓								1			
Z103990		59-60	✓											
HT# M169470		60-61	✓										✓	
CO40851		61-62	✓		2									
		62-63		R							R			
	62A-63A			R							R			
		63-64		R					4		2			
		64-65	✓						2					
	65-65A-66			R							2	R		
		66-67		R					4					
		67-68	✓										✓	✓
		68-69		R					4		3-4			
		69-70		R							4			
		70-71	✓								2			
		71-72		R							4			
		72-73	✓											
		73-74	✓											
		74-75	✓								1		✓	
		25-76	✓										✓	✓
		76-77		R							4			✓
		77-78	✓											
		78-79	✓											
		79-80	✓											
		80-81	✓						1		3			✓

. ACCEPTED Ø NO. REJECTED 1

MMENTS

MQS TECH. NO. 12970 SHT. REV.

CUST. RSS NO. SHT. REV.

REVIEWER John Petroske

CERTIFIED NDT LEVEL (RT)

John Petroske RT II Exp. 01/08

TEAM COOPERHEAT-MQS, INC.

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ADDRESS 8600 COMMERCIAL BLVD

CITY PEVELY STATE MO ZIP 63070

DATE 06/16/2005

WORK ORDER NO. 361-02341

P.O. NUMBER Rick Suria

XRAY X

GAMMA

PROCEDURE SPECIFICATION ASTM E94-93

ACCEPTANCE CRITERIA MSS-SP-54-1999

SHEET 4 OF 5

PART NUMBER	Serial No	View	No Apparent Indications: Acceptable	Rejected	Inclusion	Dross or Slag	Incomplete Penetration: Porosity	Lack of Fusion	Shrinkage: Gas	Cracks	Hot Tears	Under cut	Film Artifacts: Surface		REMARKS
MCWFA-1	1	81-82	✓								2				
		82-83	✓											✓	
Z103990		84-85	✓											✓	
HT# M169470		85-86	✓												
C040851		86-87	✓								2				
		87-88A	✓								1				
		88-89	✓						1	1			✓		
		89-90	✓						1				✓		
		90-91	✓										✓		
		92-93		R							5				
		9495		R					5		4				
		95-96		R					5		4				
		96-97		R					5		4				
		97-98		R							4				
		98-99		R							4				
		99-100	✓								2				
	100-101		✓								2				
	102-103		✓								2		✓		
	103-104		✓								2				
	104-105			R							4				
	106-107		✓												
	107-108		✓										✓		
	108-109			R							5				
	109-110		✓								2				
	111-112		✓												

NO. ACCEPTED Ø NO. REJECTED 1

COMMENTS

MQS TECH. NO. 12970 SHT. REV.

CUST. RSS NO. SHT. REV.

REVIEWER

CERTIFIED NDT LEVEL (RT)

John Petroske RT II Exp. 01/08

TEAM COOPERHEAT-MQS, INC.

CERTIFIED RADIOGRAPHIC INSPECTION REPORT

FORM 6061-RT- 002 Rev.2

5512 W. State St. Milwaukee, WI 53208 Tel:(414)771-3060 Fax:(414)771-9481 (800)818-6403 www.cooperheat-mqs.com

CUSTOMER

NAME METAL TEK INTERNATIONAL

ADDRESS 8600 COMMERCIAL BLVD

CITY PEVELY STATE MO ZIP 63070

DATE 06/16/2005

WORK ORDER NO. 361-02341

P.O. NUMBER Rick Suria

XRAY X

GAMMA

PROCEDURE SPECIFICATION ASTM E94-93

ACCEPTANCE CRITERIA MSS-SP-54-1999

SHEET 5 OF 5

PART NUMBER	Serial No	View	No Apparent Indications: Acceptable	Rejected	Inclusion	Dross or Slag	Porosity	Incomplete Penetration: Lack of Fusion	Gas	Shrinkage: Cracks	Hot Tears	Film Artifacts: Undercut	Surface	REMARKS
MCWFA-1	112	113	✓								2			
	113	114		R	5						4			
Z103990	115	116	✓						2					
HT# M169470	116	117		R					4					
CO40851	118	119	✓											
	119	120	✓										✓	
	121	122	✓											
	122	123	✓										✓	
	123	124		R					4					
	124	126		R					4					
	125	126		R							R			
	126	127	✓						1					
	127	128	✓						1					
	128	129	✓						1					
	130	131	✓										✓	
	131	132	✓						1					
	V	133		R						4				
	N	134	✓							1				

NO. ACCEPTED Ø NO. REJECTED 1

COMMENTS

MQS TECH. NO. 12970 SHT. REV.

CUST. RSS NO. SHT. REV.

REVIEWER John Petroske

CERTIFIED NDT LEVEL (RT)

John Petroske RT II Exp. 01/08

MetalTek INTERNATIONAL

RADIOGRAPHIC INTERPRETATION REPORT

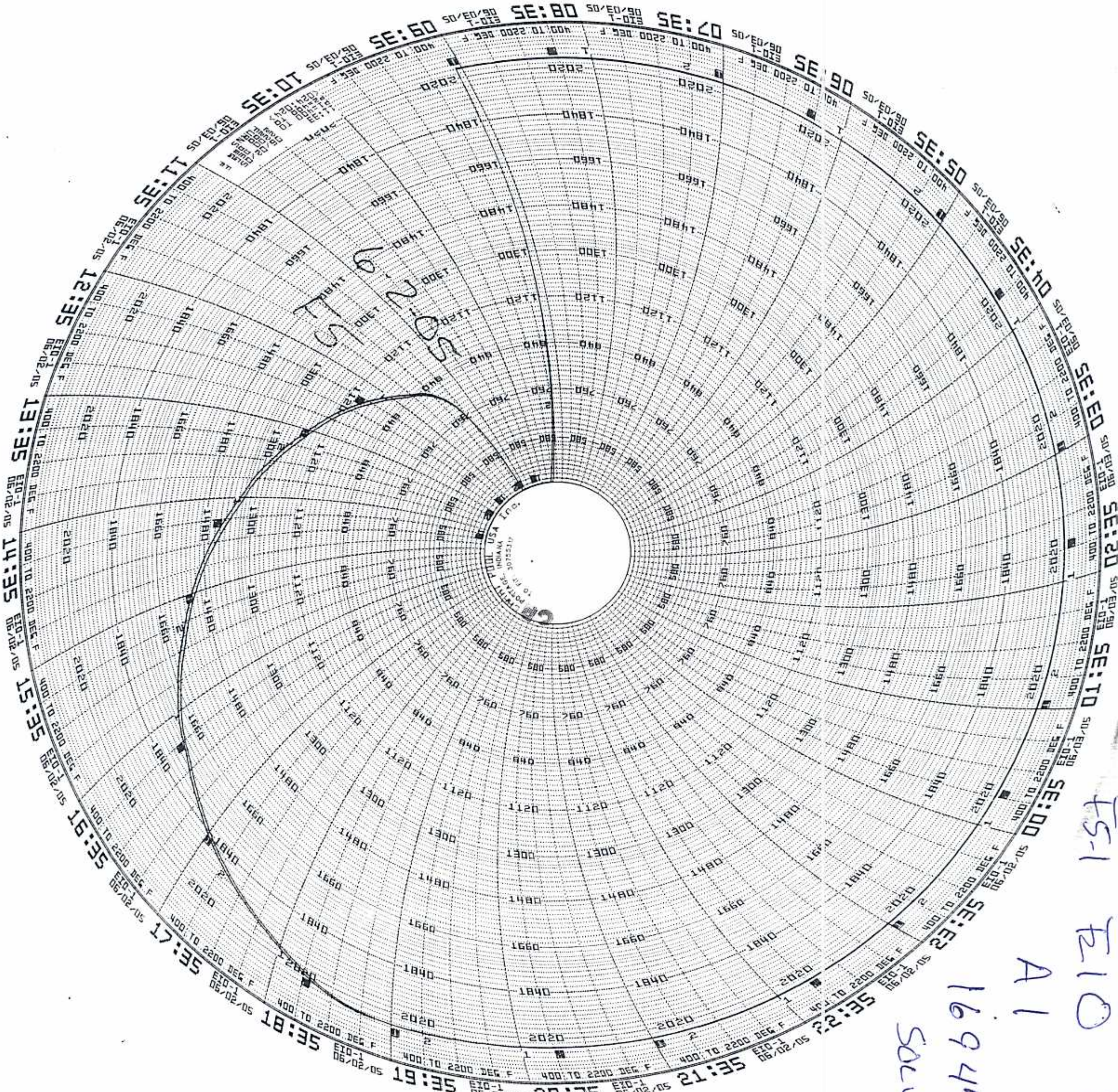
CUSTOMER	PURCHASE ORDER NUMBER	DATE	CONTROL NO.	PAGE
Energy Industries of OHIO	PPPI-FP-LTS-2	8-21-05	40851	1 of 1

PART NO.	SPECIFICATION	CLASS	TOTAL PIECES	PIECES ACCEPTED
MCWFA-1	E446/E186	See Spec	1	1

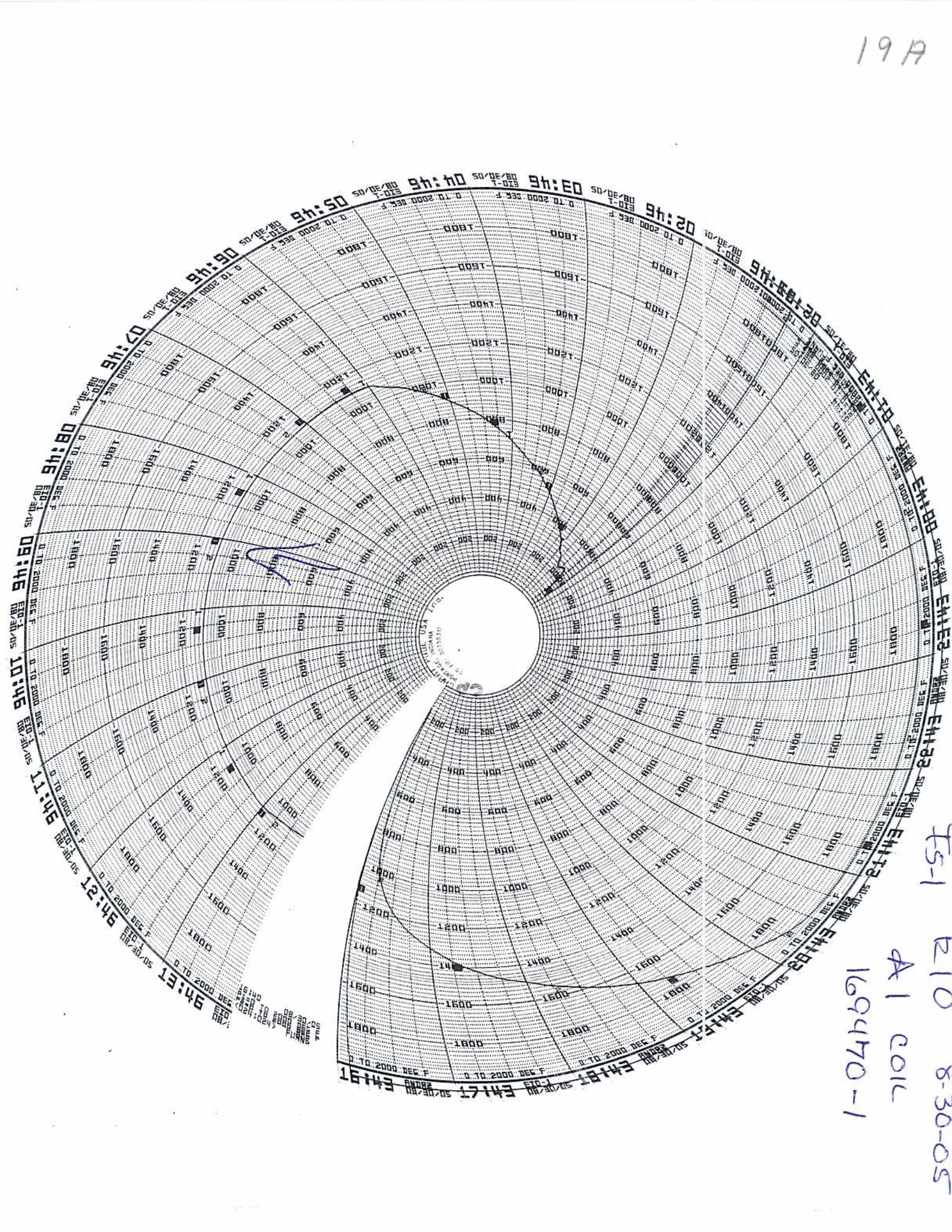
RADIOGRAPHED BY:	INTERPRETED BY:	ASNT LEVEL
Midgett/Kelley	Kelley	II

FILM TYPE	MATERIAL	ISOTOPE	CODE
29/59/80	CF8M NMV/MoDi	IRIDIUM 192 / COBALT 60	ASTM E94 / ASME MIL-STD-453

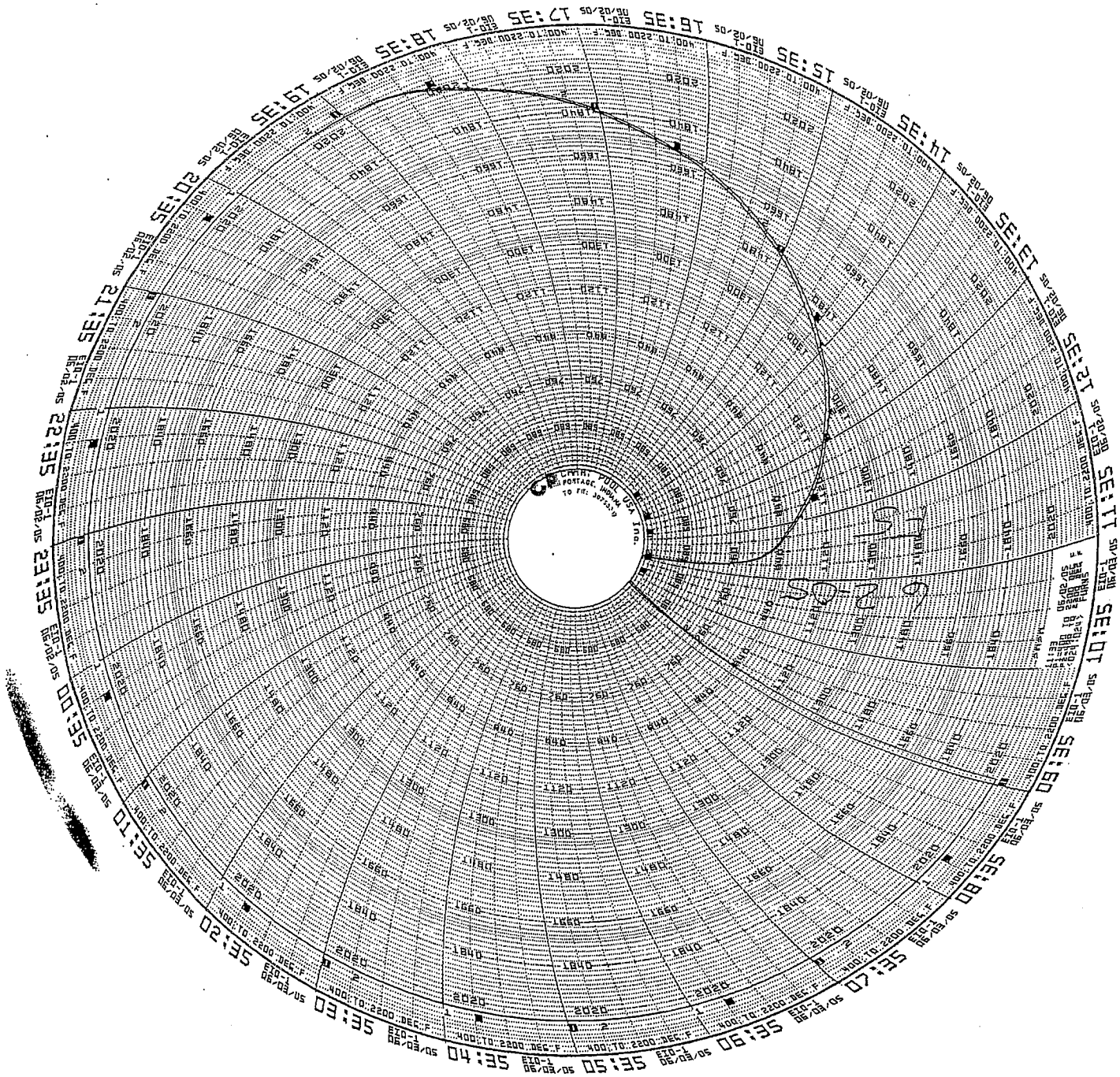
VIEW	PENE	ACCEPT	REJECT	SHRINK	INCLUSION	POROSITY	LINEAR	SURFACE	LOF/LOP	COMMENTS
R2	35-36	/				2				
↓	68-69	30	X	X		3				
↓	69-70	30/50/60	X	X					X	
↓	104-105	50	/		3	1		/		
↓	113-114	↓		X					X	
↓	124-125	30/40	/		2		2		/		
↓	125-126	↓		X			4			X	
R3	68-69	30		X						X	
↓	69-70	30/50/60		X						X	
↓	125-126	30/40		X						X	
↓	113-114	50		X						X	
R4	68-69	30		X			4			X	
↓	69-70	30/50/60	/			1	2		/		
↓	125-126	30/40		X			4			X	
↓	113-114	50		X			4			X	
R5	68-69	30	/		2	1	2		/		Lead crimps
↓	113-114	50	/			1	3		/		
↓	125-126	30/40		X			3			X	
R6	125-126	↓	/				2				Film Scratches / Lead crimp



TS-1 F10 6-2-05
A1
16940-1
SOLUTION


19A
TS-1 R10 8-30-05
A1 COIL
169470-1

A + C Shims CAL



File 25

A-1 Coil

Energy Industries of Ohio

Manufacturing and Test Sequence (MTS) Serial Number A-1

1 OF 11 **CO# 40851 Dated 3-9-05 Revision: Rev 5 Dated Issued: 5-10-05**

OPER. #	STATION	DESCRIPTION OF PROCESS	Name	Date
10	QUALITY RELEASE	REVIEW AND APPROVE MTS. RECEIVED APPROVAL FROM EIO ON 5/10/05 FROM Kate D. SIGNED QUALITY MANAGER	CAR	5/12/05
15	PATTERN NPAT SOP 0100REV2	APPLY APPROPRIATE PART NUMBER, SERIAL NUMBER, AND FOUNDRY MARK, TO THE PATTERN. CAST ON BARS REQUIRED. Place numbers on the bars as to their location.	DHL	5-24-05
20	COREMAKE CORE SOP 0100 REV 6 CALIBRATION PER CORE SOP 0200R4/0300R6	MAKE CORES IN SAND MIXTURES AS DESCRIBED BY METALTEK ENGINEERING AND VERIFIED IN MODELING TRIALS. METALTEK CORE SOP 0100 REV 6) CORE WASH WITH ZIRCONIUM CORE WASH. (CALIBRATION OF EQUIPMENT REQUIRED PER CORE SOP 0200,R4 / 0300,R6) VERIFY COUNT AND INSPECT.	BWC	5-24-05
30	MOLD MOLD SOP 0400 REV 8 CALIBRATION PER MOLD SOP 0900 REV 5 PREPARATION PER MOLD SOP 1100R2/1200R2/1300R1 SAND TESTING PER MOLD SOP 1400R2/1500R3/1600R2	MOLD PER WORK INSTRUCTIONS IN MAPICS ROUTING AND SOPS REFERENCED. ENGINEER OF RECORD – ROGER BROMAN, CONSULT ON MOLD-RELATED CONCERNS. MOLD MATERIALS REQUIRED PER MAPICS BOM. NOTIFY ENGINEER OF ANY SUBSTITUTIONS.	BWC	5-24-05
40	POUR MELT SOP 0100R5 MELT SOP 0700R2 MELT SOP 0600R2	METAL MUST BE AOD REFINED OR AOD INGOT. VIRGIN METAL ADDITIONS ALLOWED. RECORD POURING TEMPERATURE: 2750 CASTING POURED AT: DATE: 5/25/05 HEAT #'s: 29516, 29517, 29518, 29519, 29520 Reported as 3 Ladles ELAPSED POUR TIME 1:25 KEEL BLOCKS POURED: NA Cast on bars Sample from ladle to be analyzed for final chemical analysis and reported on material certifications. Sample Taken by: SR Analyzed: G. Hurt Date: 5-25-05	S. Galaska	5-25-05

to Rev 6.

A-1 Coil

Energy Industries of Ohio

Manufacturing and Test Sequence (MTS) Serial Number A-1

 CO# 40851 Dated 3-9-05 Revision: Rev 6 Dated Issued: 5-29-05

Rev 5 | Stamp

50	MELT SOP 0800R2	SHAKEOUT	CJA	5-28
60	ARC RISE SOP 0100R1	REMOVE RISERS AS DIRECTED BY SUPERVISOR.	RLC RLS	5-31 6-6-05
70	HEAT TREAT HEAT SOP 0103R5	SOLUTION ANNEAL. MAKE SURE TO BLOCK ALL FLANGES OF FORM AND RACETRACK TO MINIMIZE CREEP DISTORTION. Soak Temp: 2050F, Soak Time: 4HR + 1/2 HR/IN, Quench Type: Air Cool	DLS	6/2/05
75	PHYSICAL TESTING	OBTAIN TEST SPECIMENS AND SUBMIT FOR PHYSICAL TESTING. REPORT RESULTS AS PART OF STEP 510.	WLH	6/6/05
NOTE		**THE ORDER OF CLEANING PROCESSES MAY BE ALTERED DUE TO CAPACITY CONSTRAINTS. HOLD POINTS AND COMPLIANCE WILL NOT BE COMPROMISED. EIO WILL BE ADVISED OF ALL CHANGES THAT MAY RESULT IN A REQUEST FOR DEVIATION FROM REQUIREMENTS.**		
80	GRIND GSWA SOP 0100R3	SWING GRIND TO REMOVE RISER REMAINS AND FLASH IF REQUIRED.	AB	6-6-05
85	GRIND GCHI SOP 0100R2	CHIP AND HAD GRIND SURFACE OF PART AS REQUIRED FOR CONTOUR.	CS	6-10-05
90	SAND BLAST BLAS SOP 0100R6	SANDBLAST (REMOVE ALL BLAST MATERIAL FROM CASTING) SANDBLASTING WILL BE DONE USING RECYCLED SHARP ANGULAR AGGREGATE.	MTW MTW	6/6 6-10-05
NOTICE	WITNESS NOTIFICATION **HOLD FOR EIO APPROVAL**	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF LAYOUT. EIO NOTIFIED ON 6/3/05 pm DCMA NOTIFIED ON 6/3/05 pm APPROVAL RECEIVED ON 6/7/05 pm	Q ENG OR QA MGR	RS
100	**LAYOUT SOP LAYOUT 0100**	INSPECT CASTING TO VERIFY DIMENSIONS. THIS STEP MAY BE DELAYED. DIMENSIONED 6/7 DATE _____ RELEASED RB (ENGINEER ONLY) NOTE: THE FIRST PART PRODUCED OF EACH TYPE A, B AND C WILL BE DIMENSIONED BY LAWTON PATTERN. IF DIMENSIONED BY LAWTON IT WILL BE DOCUMENTED HERE. Subsequent casting done internally per Romer Arm.	Lawton Pattern	6/1

6/7/05

A-1 Coil

Energy Industries of Ohio

Manufacturing and Test Sequence (MTS) Serial Number A-1

 CO# 40851 Dated 3-9-05 Revision: Rev 6 Dated Issued: 5-29-05

110	VISUAL INSPECTION CQP-500 REV 4	VISUALLY INSPECT 100% of COMPONENT ACCORDING TO ASTM **A802 LEVEL 3 ALL CONDITIONS.** IF OK CHECK HERE _____ . IF REJECTED CHECK HERE ____ . MARK AND REPAIR AT STEP 120.	VT - LEVEL II	Expanded to RT will perform upon return Cdn
NOTICE	WITNESS NOTIFICATION	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF LP STEP. EIO NOTIFIED ON 6/1/05 DCMA NOTIFIED ON 6/1/05	Q ENG OR QA MGR	
115	100% L.P. CQP 0300 REV 10	L.P. 100% OF COMPONENT. ACCEPTANCE PER ASTM A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING. IF OK CHECK HERE _____ IF REJECTED CHECK HERE _____ MARK AND REPAIR AT STEP 120.	LP - LEVEL II	
120	WELD SOP 0100 REV 7	EXCAVATE ANY DEFECTS FOUND DURING 100% VISUAL AND LP INSPECTION.		
125	GRIND GCHI SOP 0100R2	CHIP AND HAND GRIND EXCAVATION AS REQUIRED.		
130	L.P. EXCAVATION CQP-300 REV 10	L.P. ALL EXCAVATIONS PRIOR TO WELDING TO ENSURE REMOVAL OF DEFECT. ACCEPTANCE PER A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING. IF OK CHECK HERE _____ IF REJECTED SEND BACK TO STEP 125.	LP - LEVEL II	
165	SAND BLAST BLAS SOP 0100R6	SANDBLAST (REMOVE ALL BLAST MATERIAL FROM CASTING) SANDBLASTING WILL BE DONE USING RECYCLED SHARP ANGULAR AGGREGATE.		
170	**HOLD POINT** WELD MAP	MAP ALL WELDS WITH DIGITAL PHOTO/MAPS INDICATING LOCATION. SERIALIZE DEFECTS ON CASTING, USE SCALE IN PHOTOS AND DOCUMENT SIZE. THIS IS TO BE PERFORMED BY SUPERVISOR, INSPECTION LEAD MAN OR THEIR DESIGNEE, FILE WITH QA. USE YELLOW MARKER. MUST SEND REPORT ON ALL WELDS OVER 10% OF NOMINAL WALL THICKNESS TO CUSTOMER. DEFECTS>10% YES _____, REPORT SENT BY _____ DATE_____ DEFECTS < 10 % _____SIGN BY QA ENG. **MAJOR WELD REPAIRS MAY NOT PROCEED UNTIL INFORMATION IS SUBMITTED.**		
NOTICE	WITNESS NOTIFICATION	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF X-RAY AND DIMENSIONAL STEPS. EIO NOTIFIED ON 6/1 DCMA NOTIFIED ON 6/1	Q ENG OR QA MGR	RS

A-1 Coil

Energy Industries of Ohio

Manufacturing and Test Sequence (MTS) Serial Number A-1

 CO# 40851 Dated 3-9-05 Revision: Rev 6 Dated Issued: 5-29-05

190	X-RAY AT MQS MQS PROCEDURE 20.H.010 REV 0	X-RAY PER TECHNIQUE # 12726 USE CALIBRATED DENSITOMETER FOR DENSITY VERIFICATION. WHEN MARKING USE BLACK MARKERS. ATTACH TECHNIQUE, READER SHEET FOR ALL RADIOGRAPHS. MUST INDICATE RADIOGRAPHER AND ASNT CERTIFICATION LEVEL ON READER SHEET.	RT – LEVEL II RS 4/24/05 to Rev 7	
210	X-RAY CQP 401 REV 5	X-RAY INTERPRETATION. ACCEPTANCE MSS SP 54. ATTACH TECHNIQUE, READER SHEET FOR ALL RADIOGRAPHS. MUST INDICATE RADIOGRAPHER AND ASNT CERTIFICATION LEVEL ON READER SHEET. IF OK CHECK HERE _____ AND SEND TO STEP 340. REJECTED CHECK HERE _____ MARK UP DEFECTS AND SEND THE CASTING TO STEP 220.	RT – LEVEL II	
220	WELD SOP 0100 REV 7	EXCAVATE ANY DEFECTS FOUND DURING RADIOGRAPHY.		
225	GRIND GCHI SOP 0100R2	CHIP AND HAND GRIND EXCAVATION AS REQUIRED.		
230	L.P. EXCAVATION CQP-300 REV 10	L.P. ALL EXCAVATIONS PRIOR TO WELDING TO ENSURE REMOVAL OF DEFECT. ACCEPTANCE PER A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING. IF OK CHECK HERE _____ IF REJECTED SEND BACK TO STEP 225.	LP - LEVEL II	
240	**HOLD POINT** WELD MAP	MAP ALL WELDS WITH DIGITAL PHOTO/MAPS INDICATING LOCATION . SERIALIZE DEFECTS ON CASTING, USE SCALE IN PHOTOS AND DOCUMENT SIZE. THIS IS TO BE PERFORMED BY SUPERVISOR, INSPECTION LEAD MAN OR THEIR DESIGNEE, FILE WITH QA. MUST SEND REPORT ON ALL WELDS OVER 10% OF NOMINAL WALL THICKNESS TO CUSTOMER. DEFECTS>10% YES _____, REPORT SENT BY _____ DATE_____ DEFECTS < 10 % _____SIGN BY QA ENG. **MAJOR WELD REPAIRS MAY NOT PROCEED UNTIL INFORMATION IS SUBMITTED.** MUST SEND REPORT ON ALL WELDS OVER 10% OF NOMINAL WALL THICKNESS TO CUSTOMER PRIOR TO REPAIR. ONCE THE REPORT IS SENT, WELDING MAY START.		
NOTICE	WITNESS NOTIFICATION	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF WELD STEP. EIO NOTIFIED ON _____ DCMA NOTIFIED ON _____	Q ENG OR QA MGR	
260	QA APPROVAL HOLD POINT	QA TO APPROVE ELECTRODE PRIOR TO USE. PROCEDURE USED: _____ MATERIAL/LOT USED:_____ QUALITY ENG. Name: _____ Date: _____		
270	WELD SOP 0100 REV 7	WELD REPAIR DEFECTS AS MARKED. FOR WELDS <2" - WPS 10-SMAW-CF8MNMN MOD REV 1 FOR WELDS <8" - WPS 15-GMAW-CF8MNMN MOD REV 2		

A-1 Coil

Energy Industries of Ohio

Manufacturing and Test Sequence (MTS) Serial Number A-1

 CO# 40851 Dated 3-9-05 Revision: Rev 7 Dated Issued: 6-14-05

190	X-RAY AT MQS MQS PROCEDURE 20.H.010 REV 0	X-RAY PER TECHNIQUE # 12726 USE CALIBRATED DENSITOMETER FOR DENSITY VERIFICATION. WHEN MARKING USE BLACK MARKERS. ATTACH TECHNIQUE, READER SHEET FOR ALL RADIOGRAPHS. MUST INDICATE RADIOGRAPHER AND ASNT CERTIFICATION LEVEL ON READER SHEET.	RT – LEVEL II RS	6/17/05
210	X-RAY CQP 401 REV 5	X-RAY INTERPRETATION. ACCEPTANCE MSS SP 54. ATTACH TECHNIQUE, READER SHEET FOR ALL RADIOGRAPHS. MUST INDICATE RADIOGRAPHER AND ASNT CERTIFICATION LEVEL ON READER SHEET. IF OK CHECK HERE _____ AND SEND TO STEP 340. REJECTED CHECK HERE ___✓___ MARK UP DEFECTS AND SEND THE CASTING TO STEP 220.	RT – LEVEL II RK	6/22
220	WELD SOP 0100 REV 7	EXCAVATE ANY DEFECTS FOUND DURING RADIOGRAPHY.	BM BM	6/23 8-23
225	GRIND GCHI SOP 0100R2	CHIP AND HAND GRIND EXCAVATION AS REQUIRED.	QB	6-25 8-23
230	L.P. EXCAVATION CQP-300 REV 10	L.P. ALL EXCAVATIONS PRIOR TO WELDING TO ENSURE REMOVAL OF DEFECT. ACCEPTANCE PER A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING. IF OK CHECK HERE _____ IF REJECTED SEND BACK TO STEP 225.	LP - CC LEVEL II CC	6-26 6-27
240	**HOLD POINT** WELD MAP	MAP ALL WELDS WITH DIGITAL PHOTO/MAPS INDICATING LOCATION . SERIALIZE DEFECTS ON CASTING, USE SCALE IN PHOTOS AND DOCUMENT SIZE. THIS IS TO BE PERFORMED BY SUPERVISOR, INSPECTION LEAD MAN OR THEIR DESIGNEE, FILE WITH QA. MUST SEND REPORT ON ALL WELDS OVER 10% OF NOMINAL WALL THICKNESS TO CUSTOMER. DEFECTS>10% YES ___✓___, REPORT SENT BY 7/18/05 DATE DEFECTS < 10 % _____ SIGN BY QA ENG. **MAJOR WELD REPAIRS MAY NOT PROCEED UNTIL INFORMATION IS SUBMITTED.** MUST SEND REPORT ON ALL WELDS OVER 10% OF NOMINAL WALL THICKNESS TO CUSTOMER PRIOR TO REPAIR. ONCE THE REPORT IS SENT, WELDING MAY START.		7/18
NOTICE	WITNESS NOTIFICATION	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF WELD STEP. EIO NOTIFIED ON 7/10 DCMA NOTIFIED ON 7/10	Q ENG OR QA MGR	
260	QA APPROVAL HOLD POINT	QA TO APPROVE ELECTRODE PRIOR TO USE. PROCEDURE USED: ~~15-GMAW-CF8MnMoN~~ Rev 1 MATERIAL/LOT USED: 316MNNF/78309 3018926/ QUALITY ENG. Name: Kirk Mc Date: 7/12/05		
270	WELD SOP 0100 REV 7	~~WELD REPAIR DEFECTS AS MARKED.~~ FOR WELDS <2" - WPS 10-SMAW-CF8MNMN MOD REV 1 FOR WELDS <8" - WPS 15-GMAW-CF8MNMN MOD REV 2	TLS	8/12

		ADD WPS FOR VERTICAL WELDS.		
280	GRIND GCHI SOP 0100R2	HAND GRIND WELDS.	M.G	8/12
290	L.P. WELD CQP 0300 REV 10	L.P. WELD REPAIRS ACCEPTANCE PER ASTM A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING. IF OK CHECK HERE ✓ WASH AND SEND TO STEP 300. IF REJECTED CHECK HERE _____	LP - LEVEL II CC	8/12
	REPEAT	REPEAT STEPS 220 TO 290 AS REQUIRED TILL CLEAR THROUGH VISUAL INSPECTION & PENETRANT INSPECTION. DOCUMENT REWORK ON STEPS S220 TO S290 ON LAST PAGE OF MTS. IF OK CHECK HERE _____ AND PROCEED TO STEP 295.	N/A	
295	TEST MAG PERM SOP MAG PERM 100, REV 1	TEST MAG PERMEABILITY REPAIR AREAS RECORD ON WELD MAP LIST. TEST AT LEAST 5 POINTS PER WELD. ACCEPTANCE 1.02. IF OK CHECK HERE X AND GO TO STEP 300. IF REJECTED CHECK HERE _____.	CJA	8/12
296	GRIND GCHI SOP 0100R2	GRIND AREAS OF NON COMPLIANCE AND RETURN TO STEP 295. REPEAT UNTIL COMPLIANCE IS ACHIEVED.	N/A	
300	X-RAY (NOTE)	IF RADIO GRAPHED AREAS ARE GREATER THAN FOUR TO FIVE INCHES THE CASTING WILL BE SENT TO MQS. SEND TO MQS CHECK HERE _____. RADIOGRAPH AT CAF CHECK HERE ✓.	QA ENGINEER RBK	8-21-05
310 A	MQS X-RAY DEFECTS REPAIRED BY WELDING	X-RAY PER TECHNIQUE # 12726 USE CALIBRATED DENSITOMETER FOR DENSITY VERIFICATION. ATTACH TECHNIQUE, READER SHEET FOR ALL RADIOGRAPHS. MUST INDICATE RADIOGRAPHER AND ASNT CERTIFICATION LEVEL ON READER SHEET.	LEVEL II N/A	
310 B	CAF X-RAY DEFECTS REPAIRED BY WELDING CQP 401 REV 5	X-RAY PER TECHNIQUE # 12726 USE CALIBRATED DENSITOMETER FOR DENSITY VERIFICATION. ATTACH TECHNIQUE, READER SHEET FOR ALL RADIOGRAPHS. MUST INDICATE RADIOGRAPHER AND ASNT CERTIFICATION LEVEL ON READER SHEET.	RT - LEVEL II RBK	8-21-05

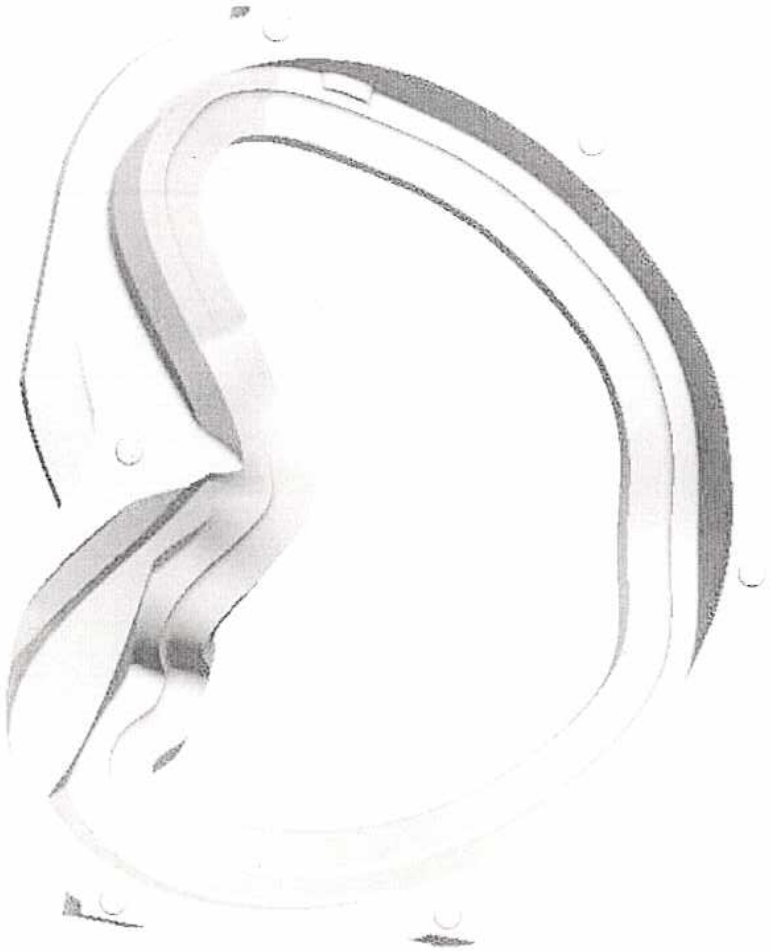
320	X-RAY CQP 401 REV 5	X-RAY INTERPRETATION. ACCEPTANCE MSS SP 54. ATTACH TECHNIQUE, READER SHEET FOR ALL RADIOGRAPHS. MUST INDICATE RADIOGRAPHER AND ASNT CERTIFICATION LEVEL ON READER SHEET. IF OK CHECK HERE _____ AND SEND TO STEP 340. REJECTED CHECK HERE ✓ MARK UP DEFECTS AND SEND THE CASTING TO STEP 220.	RT - LEVEL II EBK	8-21-05
	REPEAT	REPEAT STEPS 220 TO 320 AS REQUIRED TILL WELDS CLEAR X-RAY. DOCUMENT REWORK ON A SUPPLEMENTAL MTS	QA ENG. RS	10 S 220
340	SAND BLAST BLAS SOP 0100R6	SANDBLAST (REMOVE ALL BLAST MATERIAL FROM CASTING) SANDBLASTING WILL BE DONE USING RECYCLED SHARP ANGULAR AGGREGATE.	MW	8/31/05
NOTICE	WITNESS NOTIFICATION	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF VISUAL AND LP STEPS. EIO NOTIFIED ON 8/21 DCMA NOTIFIED ON 8/21	Q ENG OR QA MGR	
350	FINAL VISUAL INSPECTION CQP-500 REV 4	VISUALLY INSPECT 100% of COMPONENT ACCORDING TO ASTM A802 LEVEL 2 ALL CONDITIONS. IF OK CHECK HERE ✓. IF REJECTED CHECK HERE _____. MARK AND REPAIR AT STEP 385. MUST BE PERFORMED BY LEVEL II in VT.	VT - LEVEL II KRA 8-31-05	
360	FINAL L.P. CQP 0300 REV 10	FINAL L.P. 100% OF COMPONENT. ACCEPTANCE PER ASTM A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING. IF OK CHECK HERE _____ WASH AND SEND TO STEP 455. IF REJECTED CHECK HERE C.C. REJECT	LP - LEVEL II T.C. 8-31-05	
380	WELD SOP 0100 REV 7	EXCAVATE ANY DEFECTS FOUND DURING FINAL PENETRANT INSPECTION.	N/A RJG 8-31-05	
385	GRIND GCHI SOP 0100R2	CHIP AND HAD GRIND EXCAVATION AS REQUIRED.	DWP 8-31-05	
390	L.P. EXCAVATION CQP-300 REV 10	L.P. ALL EXCAVATIONS PRIOR TO WELDING TO ENSURE REMOVAL OF DEFECT. ACCEPTANCE PER A903. GRIND ONLY IF OK CHECK HERE _____ IF REJECTED SEND BACK TO STEP 385.	LP - LEVEL II KRA 8-31-05	

400	**HOLD POINT** WELD MAP	MAP ALL WELDS WITH DIGITAL PHOTO/MAPS INDICATING LOCATION. SERIALIZE DEFECTS ON CASTING, USE SCALE IN PHOTOS AND DOCUMENT SIZE. THIS IS TO BE PERFORMED BY SUPERVISOR, INSPECTION LEAD MAN OR THEIR DESIGNEE. FILE WITH QA. MUST SEND REPORT ON ALL WELDS OVER 10% OF NOMINAL WALL THICKNESS TO CUSTOMER. DEFECTS.>10% YES _____, REPORT SENT BY _____ DATE_____ DEFECTS < 10 % _____SIGN BY QA ENG. **MAJOR WELD REPAIRS MAY NOT PROCEED UNTIL INFORMATION IS SUBMITTED.** MUST SEND REPORT ON ALL WELDS OVER 10% OF NOMINAL WALL THICKNESS TO CUSTOMER PRIOR TO REPAIR. ONCE THE REPORT IS SENT, WELDING MAY START.	N/A	
420	QA APPROVAL HOLD POINT	QA TO APPROVE ELECTRODE PRIOR TO USE. PROCEDURE USED: _____ MATERIAL/LOT USED:_____ QUALITY ENG. Name: _____ Date: _____		
430	WELD SOP 0100 REV 7	WELD REPAIR DEFECTS AS MARKED. FOR WELDS <2" - WPS 10-SMAW-CF8MNMN MOD REV 1 FOR WELDS <8" - WPS 15-GMAW-CF8MNMN MOD REV 2 **ADD WPS FOR VERTICAL WELDS.**		
440	GRIND GCHI SOP 0100 REV 2	HAND GRIND WELDS.		
450	L.P. WELDS CQP 0300 REV 10	L.P. WELD REPAIRS ACCEPTANCE PER ASTM A903. IF OK CHECK HERE _____ WASH AND SEND TO STEP 460. IF REJECTED CHECK HERE _____AND RETURN TO STEP 440.	LP - LEVEL II N/A	
	REPEAT	REPEAT STEPS ___350 TO 450____AS REQUIRED TILL WELDS CLEAR FINAL LIQUID PENETRANT INSPECTION. DOCUMENT REWORK ON A SUPPLEMENTAL MTS	QA ENG. N/A	
NOTICE	WITNESS NOTIFICATION	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF VISUAL AND LP STEPS. EIO NOTIFIED ON 8/21 DCMA NOTIFIED ON 8/21	Q ENG OR QA MGR	
460	FINAL VISUAL INSPECTION CQP-500 REV 4	VISUALLY INSPECT 100% of COMPONENT ACCORDING TO ASTM A802 LEVEL 2 ALL CONDITIONS. IF OK CHECK HERE ✓. IF REJECTED CHECK HERE _____. MARK AND REPAIR AT STEP 390. MUST BE PERFORMED BY LEVEL II in VT. GRIND ONLY	VT - LEVEL II KRA 8-31-05	

470	FINAL L.P. CQP 0300 REV 10	FINAL L.P. 100% OF COMPONENT. ACCEPTANCE PER ASTM A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING. IF OK CHECK HERE ✓ WASH AND SEND TO STEP 455. IF REJECTED CHECK HERE _____	LP - LEVEL II KLA	8/30
480	TEST MAG PERM SOP MAG PERM 100, REV 1	TEST MAG PERMEABILITY REPAIR AREAS. RECORD ON WELD MAP LIST. TEST AT LEAST 5 POINTS PER WELD. ACCEPTANCE 1.02. IF OK CHECK HERE _____ AND GO TO STEP 430. IF REJECTED CHECK HERE _____.	NA	
490	GRIND GCHI SOP 0100R2	GRIND AREAS OF NON COMPLIANCE AND RETURN TO STEP 451. REPEAT UNTIL COMPLIANCE IS ACHIEVED.		
NOTICE	WITNESS NOTIFICATION	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF MAG PERM STEPS. EIO NOTIFIED ON 8/24 DCMA NOTIFIED ON 8/24	Q ENG OR QA MGR	
500	FINAL MAG PERM INSPECTION SOP MAG PERM 100, REV 1	PERFORM MAG PERM TESTING WITH SEVRIN GAUGE. ACCEPTANCE 1.02. CHECK THE ENTIRE SURFACE ON A 6"BY6" GRID. REPORT RESULTS. USE A 6" SQUARE BLOCK TO INDICATE TEST LOCATIONS AND RECORD RESULTS. COMPLIANT AREAS WILL NOT BE MARKED. MARK NONCOMPLIANT AREAS WITH AN "X" FOR REPAIR. OK CHECK HERE ✓ AND GO TO STEP 530. IF REJECTED CHECK HERE _____.	CAF	8/31
510	GRIND GCHI SOP 0100 REV 2	HAND GRIND WITH SUITABLE CONE OR OTHER SIMILAR GRINDER AS REQUIRED TO ENSURE REMOVAL OF MATERIAL TO ACHIEVE MAG PERM REQUIREMENT. CIRCLE AREA REMEDIATE FOR RETEST.	NA	
520	RETEST MAG PERM SOP MAG PERM 100, REV 1	RETEST MAG PERMEABILITY AT FAILED TEST POINTS. MARK NONCOMPLIANT AREAS WITH AN "X" FOR REPAIR. ACCEPTANCE 1.02. IF OK CHECK HERE _____. IF REJECTED CHECK HERE _____ RETURN TO STEP 510.		
530	DOC. REVIEW	REVIEW DOCUMENTS AS REQUIRED IN CAF CHECKLIST, ALL DOCUMENTS NOTED TO BE ACCESSIBLE FOR AUDITING. (SHIPPER, C OF C, M.T.R., M.T.S., INSPECTION REPORT, X-RAY READER SHEETS AND HEAT TREAT CHARTS)	CAF 9/30	
NOTICE	RELEASE FROM EIO	PROVIDE DOCUMENTS TO EIO. SENT ON 9/30 BY CAF. RECEIVED RELEASE FROM EIO ON _____.	Q ENG OR QA MGR CR	
540	PACK AND SHIP	PACKAGE AND SHIP TO MAJOR TOOL.		
1000	REVISION HISTORY	ORIGINAL 12-14-04. Approved 12-14-04. Revision level 1- Revised 1-26-05 new page 8, correct High stress areas, Revision level 2 3-16-05, delete LO step 455. Revision 3 3-28-05 Added note regarding	CARUUD	

		hold point at weld step 400. Revision level 4 written for C-2 casting 4-18-05. Rev 5 added Layout SOP# and note regarding first casting layout responsibility. 5-10-05. Rev 6 5-29-05 added "LOT" to weld material steps. Rev 7 6-14-05 added "LOT to supplement page weld step.		

RED AREA INDICATES HIGH STRESSED AREA



A-1 Coil

Energy Industries of Ohio

Manufacturing and Test Sequence (MTS) Serial Number A-1

 CO# 40851 Dated 3-9-05 Revision: Rev 7 Dated Issued: 6-14-05

	REPEAT STEPS	SUPPLEMENTAL REPAIR STEPS	1ST	2ND	3RD	4TH	5TH
S220	WELD SOP 0100 REV 7	EXCAVATE ANY DEFECTS FOUND DURING RADIOGRAPHY.	NC 8/21	8/26			
S230	L.P. EXCAVATION CQP-300 REV 10	L.P. ALL EXCAVATIONS PRIOR TO WELDING TO ENSURE REMOVAL OF DEFECT. ACCEPTANCE PER A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING.	LP - LEVEL II CC 8/26	8/26			
S240	WELD MAP	MAP ALL WELDS WITH DIGITAL PHOTO/MAPS INDICATING LOCATION . SERIALIZE DEFECTS ON CASTING, USE SCALE IN PHOTOS AND DOCUMENT SIZE. THIS IS TO BE PERFORMED BY SUPERVISOR, INSPECTION LEAD MAN OR THEIR DESIGNEE, FILE WITH QA. MUST SEND REPORT ON ALL WELDS OVER 10% OF NOMINAL WALL THICKNESS TO CUSTOMER. DEFECTS>10% YES ✓, REPORT SENT BY CC DATE 8/24 8/26 DEFECTS < 10 % _____ SIGN BY QA ENG. **REPAIRS MAY NOT PROCEED UNTIL INFORMATION IS SUBMITTED.**	8/21	8/26			
NOTICE	WITNESS NOTIFICATION	PROVIDE NOTICE TO EIO AND DCMA AT LEAST FIVE DAYS IN ADVANCE OF WELD STEP. EIO NOTIFIED ON 8/21 DCMA NOTIFIED ON 8/21	Q ENG OR QA MGR				
S260	QA APPROVAL HOLD POINT	QA TO APPROVE ELECTRODE PRIOR TO USE. PROCEDURE USED: _____ MATERIAL/LOT USED: 78309 QUALITY ENG. Name: RS Date: 8/23					
S270	WELD SOP 0100 REV 7	WELD REPAIR DEFECTS AS MARKED. FOR WELDS <2" - WPS 10-SMAW-CF8MNMN MOD REV 13 FOR WELDS <8" - WPS 15-GMAW-CF8MNMN MOD REV 2 **ADD WPS FOR VERTICAL WELDS.**	TAP 8/23	TS 8/27			
S280	GRIND GCHI SOP 0100R2	HAND GRIND WELDS.	AB 8/24	OFB 8/28			
S290	L.P. WELD CQP 0300 REV 10	L.P. WELD REPAIRS ACCEPTANCE PER ASTM A903. ACCEPTANCE CRITERIA-LEVEL 1 FOR HIGH STRESSED AREAS, LEVEL 2 FOR ALL OTHER AREAS. SEE LP DRAWING. IF OK CHECK HERE _____ WASH AND SEND TO STEP 300.	LP - LEVEL II CC 8/24	OK CC 8/26 REJ	OK REJ	OK REJ	OK RE

RT RT
2 FS OK

		IF REJECTED CHECK HERE _____AND RETURN TO STEP 220.					J
	REPEAT	REPEAT STEPS S220 TO S290 AS REQUIRED TILL CLEAR THROUGH VISUAL INSPECTION & PENETRANT INSPECTION. DOCUMENT REWORK ON A SUPPLEMENTAL MTS	QA ENG	8/28			

MetalTek INTERNATIONAL

Corrective Action 1308
Carondelet Division - CA / PA / RGA Database
Corrective Action Type NCR
Date 6/13/2005
CA Originator C. Ruud
Pattern Number: C and A Coil Shims 11 Pieces

Description of Defect / Non-Conformance
Chemistry for 11 shim castings is out of specification.

Root Cause
Chemistry specification was not changed in system and not communicated to Lab personnel.

Corrective Action
Specification was corrected in system and Lab personnel trained. Mag permeability was checked on the parts and are less than 1.02u.

Verification of Corrective Action
Chemistries were checked on subsequent parts and are within specification.

Preventive Action
Create Inspection and Test Plan summarizing all requirements.

Estimated Completion Date
6/15/05

Actual Completion Date
Complete.

Signed: C. Ruud

CC: Roger Broman, Barry Craig, Joe Edwards, E.J. Kubick

Nonconformance Report: MetalTek CA 1308

Project Disposition: Use as is.

Approvals

Procurement Technical Representative _____
Wayne Reiersen for Phil Heitzenroeder

Responsible Line Manager _____
Mike Cole for Brad Nelson

Corrective Action 1323
Carondelet Division - CA / PA / RGA Database
Corrective Action Type NCR
Date 7/27/2005
CA Originator C. Ruud
Applies to: Coil castings C-1, C-2, C-3, C-4 and A-1 and C 1 shim and four C coil and six A coil shims

Description of Defect / Non-Conformance
Phosphorus levels in material produced to date exceed specification limits. Both phosphorus and sulfur readings reported erroneously in certifications.

Certification reports have shown phosphorus and sulfur levels in the <.01% range. Independent laboratory data confirmed phosphorus in the .018 to .033% range and sulfur in the .005 to .022% range. Actual levels of some tests are above those in PPPL Specification NCSX-CSPEC-141-03-07 Rev 7.

Nonconformance was first suspected as a result of analysis of zoned attached test specimens volunteered by MetalTek International as response to PPPL questions on weighted average chemical analysis and quality of blending in the gating system. Nonconformance was verified on the bars used in the study and has been extended to evaluation of previously poured products.

Root Cause
Specification limits were set below the levels achievable through use of available raw materials. Spectrometer did not properly calibrate for phosphorus and sulfur at levels of specification due to equipment malfunction.
The chemical specification of EIO heats uses alloy CF8MNMn-Mod which incorporates a type standard calibration with a certified reference material (CRM) BS180. This enables the operator of the spectrometer to match the elemental concentrations of this alloy with corrective factors. These factors are determined by analyzing the CRM and having them compared with the calibration curves for each element. The phosphorus and sulfur content have very low measured intensities due to low concentrations. Intermittent failure of the spectrometer intensity measuring card caused higher intensity readings for phosphorus and sulfur. Subsequent checks with the CRM resulted in low corrective factors that were not detected. This in turn resulted in low reported concentrations for the EIO samples. All the major elements, which are measured on other intensity cards, have been closely monitored and matched very well with the CRM and thus were reported correctly.

Corrective Action
Modification to specification for phosphorus and sulfur will be requested. Limits will be set based on process capability and consistent with other stainless steel grades. Replacement of deficient card in spectrometer will be made upon delivery.

MetalTek INTERNATIONAL

Addendum to CA1323 8-17-05

Historical:
The proto type coil was poured on February 24, 2004. The chemistry specification at that time permitted a maximum of 0.04% for sulfur and phosphorus. The reported values for these elements were 0.01 and 0.02% respectively.

Prior to pouring the C-1 coil casting the specification was revised. MT failed to incorporate the revisions into our system. The contract review procedure did not detect the changes to the specification. Therefore normal change procedures were not implemented. This was reported in corrective action 1308 on June 13, 2005. The error was recognized when the material poured to cast C and A coil shims did not meet the revised specification.

An investigation was begun immediately to determine compliance of the C-1 and C-2 coils. It was determined that both the C-1 and C-2 met the revised chemistry, except for sulfur and phosphorus. To verify the analysis MT analyzed samples from the cast on bars taken from the coils. By this time the optical card had malfunctioned. This fact, in combination with the human error (believing that the type standard was also in the 0.002% range) led MT to believe that the sulfur and phosphorus were actually in the 0.002% range. As a result MT believed the coils to be compliant and no action was taken.

Current Activities:
Samples from A-1, C-4 and C-5 have been sent to Wisconsin Centrifugal, our parent company for independent analysis of all reported elements.

Repair to the spectrometer is scheduled for this week. In the mean time we continue our surveillance of the suspect elements during melt and chemistry analysis.

C. Ruud

CC: Jim Galaske, Barry Craig, Joe Edwards, E.J. Kubick

MetalTek INTERNATIONAL

Addendum to CA1323 9-8-05

This is to supplement and report our progress on this corrective action.

As previously committed, samples from A-1, C-4 and C-5 were sent to Wisconsin Centrifugal, our parent company, for independent analysis of all reported elements. The results indicated a discrepancy in the level of manganese in the results of the analyses performed by the two labs. Consistently, the Pevely lab measured Mn about 0.4 to 0.5% higher than WC measured. To confirm this information we sent three samples to an outside laboratory for wet chemistry analysis. The results correlated well with the results achieved at Wisconsin Centrifugal. See attached report.

In follow-up, samples from C-1, C-2 and C-3 were also sent for verification, with similar outcome. We then located and tested a sample from a test heat #21424 of CF8MNMNMOD made in January 2004. Testing indicated similar results.

It can be stated that, for at least the period of time comprising the Prototype and the Production to the repair of the Spectrometer, that our analysis of Manganese levels has been higher than the level actually present in the alloy. Typically, this deviation is on the order of 0.4-0.5%.

The spectrometer received the preventive maintenance on August 29, 2005. The report was submitted on September 2, 2005. The repair made to the optical card was determined to have rectified the previously reported issue with P and S reporting. No other mechanical or software problem that would affect Mn was determined at the time of the preventative maintenance.

In follow up to the Manganese discrepancy, the same samples were analyzed on the Pevely spectrometer. The levels reported after PM now correlate with the results from WC and the independent laboratory. Further investigation indicates that the BS180 standard used for type standardization may be sufficiently outside the range of Mn and inducing error. No other root cause has been determined, but the investigation continues.

In consideration of the erroneous Mn and other elemental readings, the following actions are proposed:

Create a type standard that closely matches the Mn in CF8MNMNMOD. (In process)
Request a revision to the chemistry range for Mn. (propose widening of Manganese since it has been proven to be effective at much lower concentrations than previously thought).
Have each heat of CF8MNMNMOD verified independently for balance of program.

C. Ruud

CC: Jim Galaske, Barry Craig, Joe Edwards, E.J. Kubick

Chemistry Check with WISCO

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	C-5,I-1	Button #1	0.05	0.3	2.6	18.1	13.4	2.4	0.26	0.023	0.011	
CAF	C-5,I-1	Button #2	0.05	0.4	2.6	18.0	13.4	2.6	0.26	0.026	0.013	
WC	C-5,I-1	Button #2	0.02	0.3	2.2	18.2	13.5	2.4	0.25	0.025	0.010	
STL Wet	C-5,I-1	Button #1			2.2							
CAF	C-5,I-1	Button #1	*	0.3	2.3	18.3	13.4	2.4	*	0.029	0.012	re-run after PM

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	C-5,I-3	Button #1	0.05	0.4	2.2	17.9	13.4	2.5	0.24	0.033	0.012	
CAF	C-5,I-3	Button #2	0.05	0.4	2.2	17.9	13.2	2.4	0.24	0.033	0.012	
WC	C-5,I-3	Button #2	0.05	0.4	1.8	18.2	13.4	2.5	0.23	0.034	0.018	
STL Wet	C-5,I-3	Button #1			1.8							
CAF	C-5,I-3	Button #1	*	0.4	1.8	18.3	13.3	2.5	*	0.034	0.012	re-run after PM

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	C-5,I-6	Button #1	0.05	0.3	2.4	18.1	13.2	2.4	0.25	0.030	0.012	
CAF	C-5,I-6	Button #2	0.05	0.3	2.4	18.1	13.2	2.4	0.25	0.029	0.011	
WC	C-5,I-6	Button #2	0.04	0.3	2	18.3	13.3	2.4	0.24	0.031	0.018	
STL Wet	C-5,I-6	Button #1			1.9							
CAF	C-5,I-6	Button #1	*	0.3	2.0	18.4	13.3	2.4	*	0.033	0.012	re-run after PM

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	A-1	Reported	0.04	0.4	2.4	18.2	13.3	2.4	0.26	*	*	
CAF	A-1	Cast on sample	*	0.5	2.1	18.0	13.4	2.4	*	0.034	0.009	
WC	A-1	Cast on sample	0.06	0.6	1.6	18.1	13.7	2.4	0.25	0.027	0.009	
CAF	A-1	Cast on sample	*	0.6	1.6	18.2	13.5	2.4	*	0.028	0.009	re-run after PM

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	C-4	Reported	0.04	0.4	2.5	18.2	13.2	2.2	0.26	.030**	.014**	
CAF	C-4	Cast on sample	*	0.6	1.9	17.9	13.5	2.3	*	0.037	0.013	
WC	C-4	Cast on sample	0.04	0.6	1.5	17.8	13.6	2.4	0.25	0.030	0.012	
CAF	C-4	Cast on sample	*	0.6	1.4	18.2	13.6	2.4	*	0.031	0.009	re-run after PM

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	C-1	Reported	0.06	0.5	2.7	18.1	13.1	2.2	0.27	0.018**	0.014**	
CAF	C-1	Cast on sample	*	0.7	2.2	18.1	13.1	2.2	*	0.021	0.010	
WC	C-1	Cast on sample	0.06	0.7	1.8	18.3	13.4	2.4	0.24	0.021	0.014	
CAF	C-1	Cast on sample	*	0.7	1.9	18.3	13.2	2.4	*	0.024	0.013	re-run after PM

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	C-2	Reported	0.06	0.5	2.8	18.0	13.2	2.3	0.26	0.023**	0.018**	
CAF	C-2	Cast on sample	*	0.8	2.2	18.1	13.4	2.2	*	0.030	0.012	
WC	C-2	Cast on sample	0.07	0.9	1.6	18.2	13.7	2.2	0.23	0.023	0.014	
CAF	C-2	Cast on sample	*	0.8	1.6	18.2	13.5	2.3	*	0.024	0.012	re-run after PM

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	C-3	Reported	0.04	0.4	2.5	18.2	13.3	2.3	0.25	0.023**	0.013**	
CAF	C-3	Cast on sample	*	0.6	1.9	18.0	13.3	2.4	*	0.027	0.010	
WC	C-3	Cast on sample	0.06	0.6	1.6	18.3	13.7	2.4	0.24	0.029	0.009	
CAF	C-3	Cast on sample	*	0.6	1.6	18.1	13.5	2.4	*	0.028	0.011	re-run after PM

Test Heat poured 1/14/04

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	24424	Button	0.05	0.4	2.8	18.1	12.9	2.2	0.27	0.020	0.010	
CAF	24424	Keel bar	*	0.4	2.2	18.2	13.2	2.2	*	0.018	0.010	re-run after PM

* not analyzed by spectrometer.
** analyzed by wet chemistry.
For C-5 C and N were analyzed at CAF and at WC by Leco Analyzer, P+S analyzed on spectrometer.

MetalTek INTERNATIONAL

Addendum to CA1323 9-30-05

This is to supplement and report our progress on this corrective action.

We have discussed the variation in reading the Mn levels with the service technician and the spectrometer manufacturer. No new information has been obtained to explain the differences in reading Mn levels.

The chemistry for the shims poured from heat 29198 has been analyzed and is added to the spreadsheet attached. It shows similar readings for Mn.

The chemistry for the C-6 coil is also added to the spreadsheet. We aimed for higher Mn at the furnace to assure the higher Mn levels. The results indicate the effort was successful.

Update as to action steps:
Create a type standard that closely matches the Mn in CF8MNMNMOD.
Completed at WC and has been sent to another laboratory.
Request a revision to the chemistry range for Mn. (propose widening of Manganese since it has been proven to be effective at much lower concentrations than previously thought).
Pending.
Have each heat of CF8MNMNMOD verified independently for balance of program.
Complete for all coils to date.

C. Ruud

CC: Jim Galaske, Barry Craig, Joe Edwards, E.J. Kubick

Chemistry Check with WISCO			Revised 9-30-05			Information in blue added 9-30-05						
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
Heat #29198 for 5 C and 6 A shims												
CAF	29198	Reported 9/24/05	0.07	0.7	2.97	18.1	13.12	2.45	0.255	0.013**	0.01**	
CAF	29198	Separate Test bar	*	0.8	2.7	18.2	13.2	2.4	*	0.025	0.011	re-run after PM
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-6,I-1	Button #1	0.04	0.3	2.5	18.2	13.5	2.4	0.25	0.028	0.010	run after PM
CAF	C-6,I-1	Button #2	*	0.2	2.4	18.1	13.6	2.4	*	0.037	0.012	run after PM
WC	C-6,I-1	Button #2	0.03	0.2	2.4	17.9	13.7	2.5	0.26	0.028	0.010	
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-6,I-3	Button #1	0.04	0.4	2.4	18.2	13.4	2.3	0.25	0.034	0.011	run after PM
CAF	C-6,I-3	Button #2	*	0.4	2.4	18.2	13.7	2.3	*	0.033	0.012	run after PM
WC	C-6,I-3	Button #2	0.03	0.4	2.2	17.9	13.6	2.4	0.25	0.028	0.013	
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-6,I-6	Button #1	0.04	0.4	2.6	18.3	13.4	2.4	0.26	0.031	0.010	run after PM
CAF	C-6,I-6	Button #2	*	0.4	2.5	18.2	13.7	2.4	*	0.031	0.013	run after PM
WC	C-6,I-6	Button #2	0.04	0.4	2.4	18.2	13.7	2.4	0.26	0.030	0.014	
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-6,Z-3	Cast on sample	*	0.6	1.7	18.1	13.6	2.4	*	0.031	0.012	run after PM
WC	C-6,Z-3	Cast on sample	0.04	0.6	1.7	17.8	13.8	2.4	0.26	0.025	0.011	
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-5,I-1	Button #1	0.05	0.3	2.6	18.1	13.4	2.4	0.26	0.023	0.011	
CAF	C-5,I-1	Button #2	0.05	0.4	2.6	18.0	13.4	2.6	0.26	0.026	0.013	
WC	C-5,I-1	Button #2	0.02	0.3	2.2	18.2	13.5	2.4	0.25	0.025	0.010	
STL Wet	C-5,I-1	Button #1			2.2							
CAF	C-5,I-1	Button #1	*	0.3	2.3	18.3	13.4	2.4	*	0.029	0.012	re-run after PM
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-5,I-3	Button #1	0.05	0.4	2.2	17.9	13.4	2.5	0.24	0.033	0.012	
CAF	C-5,I-3	Button #2	0.05	0.4	2.2	17.9	13.2	2.4	0.24	0.033	0.012	
WC	C-5,I-3	Button #2	0.05	0.4	1.8	18.2	13.4	2.5	0.23	0.034	0.018	
STL Wet	C-5,I-3	Button #1			1.8							
CAF	C-5,I-3	Button #1	*	0.4	1.8	18.3	13.3	2.5	*	0.034	0.012	re-run after PM
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-5,I-6	Button #1	0.05	0.3	2.4	18.1	13.2	2.4	0.25	0.030	0.012	
CAF	C-5,I-6	Button #2	0.05	0.3	2.4	18.1	13.2	2.4	0.25	0.029	0.011	
WC	C-5,I-6	Button #2	0.04	0.3	2	18.3	13.3	2.4	0.24	0.031	0.018	
STL Wet	C-5,I-6	Button #1			1.9							
CAF	C-5,I-6	Button #1	*	0.3	2.0	18.4	13.3	2.4	*	0.033	0.012	re-run after PM
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	A-1	Reported	0.04	0.4	2.4	18.2	13.3	2.4	0.26	*	*	
CAF	A-1	Cast on sample	*	0.5	2.1	18.0	13.4	2.4	*	0.034	0.009	
WC	A-1	Cast on sample	0.06	0.6	1.6	18.1	13.7	2.4	0.25	0.027	0.009	
CAF	A-1	Cast on sample	*	0.6	1.6	18.2	13.5	2.4	*	0.028	0.009	re-run after PM
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-4	Reported	0.04	0.4	2.5	18.2	13.2	2.2	0.26	.030**	.014**	
CAF	C-4	Cast on sample	*	0.6	1.9	17.9	13.5	2.3	*	0.037	0.013	
WC	C-4	Cast on sample	0.04	0.6	1.5	17.8	13.6	2.4	0.25	0.030	0.012	
CAF	C-4	Cast on sample	*	0.6	1.4	18.2	13.6	2.4	*	0.031	0.009	re-run after PM
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-1	Reported	0.06	0.5	2.7	18.1	13.1	2.2	0.27	0.013**	0.014**	
CAF	C-1	Cast on sample	*	0.7	2.2	18.1	13.1	2.2	*	0.021	0.010	
WC	C-1	Cast on sample	0.06	0.7	1.8	18.3	13.4	2.4	0.24	0.021	0.014	
CAF	C-1	Cast on sample	*	0.7	1.9	18.3	13.2	2.4	*	0.024	0.013	re-run after PM
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	C-2	Reported	0.06	0.5	2.8	18.0	13.2	2.3	0.26	0.023**	0.018**	
CAF	C-2	Cast on sample	*	0.8	2.2	18.1	13.4	2.2	*	0.030	0.012	
WC	C-2	Cast on sample	0.07	0.9	1.6	18.2	13.7	2.2	0.23	0.023	0.014	
CAF	C-2	Cast on sample	*	0.8	1.6	18.2	13.5	2.3	*	0.024	0.012	re-run after PM

Lab	I.D.	Sample	C	Si	Mn	Cr	Ni	Mo	N	P	S	
CAF	C-3	Reported	0.04	0.4	2.5	18.2	13.3	2.3	0.25	0.023**	0.013**	
CAF	C-3	Cast on sample	*	0.6	1.9	18.0	13.3	2.4	*	0.027	0.010	
WC	C-3	Cast on sample	0.06	0.6	1.6	18.3	13.7	2.4	0.24	0.029	0.009	
CAF	C-3	Cast on sample	*	0.6	1.6	18.1	13.5	2.4	*	0.023	0.011	re-run after PM
Test Heat poured 1/14/04												
Lab	**I.D.**	**Sample**	**C**	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**P**	**S**	
CAF	24424	Reported	0.054	0.4	2.8	18.1	12.94	2.21	0.27	0.020	0.010	
CAF	24424	Keel bar	*	0.4	2.2	18.2	13.2	2.2	*	0.013	0.010	re-run after PM
* not analyzed by spectrometer.												
** analyzed by wet chemistry.												
For C-5 and C-6 - C and N were analyzed at CAF and at WC by Leco Analyzer, P+S analyzed on spectrometer.												

Subsequent immediate analysis of chemistry results, obtained by wet analysis, is attached and demonstrate top of specification for sulfur and over specification for phosphorus. The spectrometer manufacturer has performed an analysis to determine the cause of the malfunction and verified that the intensity card has an intermittent fault and must be replaced. The card has been ordered and scheduled for replacement on August 15, 2005.
Until the card is replaced we will be performing additional type standardizations to ensure accurate sulfur and phosphorus analysis. Additionally, for coils made until the card is replaced, an independent laboratory will perform a verification of the chemical analysis.

Verification of Corrective Action
Will be determined at a later date.

Preventive Action
In addition to spectrometer faults, we have identified that the specification ranges for sulfur and phosphorus is unattainable. Analysis and specifications for virgin charge materials predict sulfur at 0.040% maximum and phosphorus at 0.040% maximum. We have no way to remove phosphorus from the melt and do not intentionally add phosphorus. So, the confirmed coil analyses, along with analyses of virgin material heats, demonstrate sulfur in the range of 0.010% to 0.022% and phosphorus in the range of 0.018% to 0.033%. These results are consistent with our charge material analysis. We will request a deviation for phosphorus in the subject parts and also request a permanent specification change to 0.040% maximum for both phosphorus and sulfur, to allow us to provide non-discrepant material. This change will not affect, in any way, the physical properties or material performance because all coils and test material exhibited sulfur and phosphorus within the new ranges despite inaccurate reporting.
Other actions: Specifications have been added to the BS 180 standard and the type standard will be measured against the criteria.

Estimated Completion Date
August 15, 2005

Actual Completion Date TBD

Signed: C. Ruud 

CC: Jim Galaske, Barry Craig, Joe Edwards, E.J. Kubick

Guide to St Louis Testing Report Dated 7-26-05

Sample name	Sample origin
A1Z1	Cast on bar A-1 coil, zone 1
A1Z2	Cast on bar A-1 coil, zone 2
A1Z3	Cast on bar A-1 coil, zone 3
C1	Cast on bar C-1 coil
C2Z1	Cast on bar C-2 coil, zone 1
C2Z2	Cast on bar C-2 coil, zone 2
C2Z3	Cast on bar C-2 coil, zone 3
C3Z1	Cast on bar C-3 coil, zone 1
C3Z2	Cast on bar C-3 coil, zone 2
C3Z3	Cast on bar C-3 coil, zone 3
F1	Final analysis button from ladle for C-4 coil
F2	Final analysis button from ladle for C-4 coil
F3	Final analysis button from ladle for C-4 coil
P1	Preliminary analysis button from ladle for C-4 coil

Testing is underway of the heat used to pour the four C coil and six A coil shims.

Attachment 40
CA 1323

Founded 1929 **St. Louis Testing Laboratories** INCORPORATED

Chemical, Metallurgical, Mechanical, Nondestructive, Environmental Testing, Analyses and Field Service

July 26, 2005
Lab No. 05C-0608
Invoice No. 59891
P.O. No. 21324
Page 1 of 1

METALTEK INTERNATIONAL
8600 Commercial Blvd.
Pevely, MO 63070

Attention: Chuck Ruud

REPORT OF CHEMICAL ANALYSIS

SAMPLE ID: A1 Z1, A1 Z2, A1 Z3, C1, C2 Z1, C2 Z2, C2 Z3, C3 Z1, C3 Z2, C3 Z3, F1, F2, F3, P1

RESULTS: %

ANALYTE	A1Z1	A1Z2	A1Z3
Sulfur	.013	.005	.010
Phosphorus	.025	.023	.018

ANALYTE	C1	C2Z1	C2Z2	C2Z3
Sulfur	.014	.022	.018	.015
Phosphorus	.018	.024	.021	.025

ANALYTE	C3Z1	C3Z2	C3Z3
Sulfur	.013	.014	.012
Phosphorus	.024	.025	.021

ANALYTE	F1	F2	F3	P1
Sulfur	.014	.015	.012	.010
Phosphorus	.029	.033	.028	.030

Sulfur Test Method: ASTM E1019-03

Phosphorous Test Method: Colormetric

Identification of tested specimen provided by the client.

Robin E. Sinn
Laboratory Director

RES/nmc

MetalTek International
Carondelet Division - CA / PA / RGA Database

Corrective Action 1324

Corrective Action Type FOR CASTING DISCONTINUITIES
Date 7/18/2005
CA Originator C. Ruud

Pattern Number: A-1 Coil

Description of Defect / Non-Conformance
98 major weld defects found in the A-1 coil casting.

Root Cause : Casting defects primarily due gas and shrink.

Corrective Action: Weld upgrade A1 casting. Welding will be performed following the approved procedure FOR WELDS <2" - WPS 10-SMAW-CF8MNMN MOD REV 1. FOR WELDS <8" - WPS 15-GMAW-CF8MNMN MOD REV 2.

Verification of Corrective Action: All repairs will be verified by the inspection method used to discover the original defect.

Preventive Action: We will use the xray information from the A1 casting to determine if changes are required to the tooling.

Verification Of Preventative Action: Radiograph A-2 coil and compare results.

Estimated Implementation Date: Prior to shipment.

Signed: CA Ruud

CC: EIO, Barry Craig, Joe Edwards, E.J. Kubick, Geoff Mergel, File

Disposition for CA 1324: Perform weld upgrades per MTM procedures.

Approved:

Tech. Representative Phil Heitzenroeder 2005.08.25 16:20:38 -04'00'

RLM Brad Nelson

Digitally signed by Brad Nelson
DN: cn=Brad Nelson, c=US, o=ORNL, ou=FED, email=nelsonba@ornl.gov
Date: 2005.08.25 17:23:22 -04'00'

MetalTek INTERNATIONAL

Corrective Action 1347
Carondelet Division - CA / PA / RGA Database
Corrective Action Type NCR
Date 8/1/2005
CA Originator C. Ruud
Applies to: A-1Coil

Description of Defect / Non-Conformance
Wall thickness below model minimum. Localized areas were measured below the 1.375" minimum wall thickness during metrology. MetalTek independently verified wall thickness and confirmed condition.

Root Cause
Cannot be determined at this time. Under evaluation.

Corrective Action
Request "Use As Is" disposition on wall thickness related dimensions on A-1 coil.

Verification of Corrective Action
Not required. PPPL independently verified in conjunction with ORNL the design performance at a wall thickness of 1.05". Results were deemed adequate. Minimum measured dimension is 1.18" (to be verified).

Preventive Action
Several steps need to be taken to resolve and propose:

1. Validation of 3D Scanco data. MetalTek proposes to use Romer Arm with Laser scanner as validation technique. This instrument will be used to validate subsequent parts and minimizes measurement technique error. Date TBD.
2. Report to PPPL/ORNL. Understanding the concern that the wall not be thinner than measured and the limitations of the process, e.g. setting a large core into a mold with overhead crane, MetalTek will submit layout results to EIO wand set teleconference to review remediations to tool. Date TBD.
3. Upon verification of 3D Scanco data, MetalTek will confirm results to EIO team to begin root cause determination. Additional layout may be required to assure compliance of tooling, depending on results of layout. Date TBD.
4. Modification to tooling. Limited tooling modifications may be performed without severely impacting schedule or negating previous engineering (solidification modeling, etc.). These will be evaluated and proposed, where appropriate.
5. Permanent deviation. Based on results of above, a permanent deviation may be required to dimensional tolerances in limited areas of the component. These will be known in greater detail later.

Estimated Completion Date TBD

Actual Completion Date TBD

Signed: C. Ruud 

CC: Roger Broman, Barry Craig, Joe Edwards, E.J. Kubick

NCSX Disposition to CA 1347

Analyses were performed to determine the effect of the thin section on deflections and stresses and are summarized below.

- Thin shell areas like that of A1 **has an extremely minor affect on the stresses and displacements in ANY of the coils or shells** with the thickness being either 1.18" as for A1 or even with the thickness being 1.05" which MTK projects is the minimum if the shell is not changed. Reasons:
  a) The shape of the tee is not changed by this, and the tee provides most of the bending stiffness
  b) Some EM forces are transferred to the shell B from the wing.
  c) The thin wall region is not the location for the peak stress and much of the area will be machined away.

		Shell Type A		Coil Type A		All Coils	
Run #	Configuration	Max. Displacement - mm	Max. Stress - Mpa	Max. Displacement - mm	Max. Stress - Mpa	Max. Displacement - mm	Max. Stress - Mpa
1	Baseline	0.98	168	1.246	239	2.711	239
5	Updated E	1.17	160	1.513	248	2.934	248
6	Updated E; thin sect. =1.18"	1.169	161	1.516	249	2.984	249
4	Updated E; thin sect. =1.05"	1.168	161	1.517	248	2.971	248

Since the effect has been shown to be extremely minor, the disposition for the A1 winding form is **Accept As Is.**

However, since the root cause determination is still underway, this NCR should be kept open. It is requested that EIO re-issue an amended CA with the root cause determination and preventive action; PPPL will disposition that portion of the NCR at that time.

Approved:

Phil Heitzenroeder
2005.08.19 14:10:46 -04'00'

P. Heitzenroeder, Tech. Rep.

Brad Nelson

Digitally signed by Brad Nelson
DN: cn=Brad Nelson, c=US, o=ORNL, ou=FED, email=nelsonbe@ornl.gov
Date: 2005.08.19 16:56:28 -04'00'

B. Nelson, RLM

Corrective Action 1371
Carondelet Division - CA / PA / RGA Database
Corrective Action Type NCR
Date 8/23/2005
CA Originator R. Suria
Applies to: A-1Coil

Description of Defect / Non-Conformance

Lack of fusion and porosity in weld repairs were observed during radiography of the R-2 through R-6 x-ray confirmation shots.

Root Cause
Porosity was caused by the use of fans in the welding booth. Lack of fusion was the result of poor operator technique and or fatigue. Some repair loops resulted from the original defects not fully being removed during excavation.

Corrective Action
Unplug fans during GMAW welding. Reviewed proper GMAW gun angles and excavation techniques with the welders.

Verification of Corrective Action
Re x-ray the defective welds.

Estimated Completion Date
8/31/05

Actual Completion Date
8/31/05

Signed: R. Suria RS

CC: Barry Craig, Joe Edwards, E.J. Kubick

Carondelet Division

8600 Commericial Blvd. - Pevely, MO 63070 USA
Phone: 636-479-4499 - Fax: 636-479-3399

Final Inspection Report

Customer Name: ENERGY INDUSTRIES OF OHIO

Pattern: MCWF-A1 COIL

Order Number: PPPL-FP-LTS-2

ASTM Metal CF8MNMN MOD

Date 8/30/2005

Type Description	Cert Number	Procedure	Acceptance Criteria	Actual
Liquid Penetrant	169470-1	CQP - 300 Rev 9	SEE NOTE	Acceptable
Notes Acceptance per ASTM A903. Acceptance criteria - level 1 for high stressed areas, level 2 for all other areas.				
Mag Perm	169470-1	SOP Mag Perm 100 Rev 1	<1.02	Acceptable
Radiographic	169470-1	Technique # 12726	MSS SP 54	Acceptable
Visual	169470-1	CQP - 500 REV 4	ASTM A802 LEVEL 2	Acceptable

Liquid Penetrant
Visual

Technician: Kevin Anderson

ASNT Level II

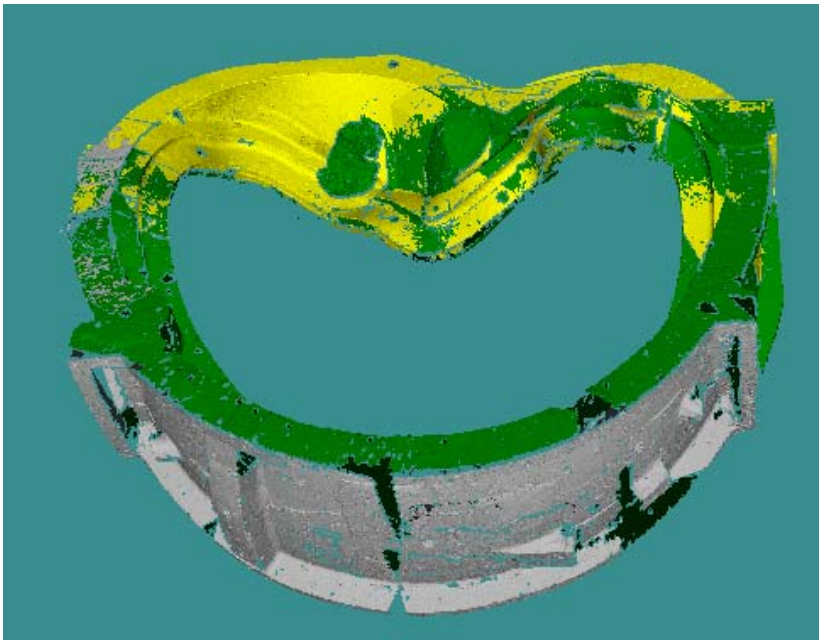
Respectfully Submitted,
Charles A. Ruud
Quality Assurance Manager

December 28, 2005

Project # 0412
Fusion Chamber Castings
A Casting

Tim Wenninger
Project Manager
Lawton Pattern Division
1950 De Pere, WI 54115
timw@calawton.com
920-983-4053

This letter is intended to document a tolerance loss observed during dimensional inspection of an A casting and the corrective actions that were used to recover satisfactory tolerances. The tolerance loss occurred due to an unforeseen set of circumstances and Standard Operating Procedures will be updated to prevent future problems even in such a rare occurrence.



The castings were scanned in three separate "sessions" as shown in yellow, green, and gray. Each session was scanned using a Konica-Minolta 9i/PSC-1 measurement system ISO certified to +/-0.05mm (0.002in).

This system uses a widely accepted technique called Photogrammetry to establish the accuracy of the measurement session. Theoretically only 3 points are required to establish a reference system. When more than three points are used the redundancy allows the system to track error. For this part, over 300 reference markers were used.

Figure 1: The part was measured in 3 separate measurement sessions.

Each of the three major sessions shown above when considered independently is known to be within the accuracy capabilities of the system. The task of combining the separate measurement sessions typically relies on simply locking in overlapping data to lock in the separate sessions together. The unique geometries provide a 3d "lock and key" that ensures an accurate alignment.

The problem encountered on this casting occurred when trying to locate the bottom session (in grey above) relative to the main session (in green above). The main session was taken with the part resting on the floor such that the entire grey surface was not accessible as shown in Figure 2.

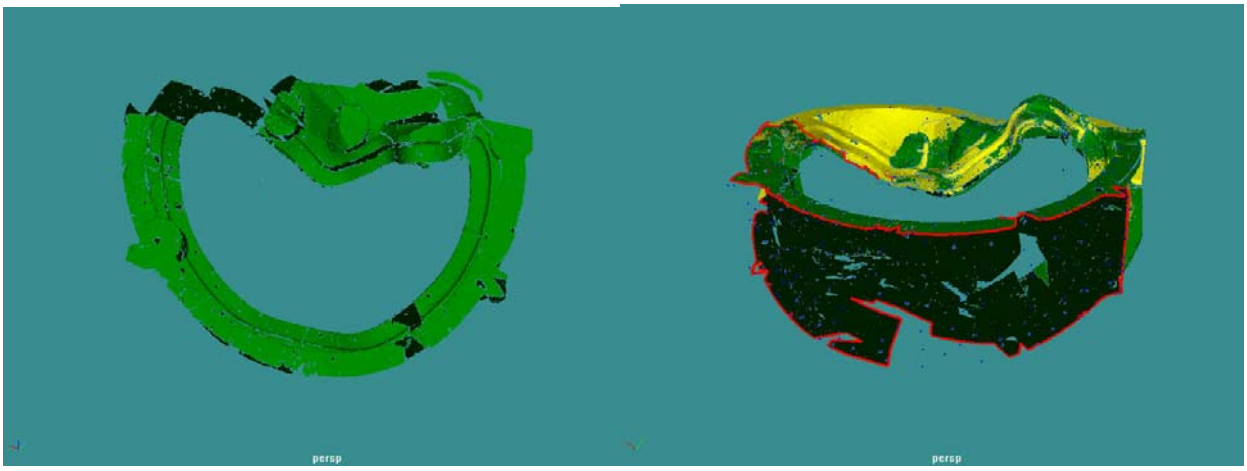


Figure 2: The main scan was performed with the part in an upright orientation. This left the underside of the part un-scanned since it was facing the floor.

Typically the goal is to get enough overlap between any two sessions so as to enable a tight lock between them, as shown between the yellow and green sessions in Figures 2 and 3. When the part was layed down to scan the bottom (grey side) the problem was that the edge of the scan almost exactly matched the edge of the green session. There was some overlap on the left side but the lack of overlap on the right side caused a misalignment to occur that resulted in the grey session not being placed properly and thus producing error in thickness calculations in that area. The fact that the outlines (shown in red) matched so closely is a rare occurrence that caused an unforeseen problem.

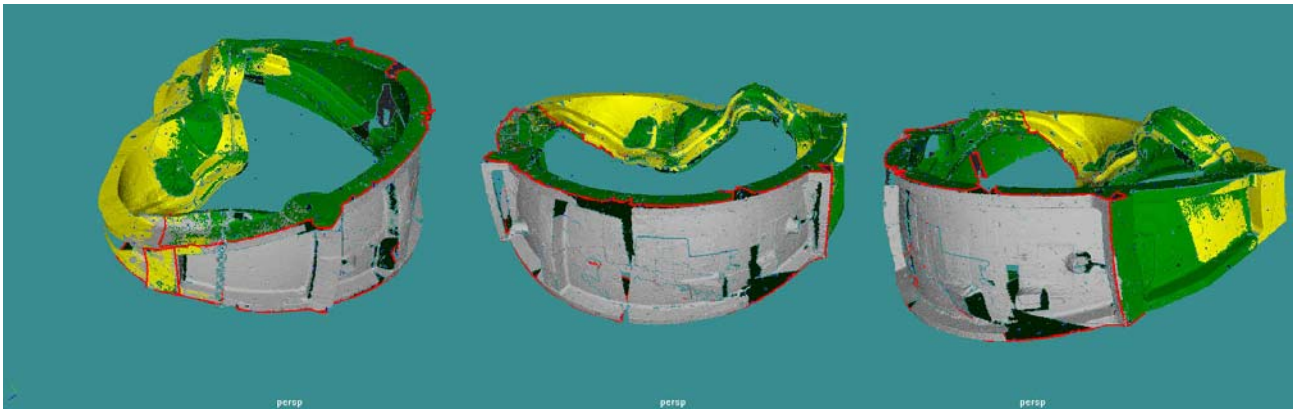


Figure 3: The edges of the green and grey sessions are shown in red.

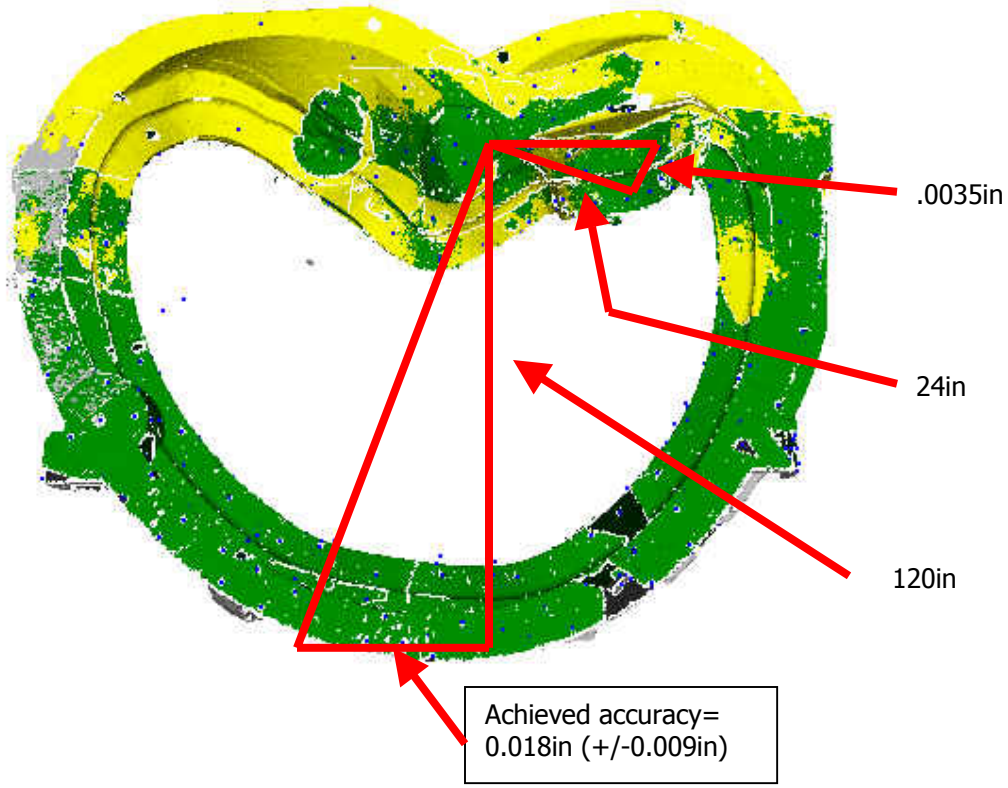
The Solution:

To rectify the problem, reference marks were recovered from the original data. The points circled in Figure 4 were captured in the background on the opposite side of the part. These reference marks were then able to be used to register the grey session to the green session. Not only did it provide a solution for aligning the two but it also provides an achieved accuracy result. The cluster of reference marks matched from grey to green sessions to within +/- 0.00175 inches! Unfortunately because there were no reference marks in common in the foreground of the grey scan and the fact that these reference marks are on the opposite side of the part, a lever arm effect must be accounted for to compensate for how a small error on the opposite side is magnified before it resolves on the foreground side.

Figure 4: A cluster of reference markers was fortunately recovered in the background of this scan.

Achieved Accuracy:

All three sessions independently remained within working tolerances during the scanning operation and thus the quoted system accuracy of 0.05mm (0.002in) applies. When considering the entire inspection as a whole, the largest error source is from this lever arm effect due to having to use reference marks from across the part. A conservative distance of 120in was used for the lever arm as the part can easily fit inside that distance. Similarly a conservative "platform width" of 24in was used to approximate the width of the "base" of the lever arm since the cluster of reference marks used is at least 24in in the narrowest area. Therefore the achieved accuracy when considering the fact that there is a lever arm effect comes to 120tan(sin^ -1(0.0035/24))=0.018in or +/-0.009in. Therefore the thickness measurements and all other measurements on the inspection should have tolerance of +/- 0.009in taken into consideration at all times. If that achieved accuracy is not sufficient, then it may be necessary to rescan in order to attempt to achieve a higher tolerance.



3dScanCo	
Project	0412
Measured by	Karol Hatzilias
Dates	6-7-05 & 7-5-05
Scanner Make	Konica Minolta
Scanner Model Number	9i
Scanner Serial Number	1001020
Scanner Last Calibrated	6-6-05
Scanner Cal Artifact	1001020
Photogrammetry Make	Konica Minolta
Photogrammetry Model	PSC-1
Photogrammetry Serial	7281026
Photogrammetry Last Cal	6-6-05 & 6-16-05
Photog Cal Artifact	7141013

Date: 7/7/2005 / Time: 7:30:05PM Length Unit: in

Source Filename: inspecting_01.mdl Angle Unit: deg

Whole Deviation Session

Type: **Surface Type**

Name: **Whole Deviation 2**

1st Reference Entity: scan_2_merge3_PGNOPG and scan_merge_02

2nd Reference Entity: 521 Surfaces

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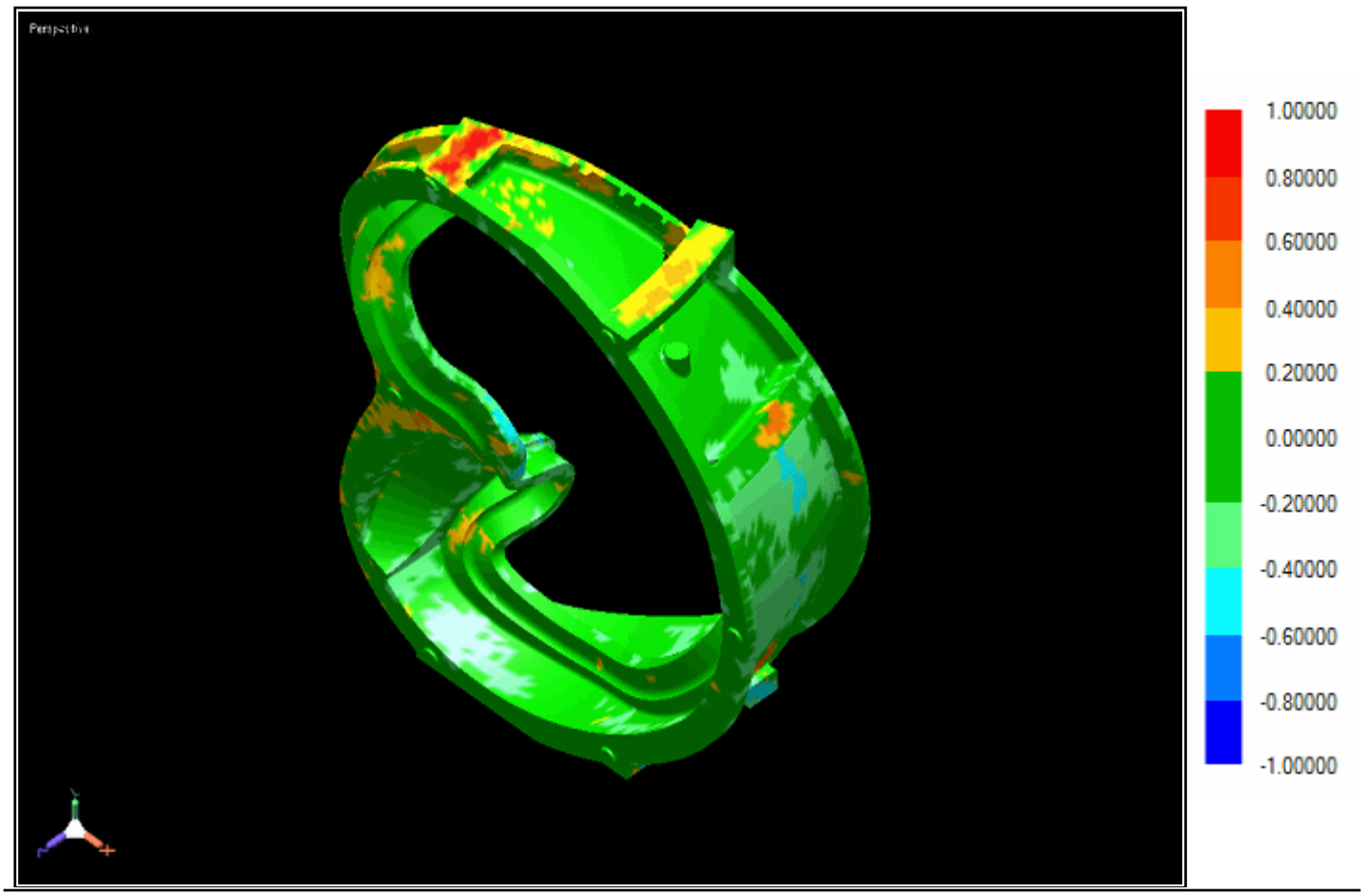
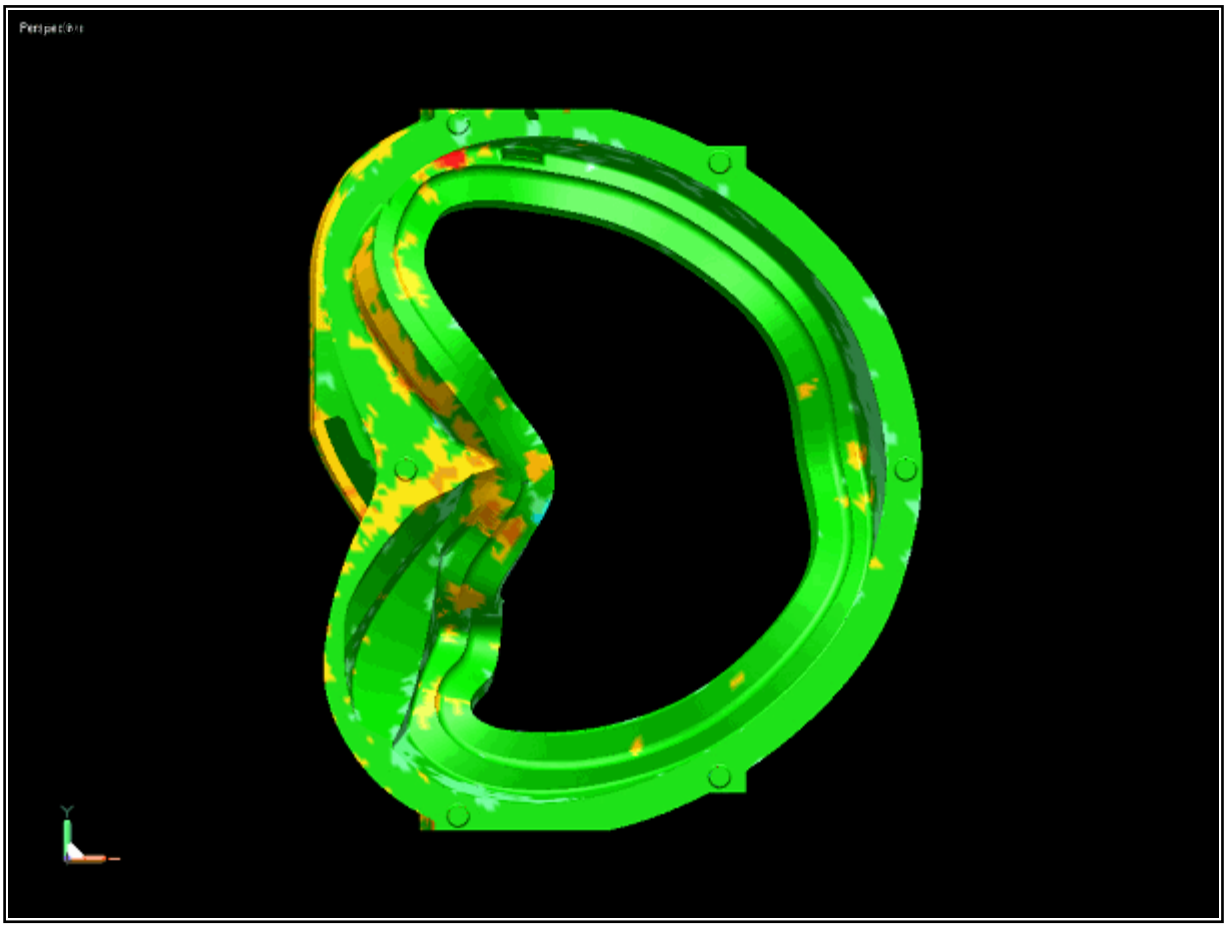
Maximum Range:	1.00000
Minimum Range:	-1.00000
Average:	-0.01692
Standard Deviation:	0.26034

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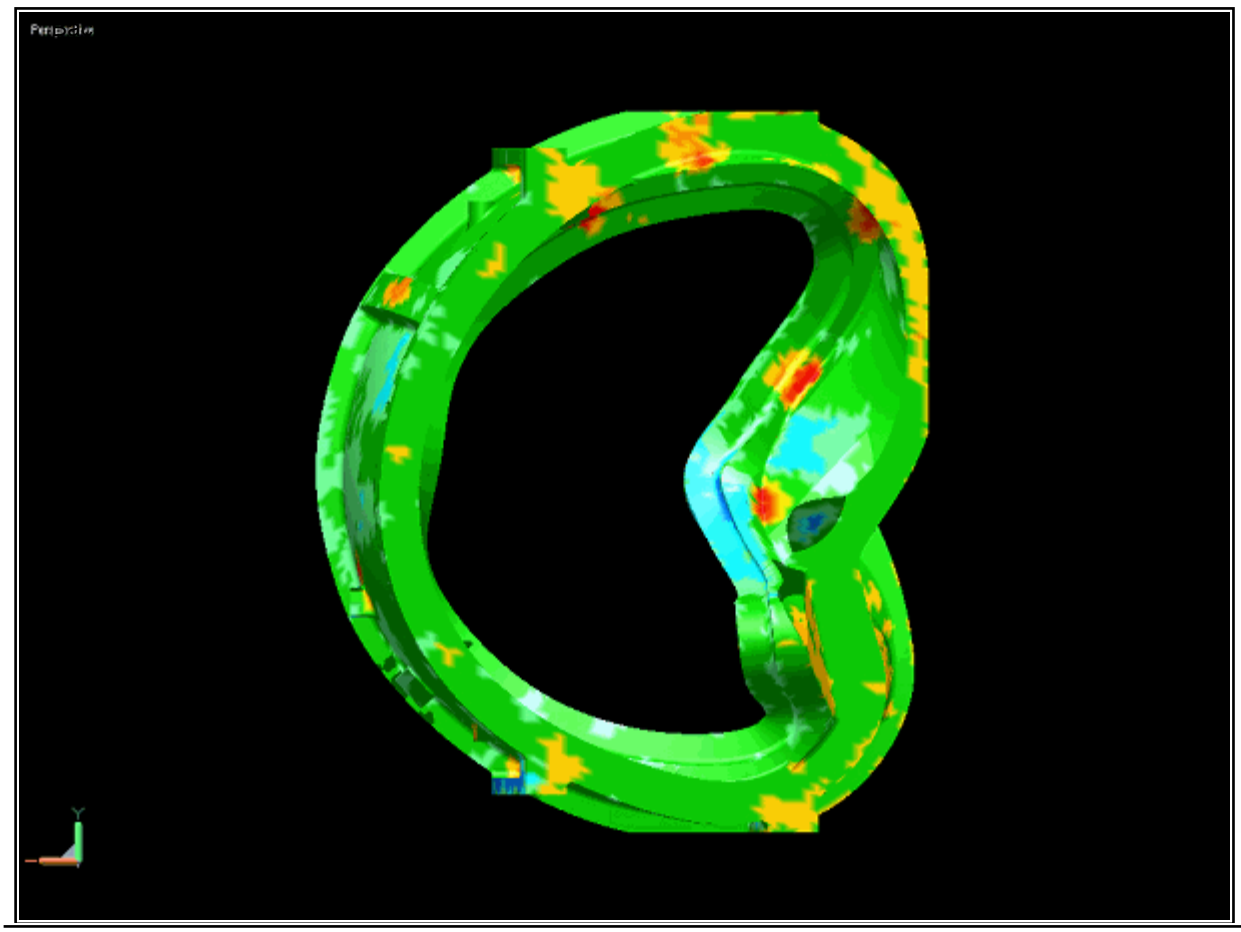
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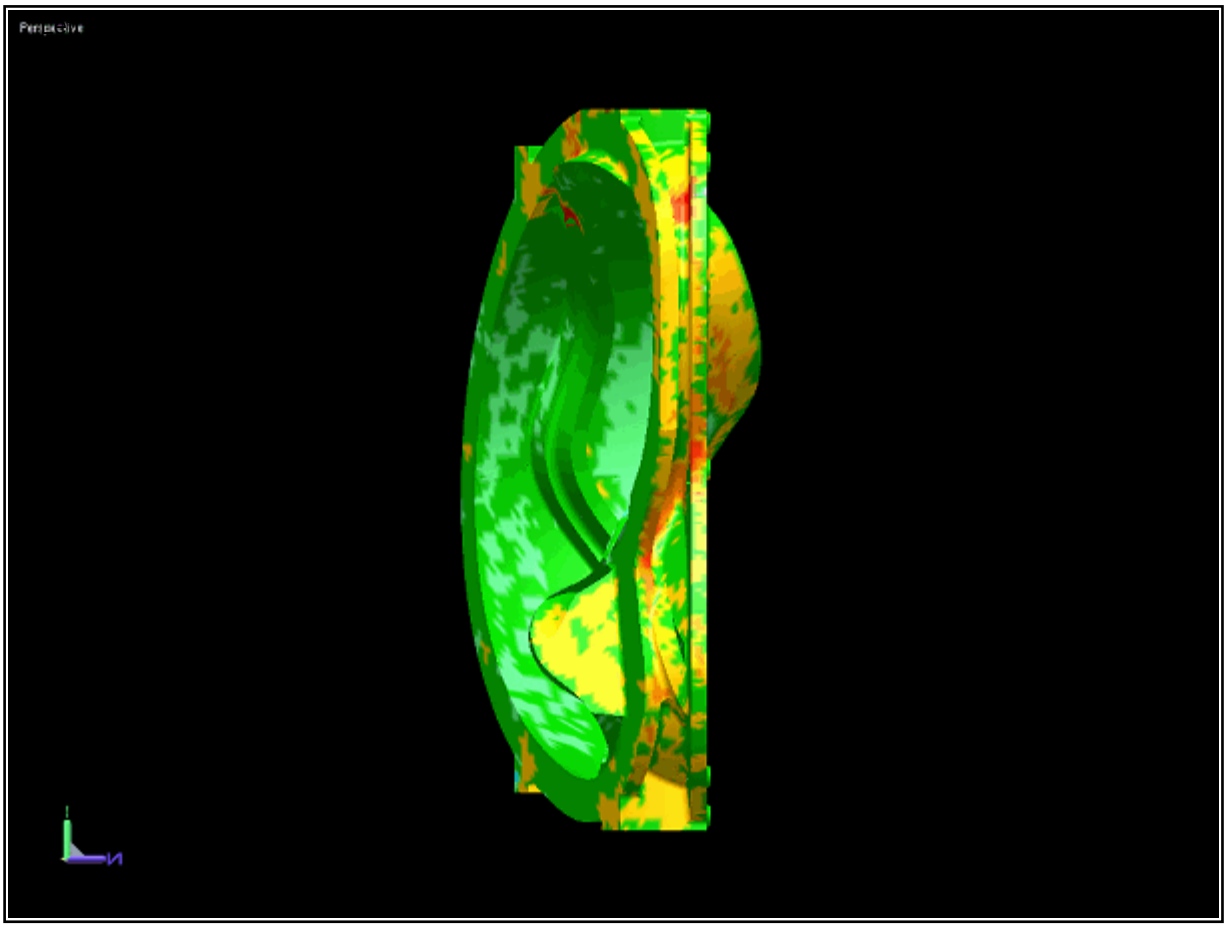
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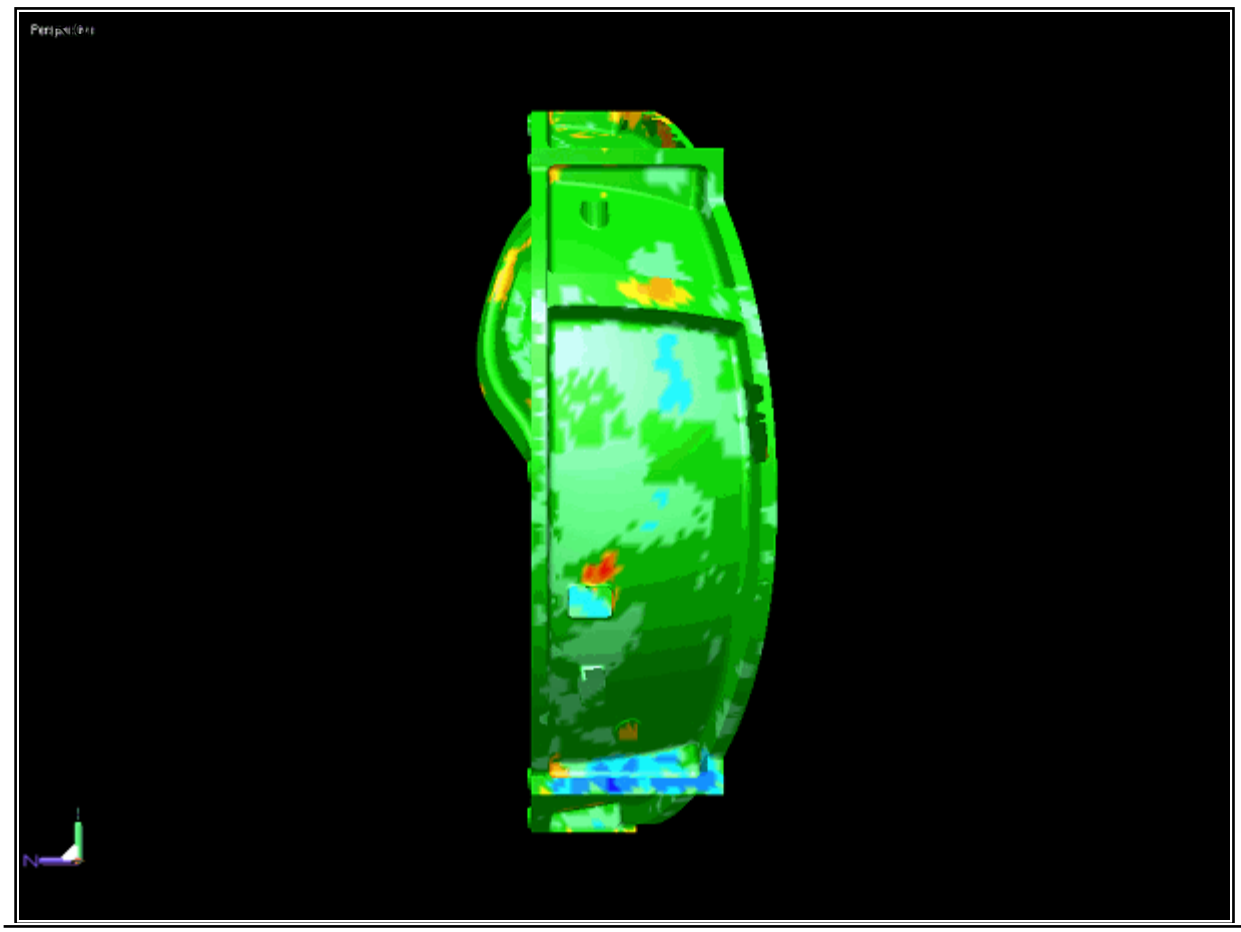
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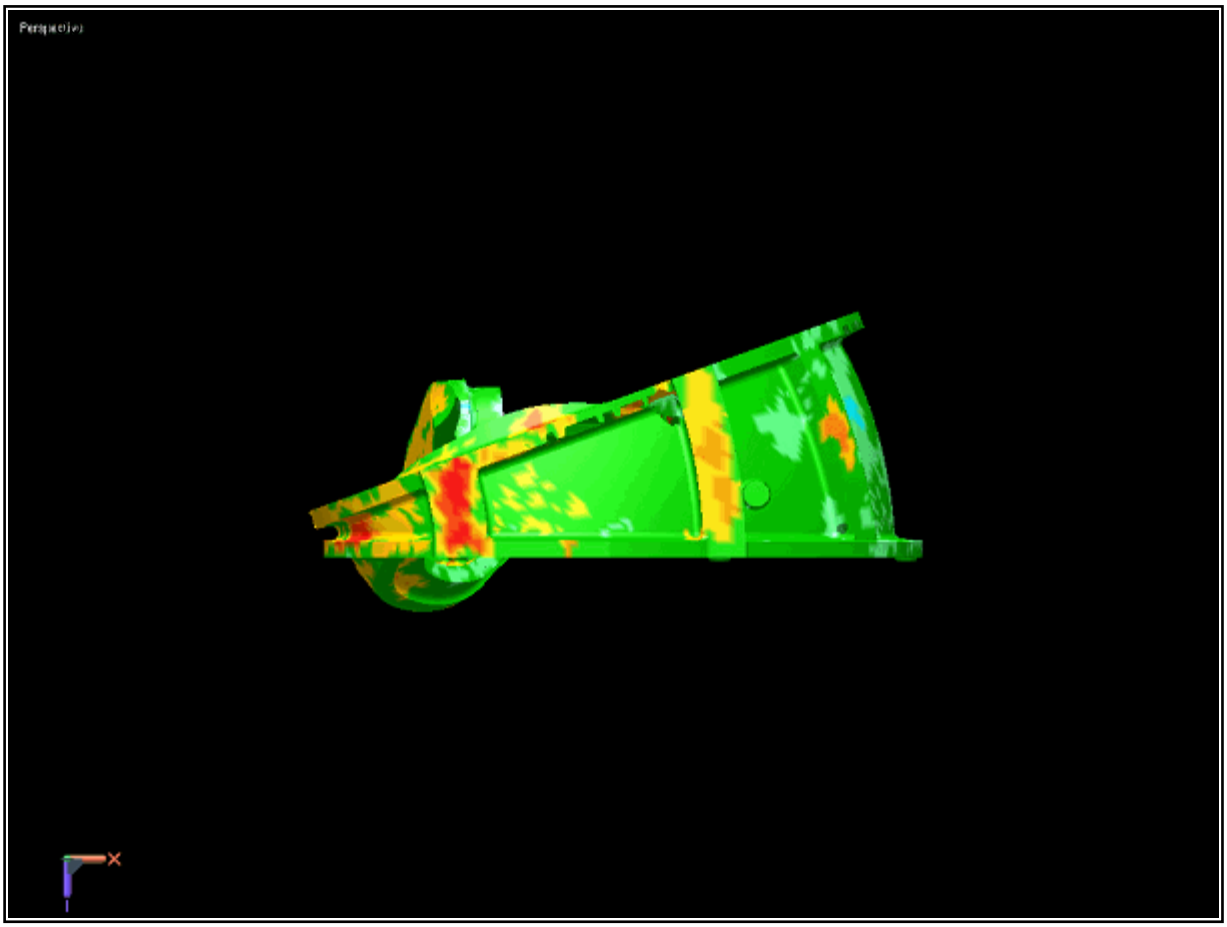
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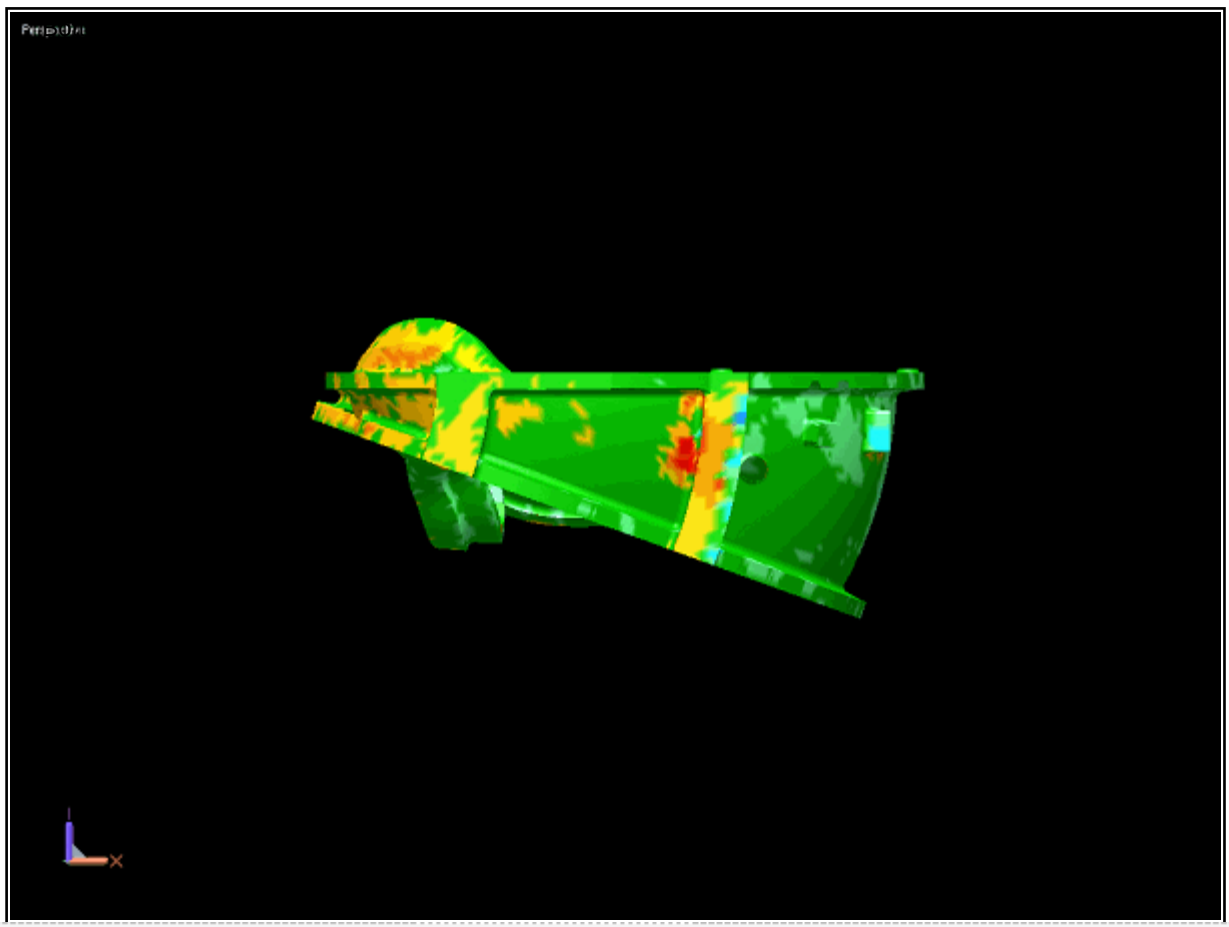
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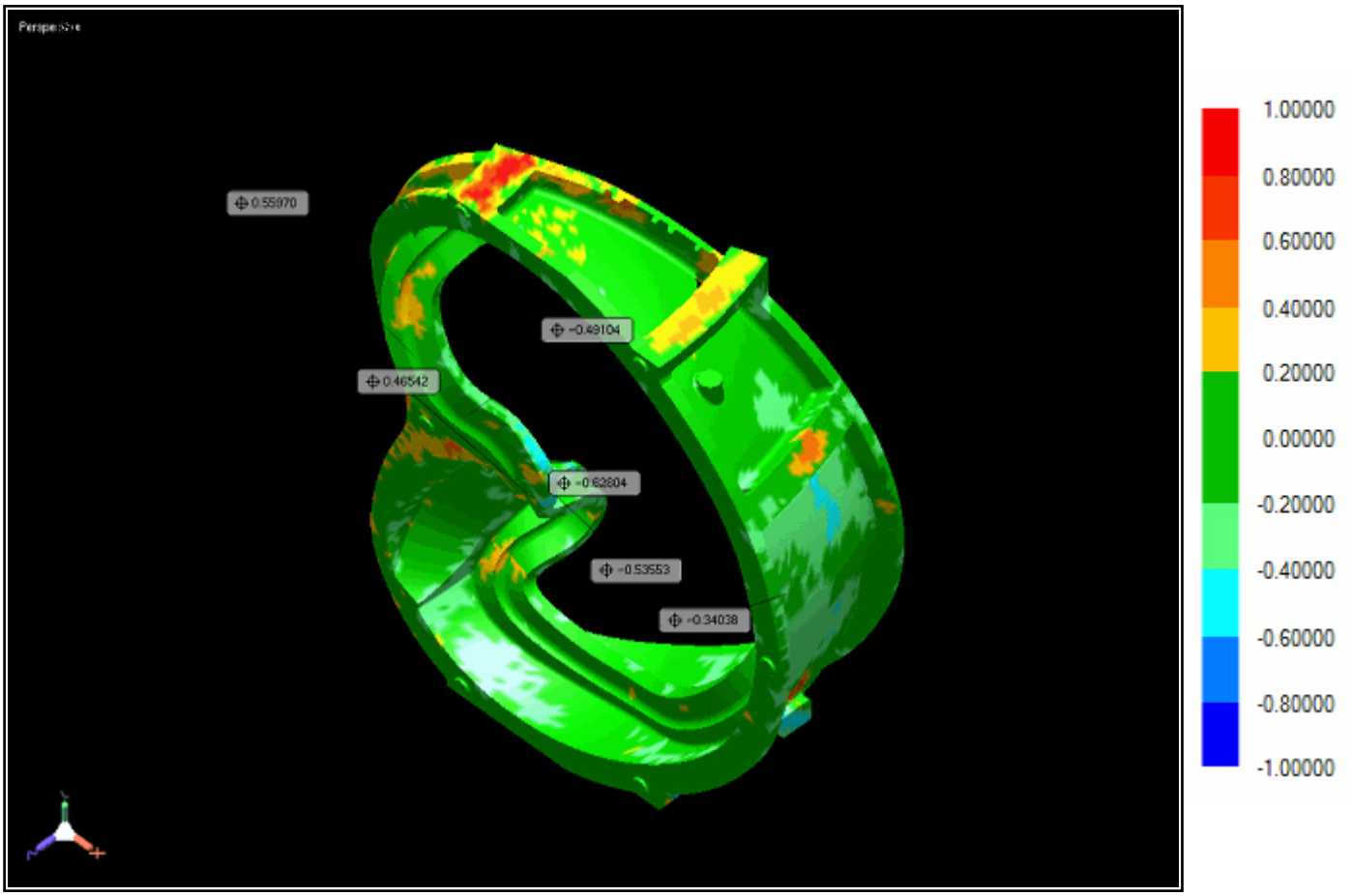
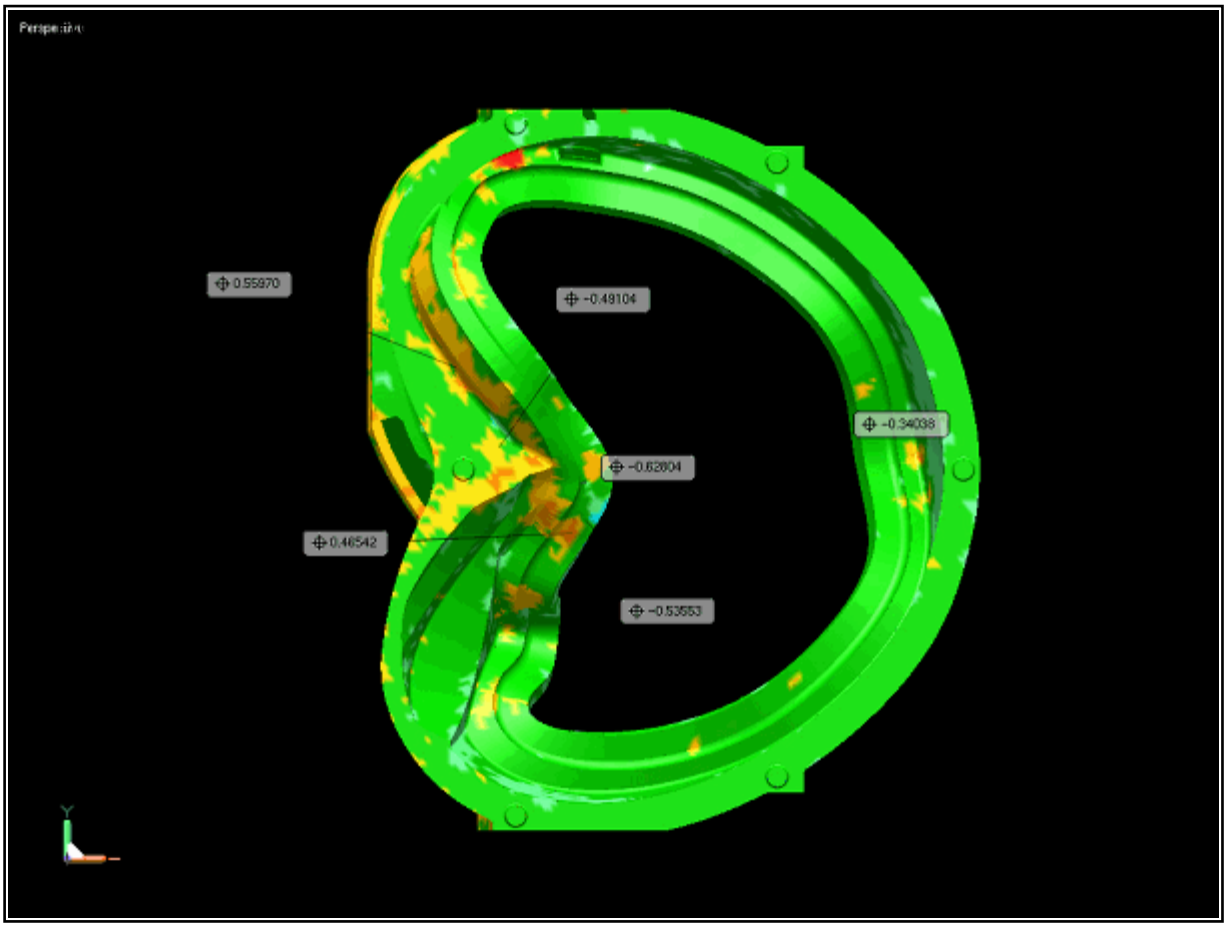
Annotation Session

Reference Whole Deviation Name: **Whole Deviation 2**

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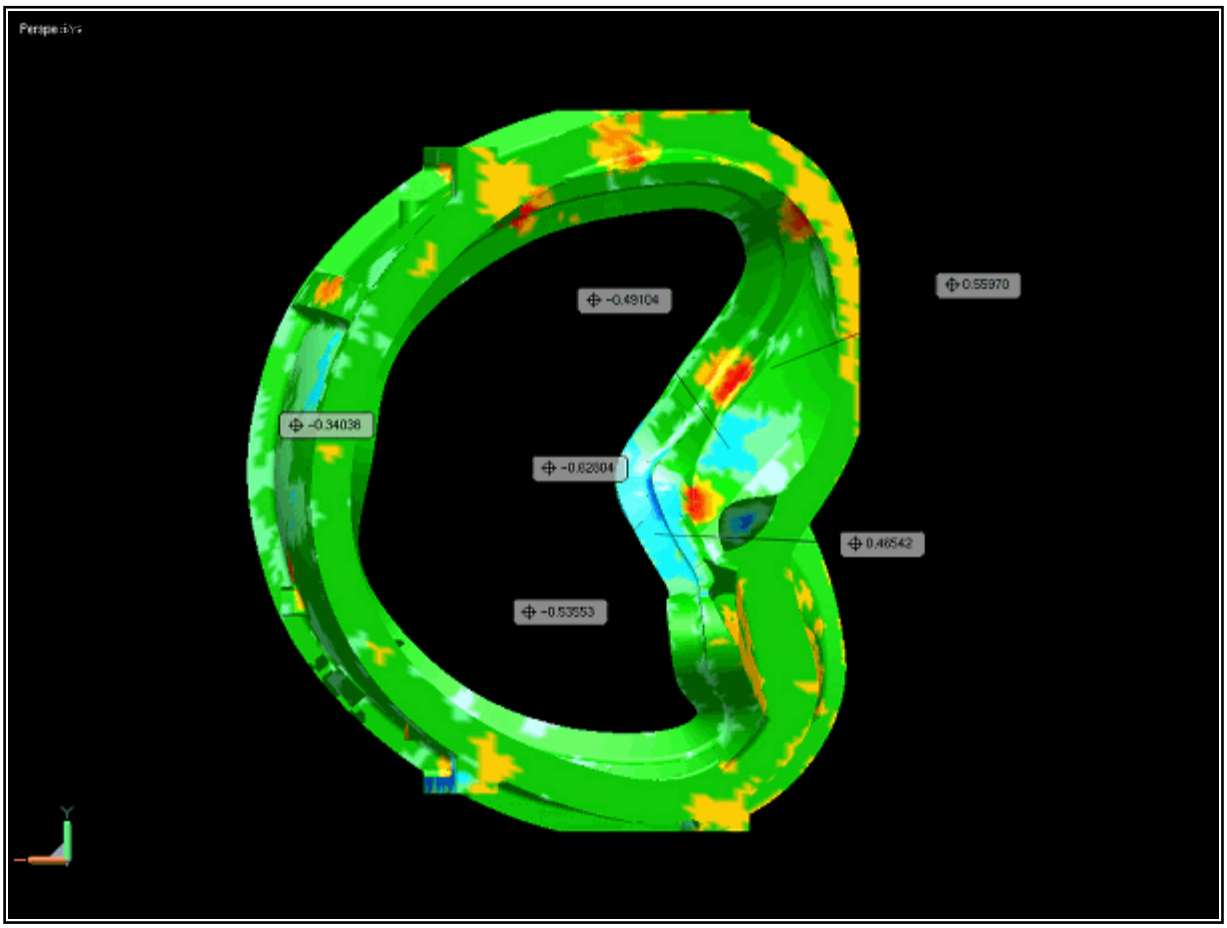
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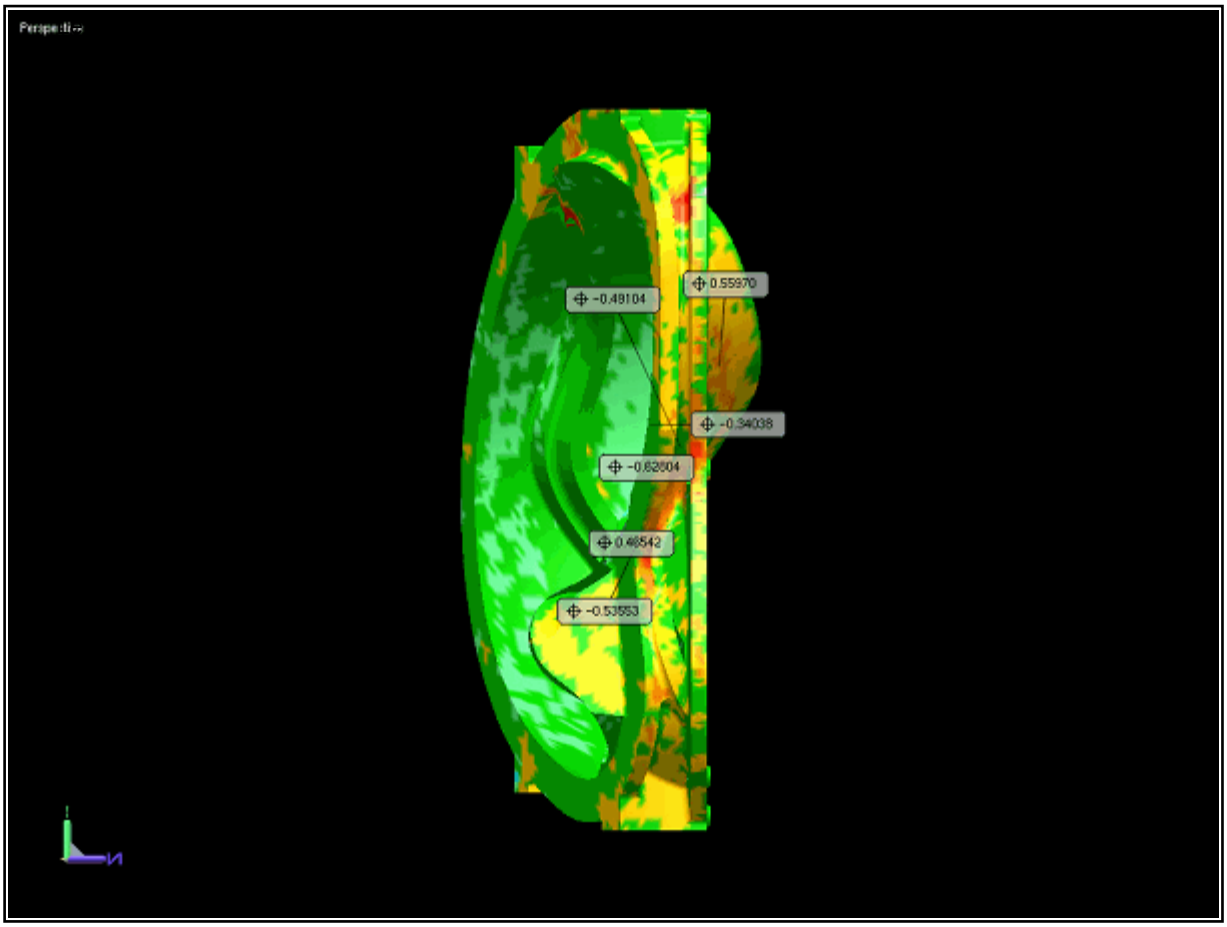
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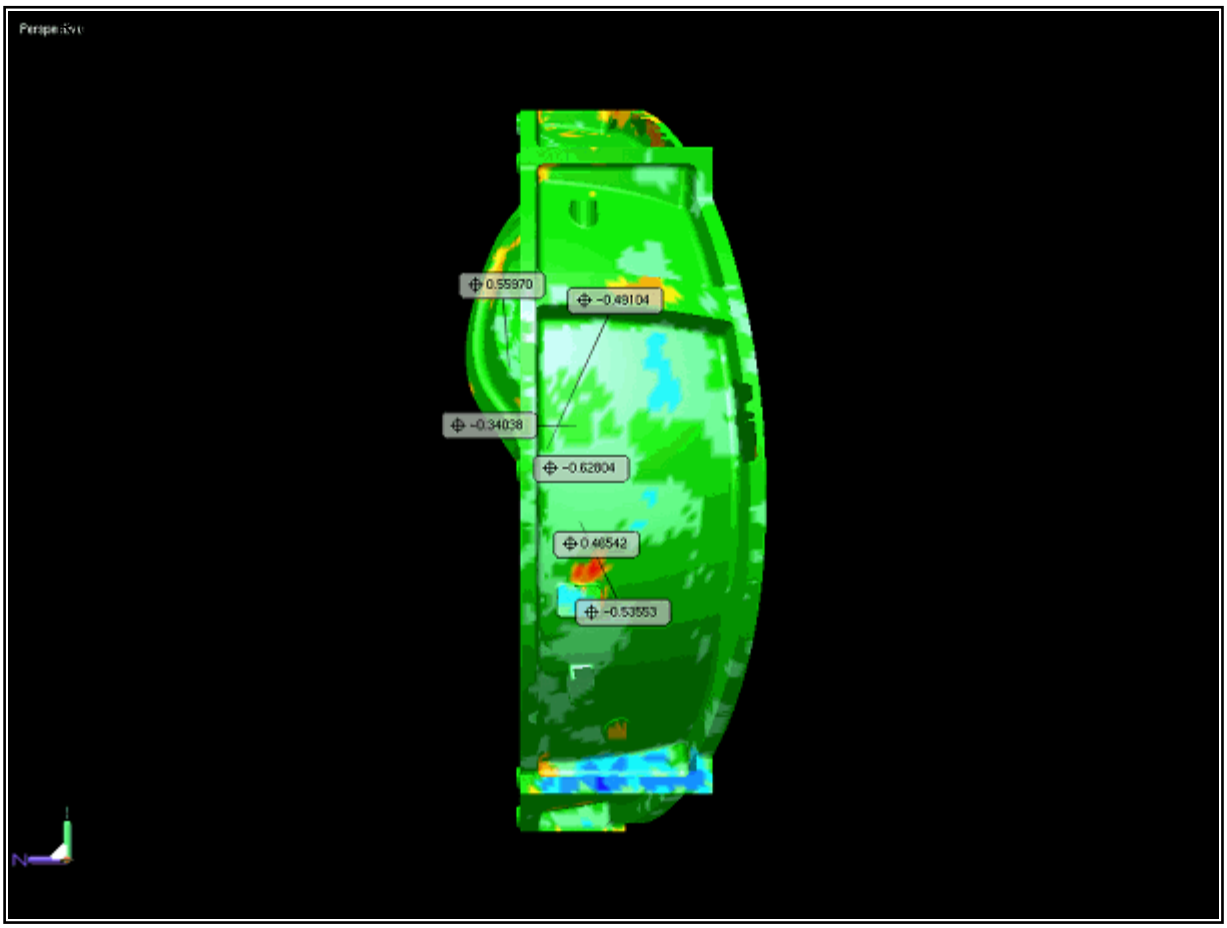
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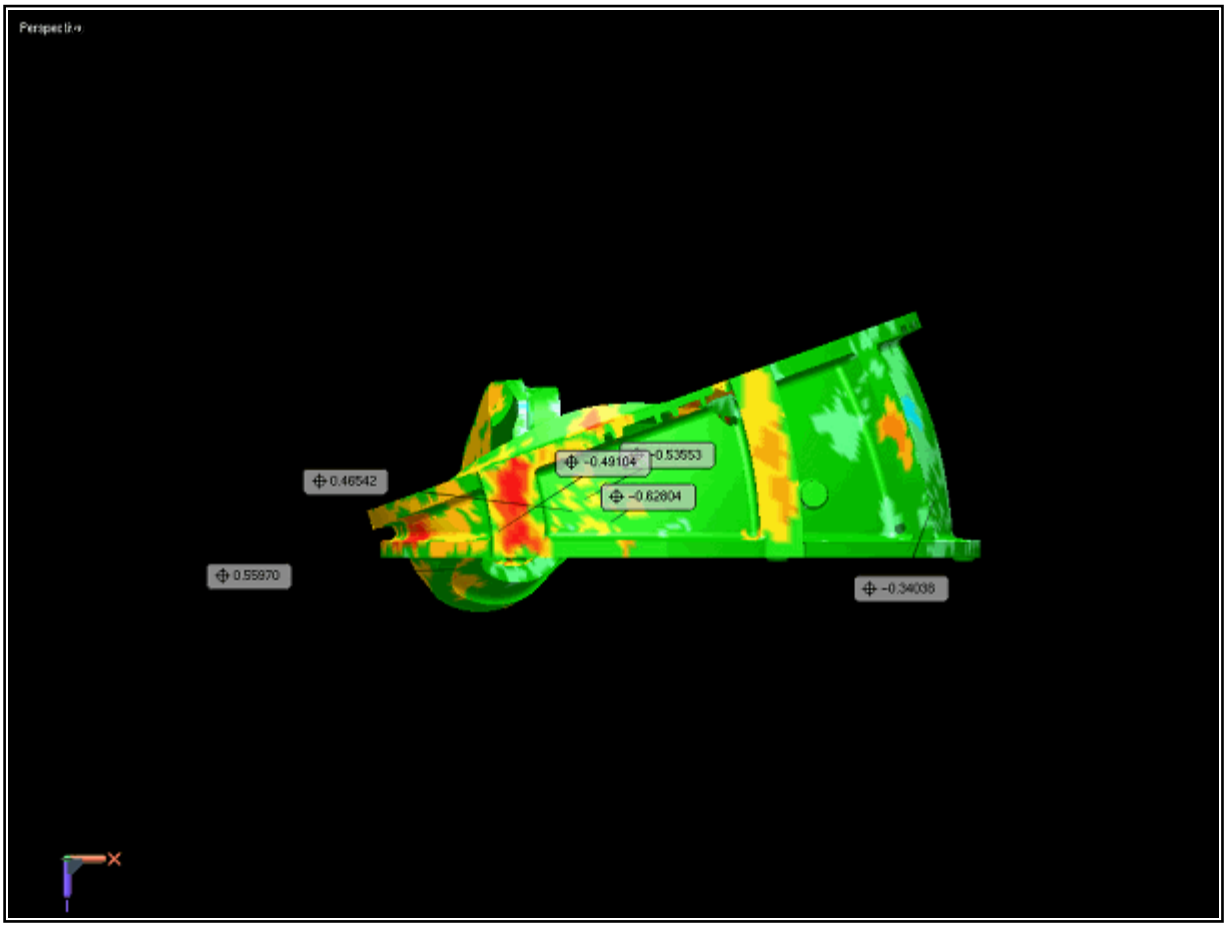
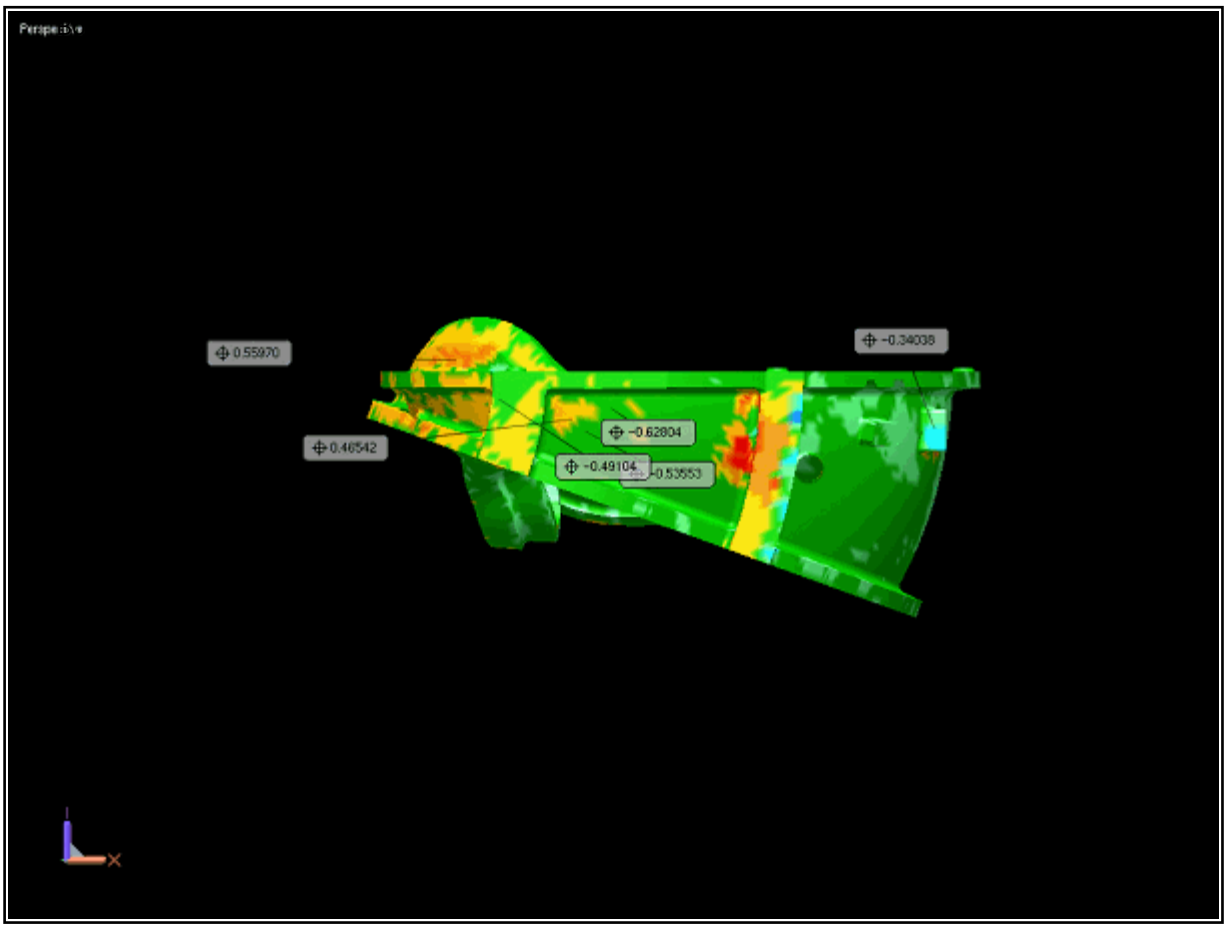




	Scan Data Position			Design Data Position			Displacement			
Name	X	Y	Z	X	Y	Z	X	Y	Z	Distance
Annotation 6				52.63935	-0.64813	-4.82390				-0.62804

December 28, 2005

Project # 0412
Fusion Chamber Castings
A Patterns

Tim Wenninger
Project Manager
Lawton Pattern Division
1950 De Pere, WI 54115
timw@calawton.com
920-983-4053

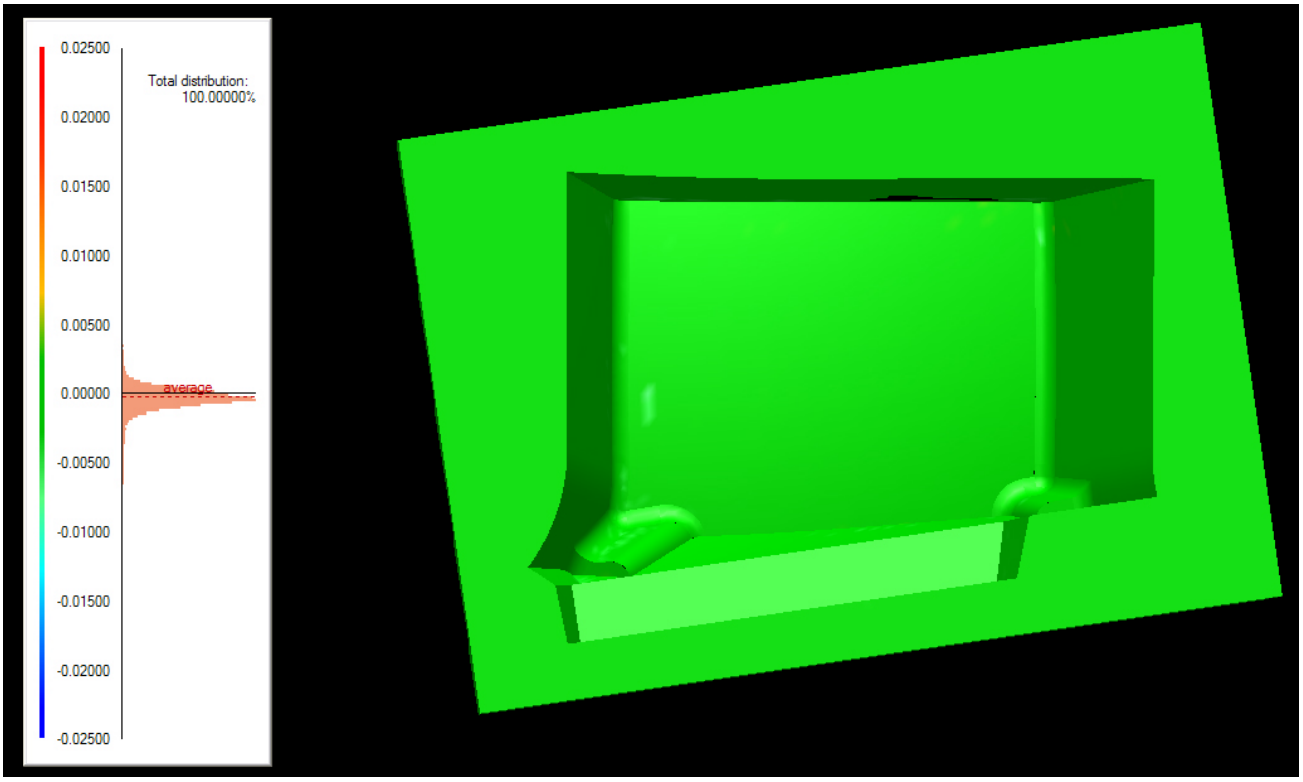
After reviewing the scan data from the A patterns it is evident the original results provided with inspection results are sound. A double check of the data was done for all core boxes including the cope and drag. The alignment of the scan data to CAD was also verified.

The patterns are machined using precision CNC mills. The accuracy achieved on these patterns is at least an order of magnitude better then that observed on the casting. The patterns all came in with an RMS residual error under 0.0050" except core box 6, which was the largest RMS value at 0.0052". Each pattern was scanned using a photogrammetry session, each session has an overall RMS residual error. This means we are confident in the data of each session to this value. Here are the results of each photogrammetry session.

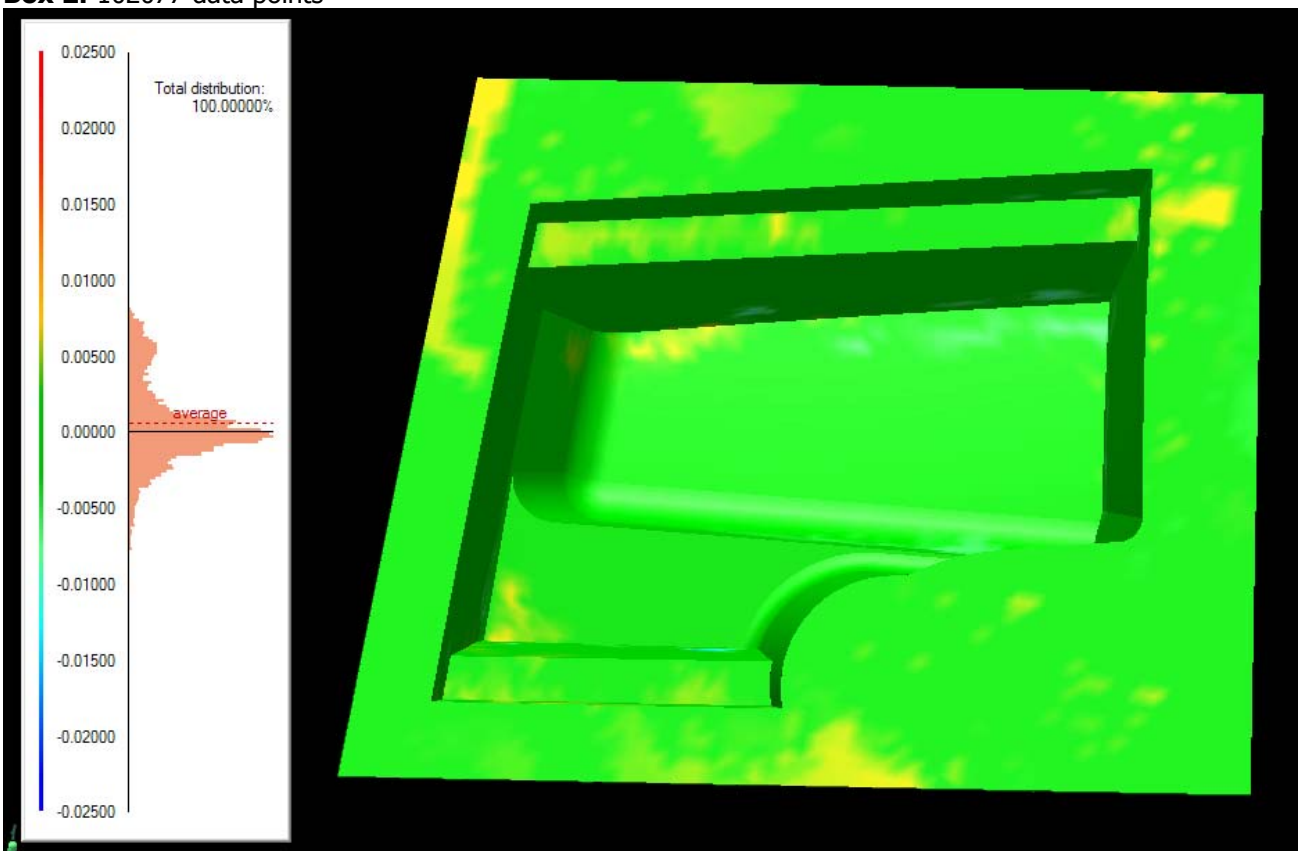
Core Box	Overall RMS residual error(mm)
1	0.0299
2	0.0425
3	0.117
4	0.0593
5	0.0744
6	0.132
7	0.0642
8	0.0647
9	0.0743
10	0.0793
cope	0.113
drag	0.106
polodial	0.0303

The color maps below show the deviations of scan data when compared to CAD. These are the same color maps as were in the original inspection reports. Shown here is also the histogram report, which shows how much of the data resides within each deviation band. For example 100% of the 428,125 points scanned for box 1 are within 0.025" and the majority are within 0.005".

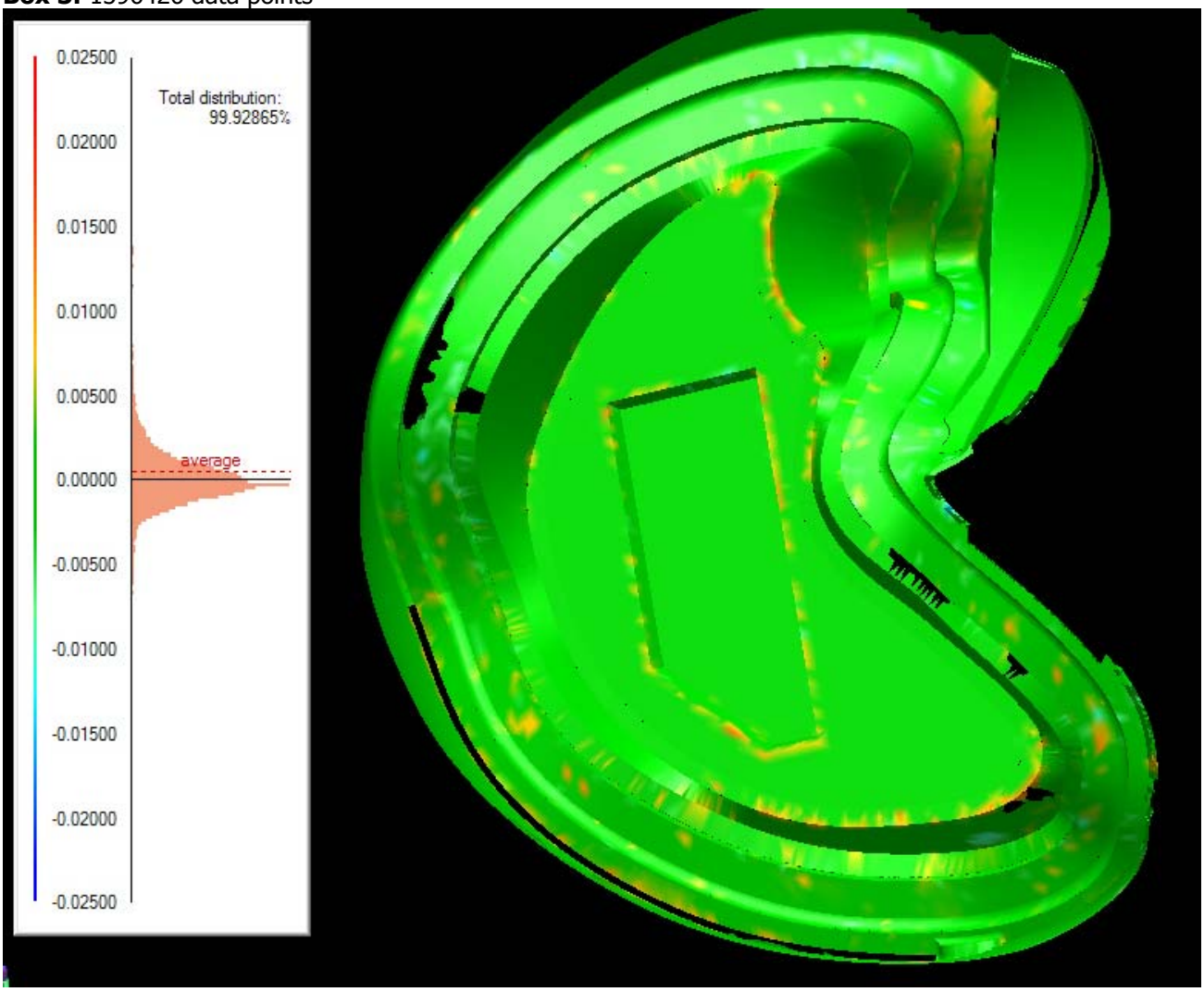
Box 1: 458125 data points



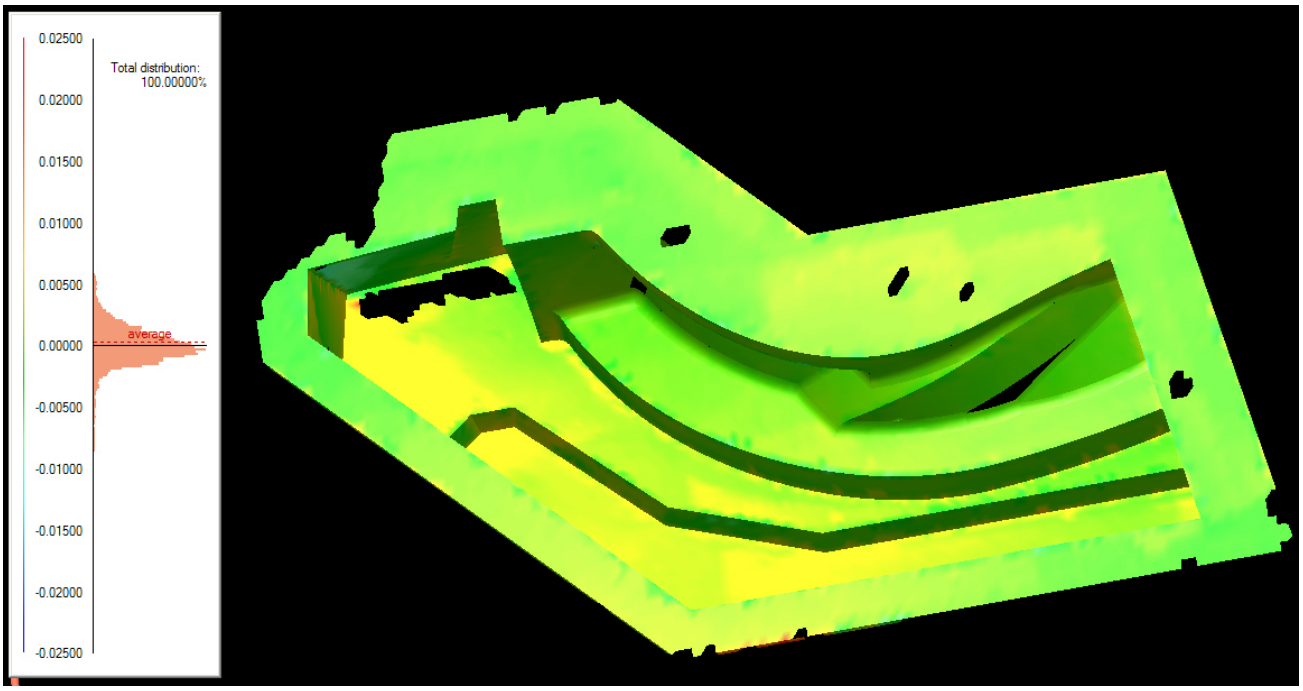
Box 2: 102077 data points



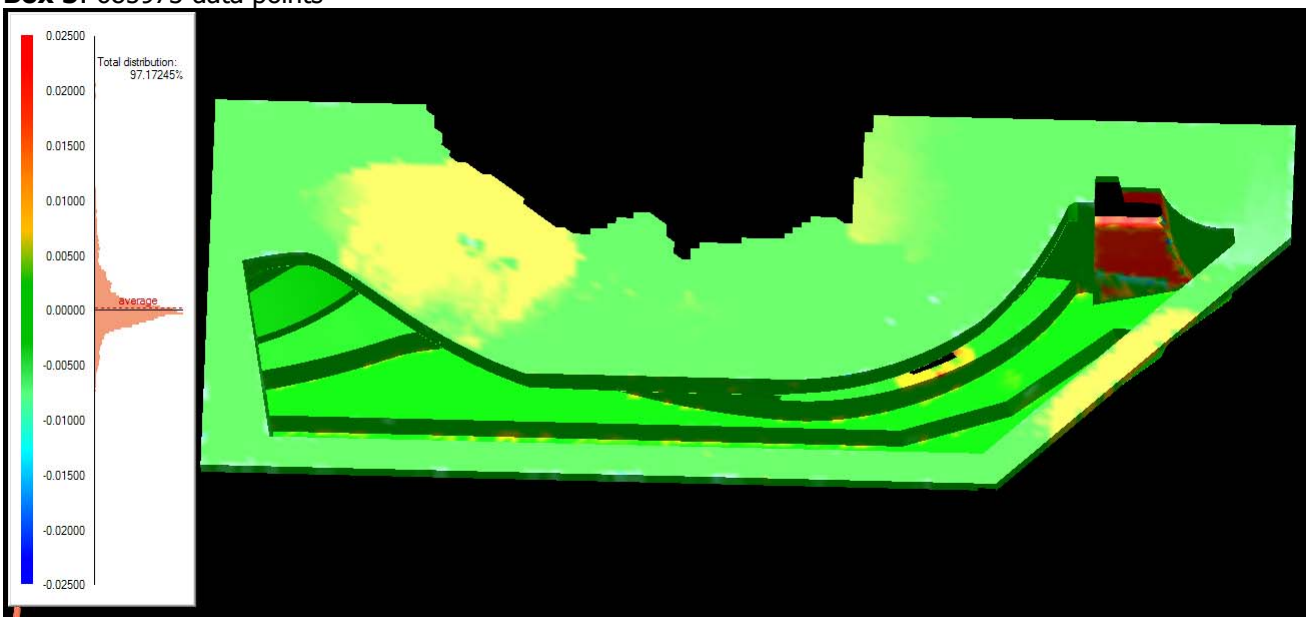
Box 3: 1396426 data points



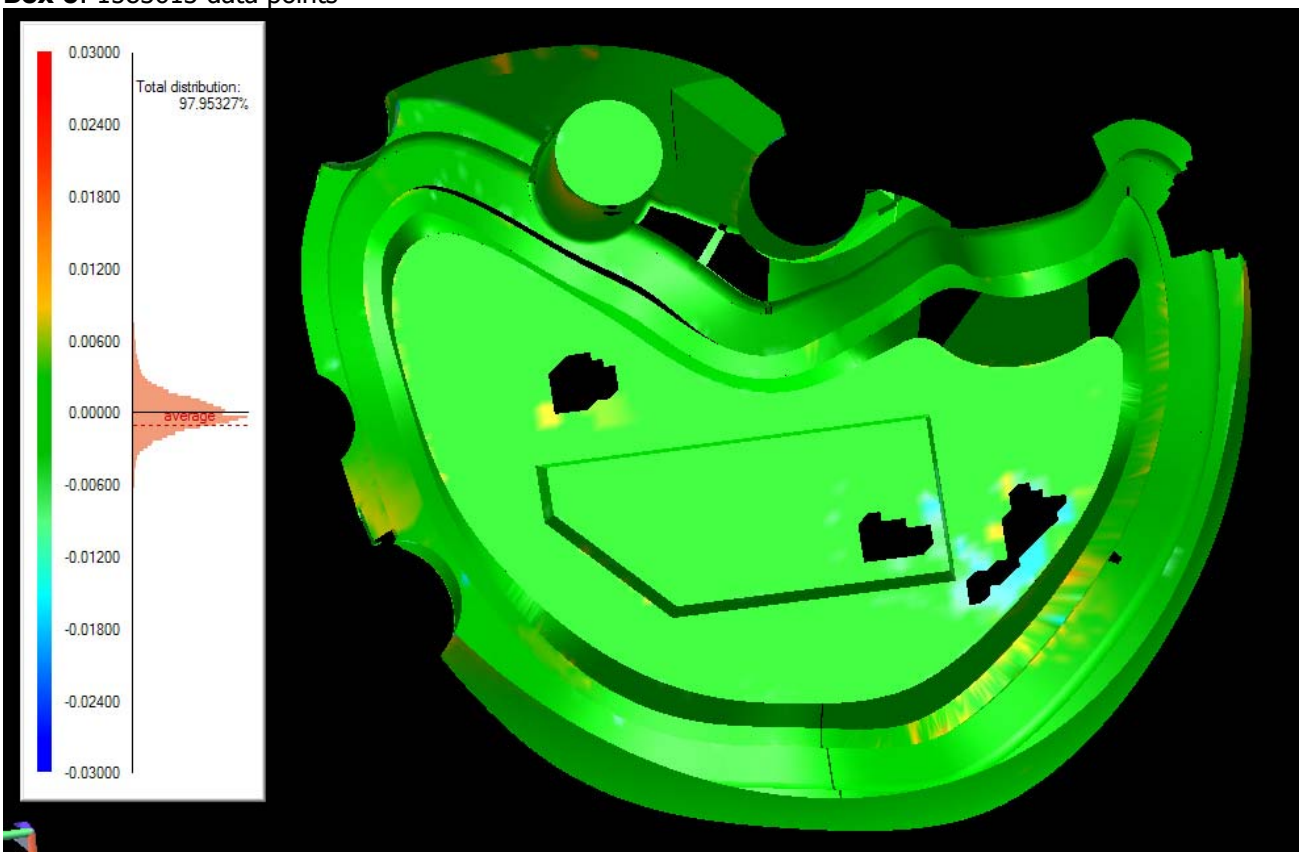
Box 4: 382140 data points



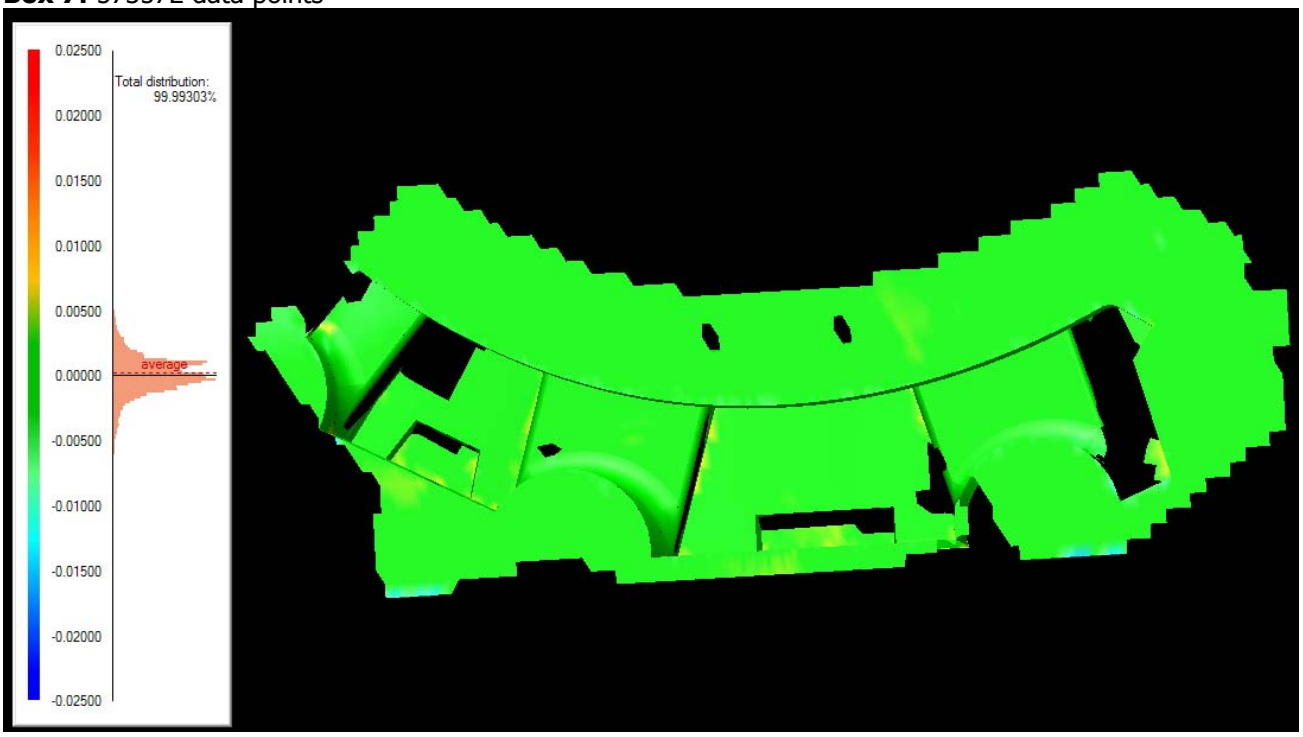
Box 5: 685973 data points



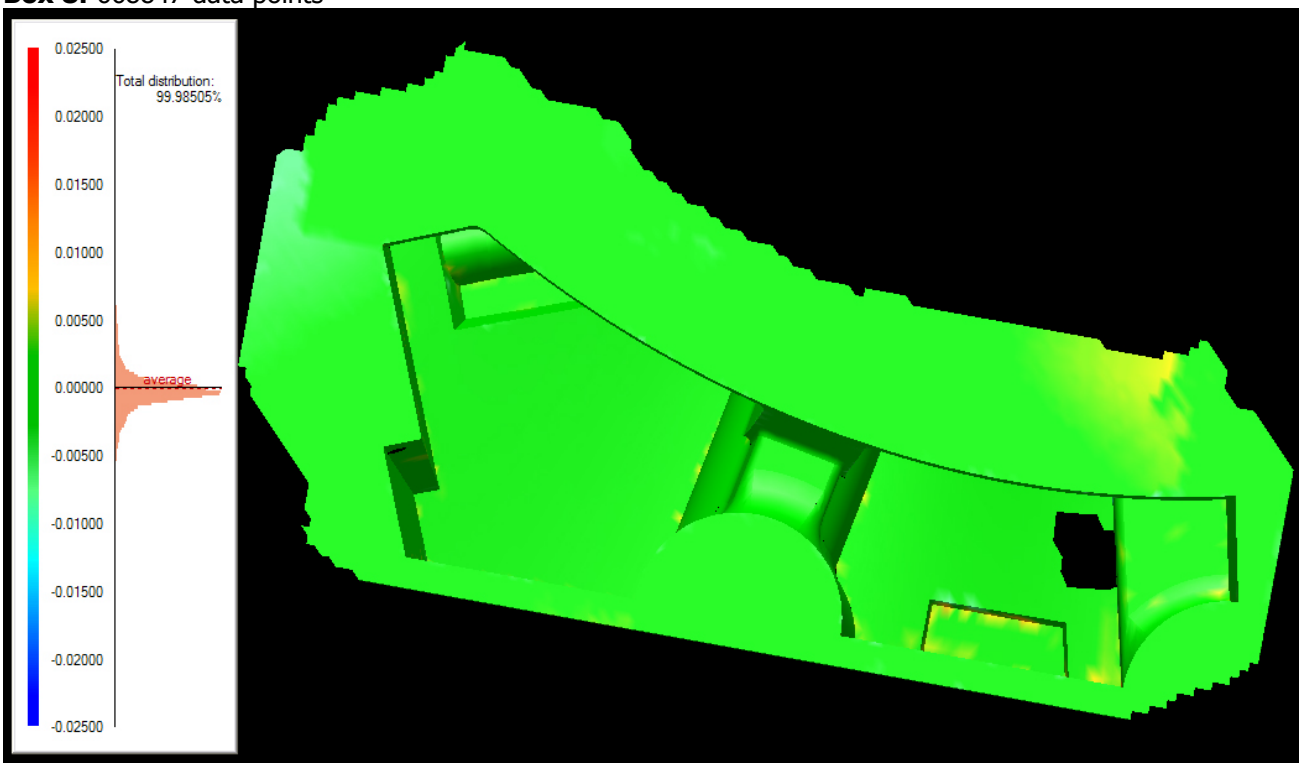
Box 6: 1583613 data points



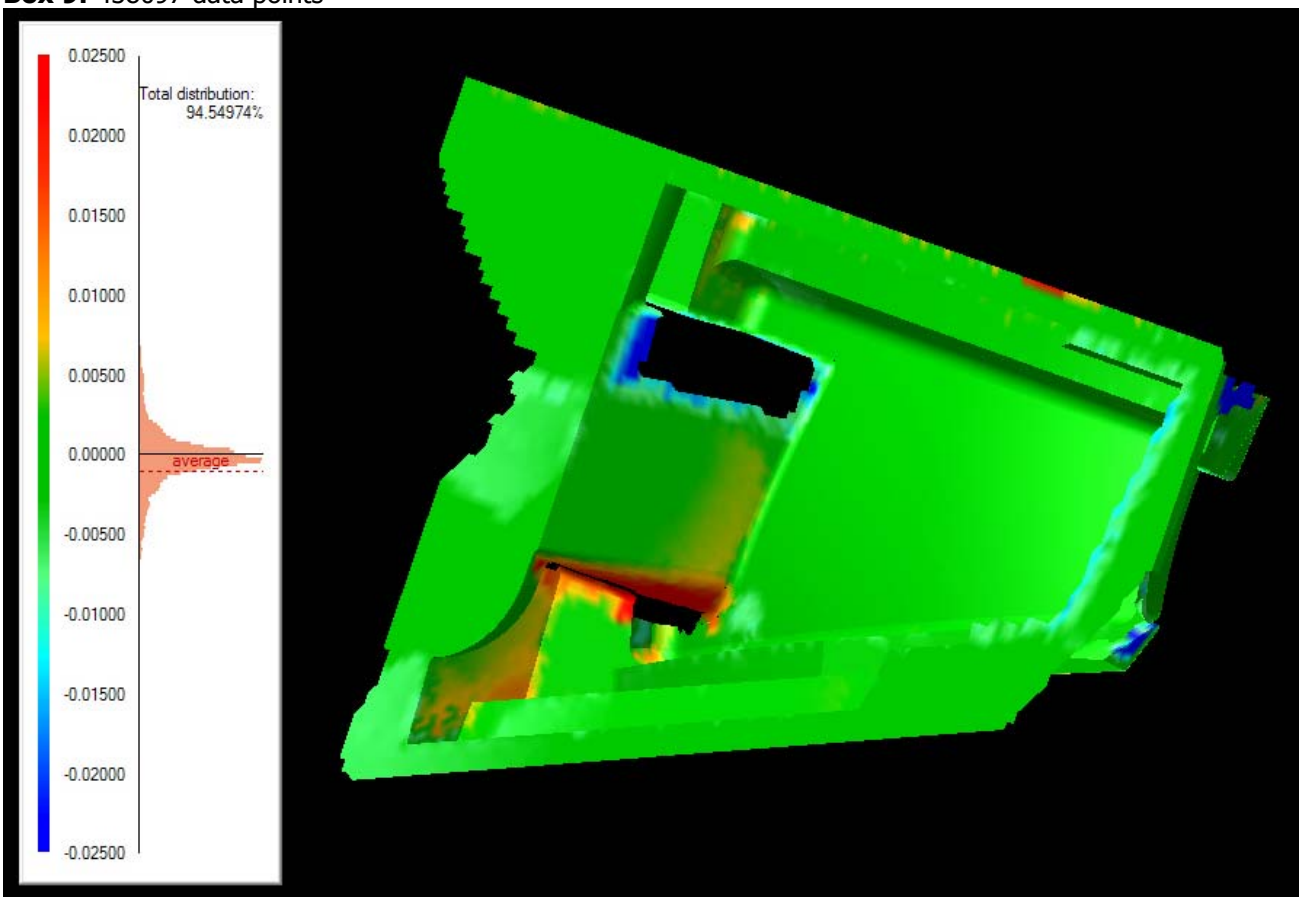
Box 7: 573572 data points



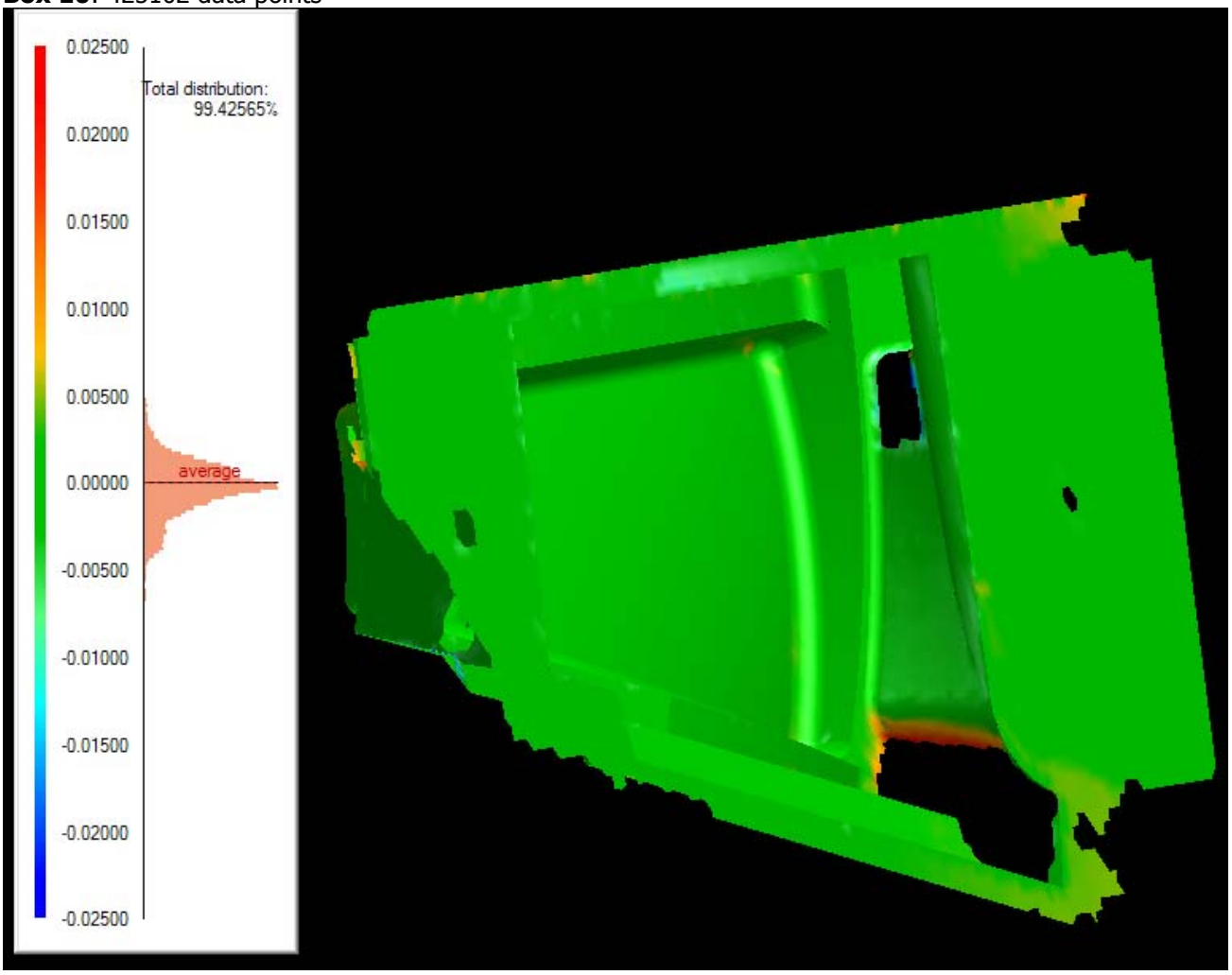
Box 8: 668847 data points



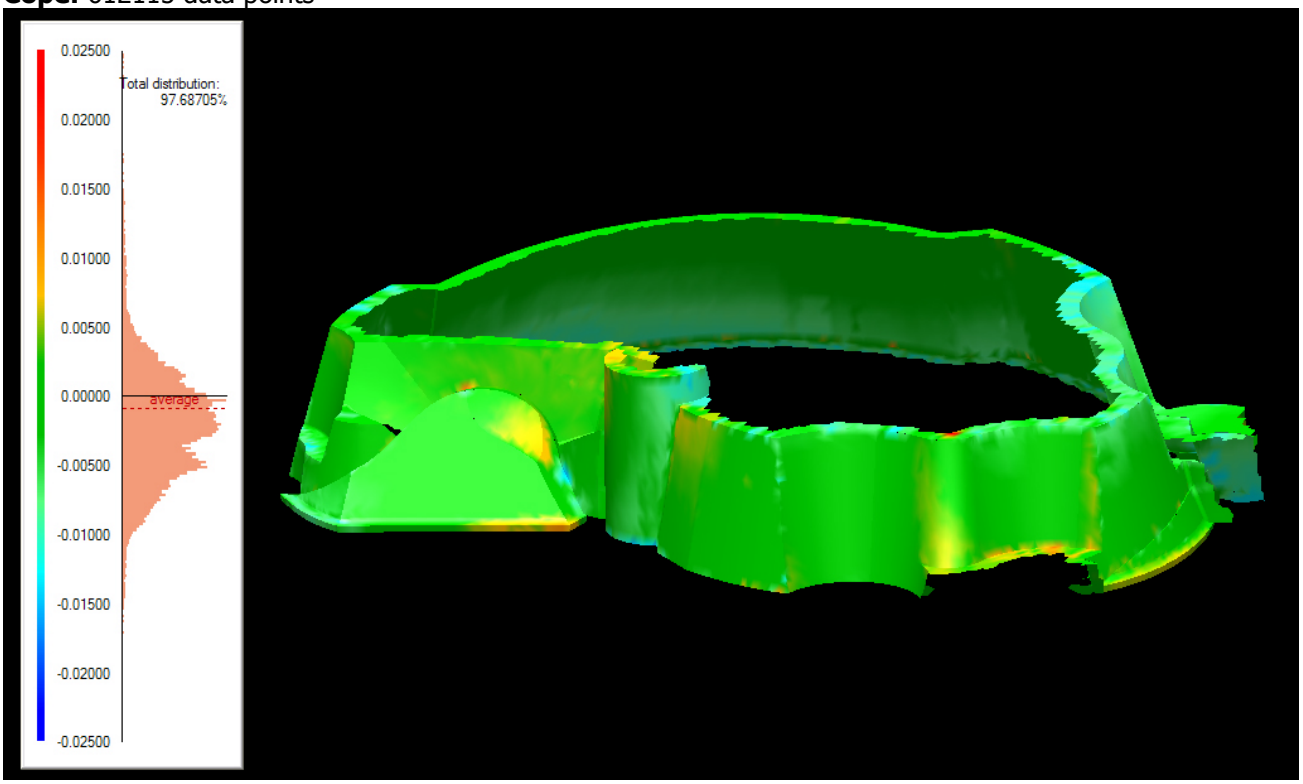
Box 9: 438097 data points



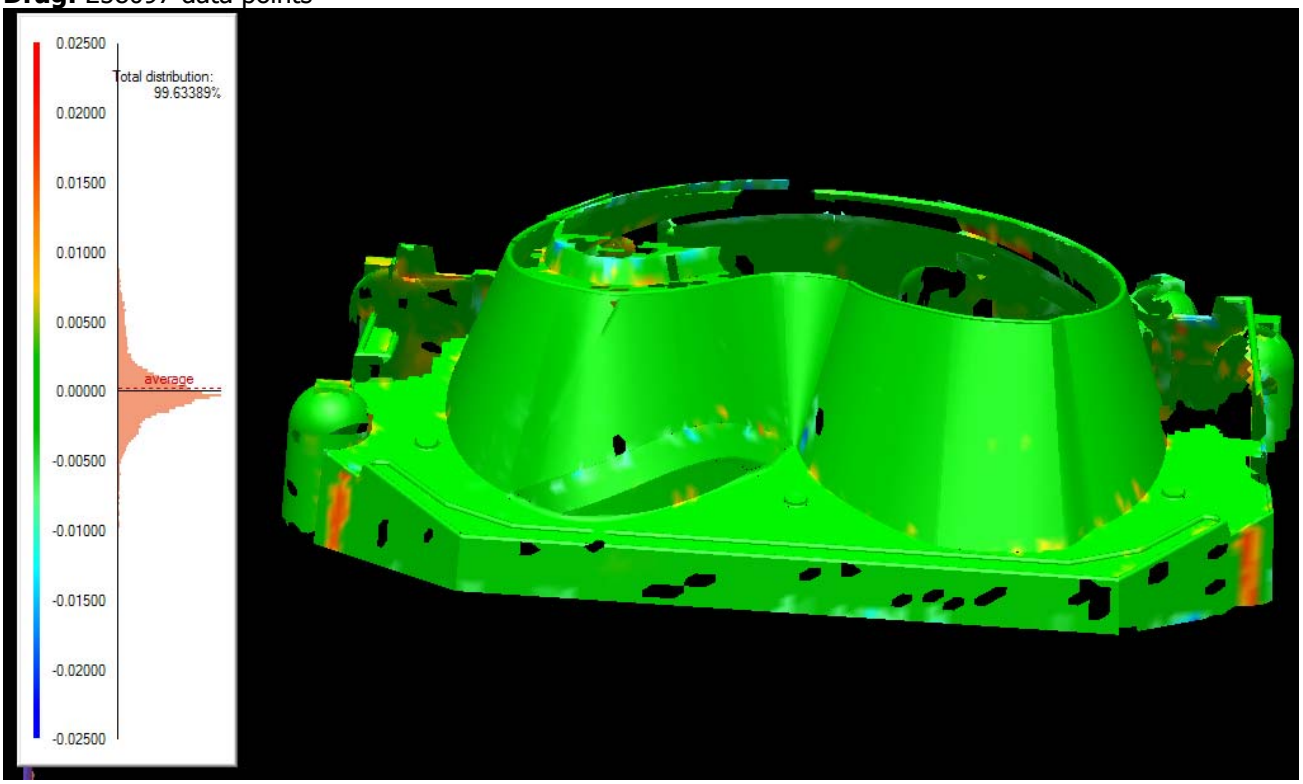
Box 10: 425102 data points



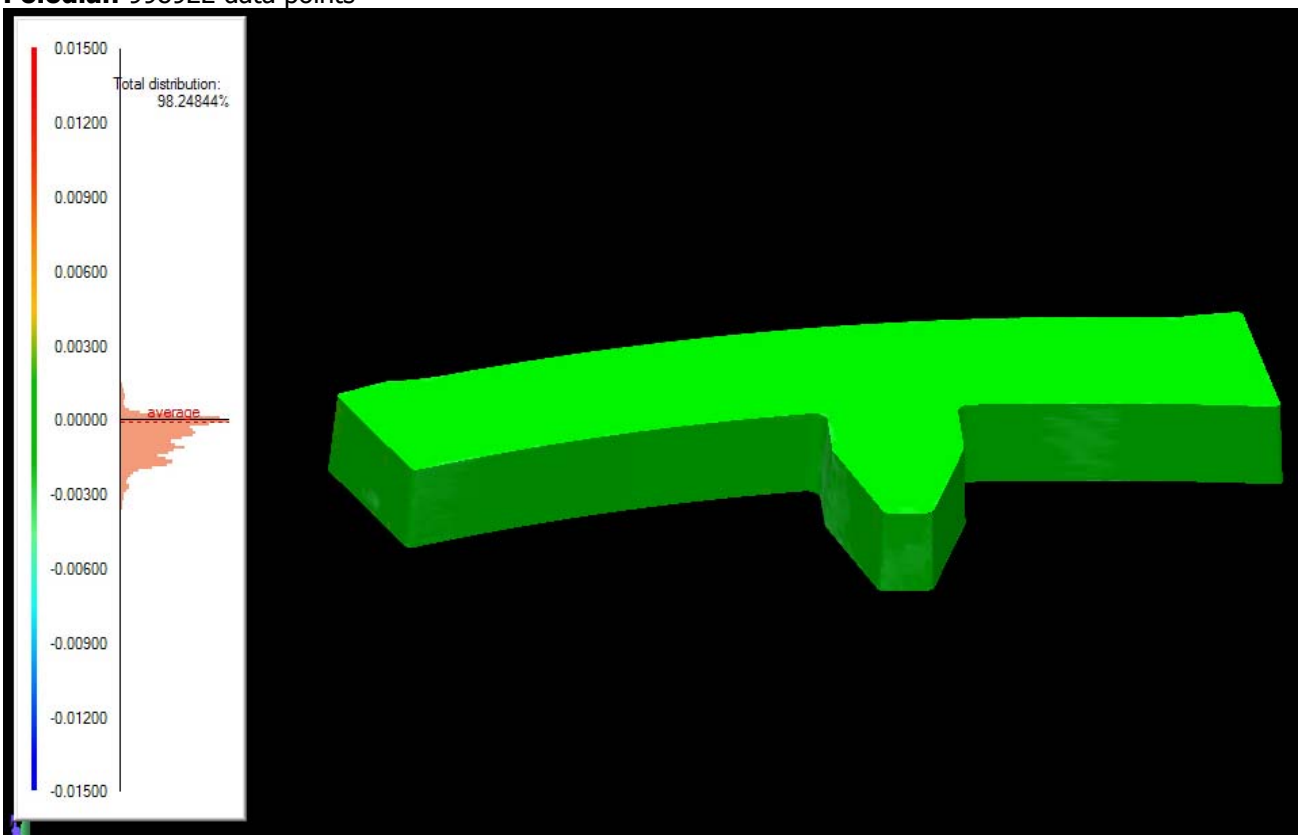
Cope: 612115 data points

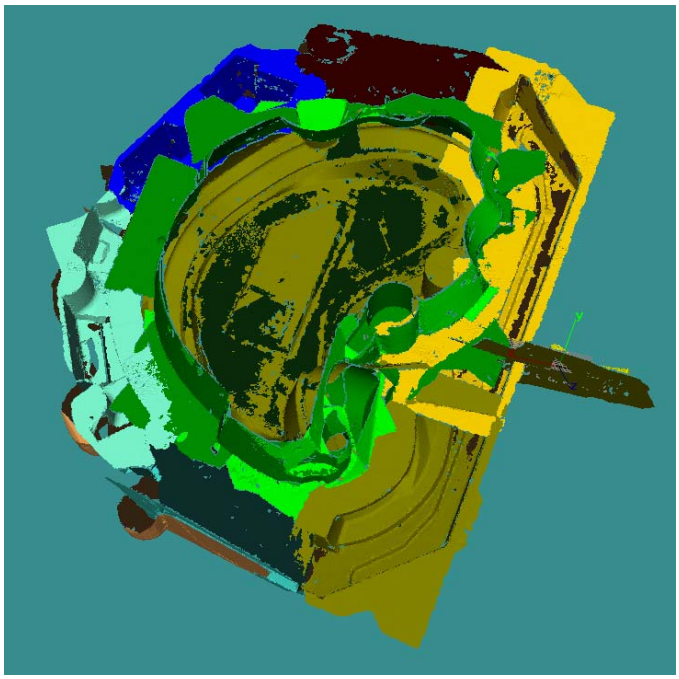


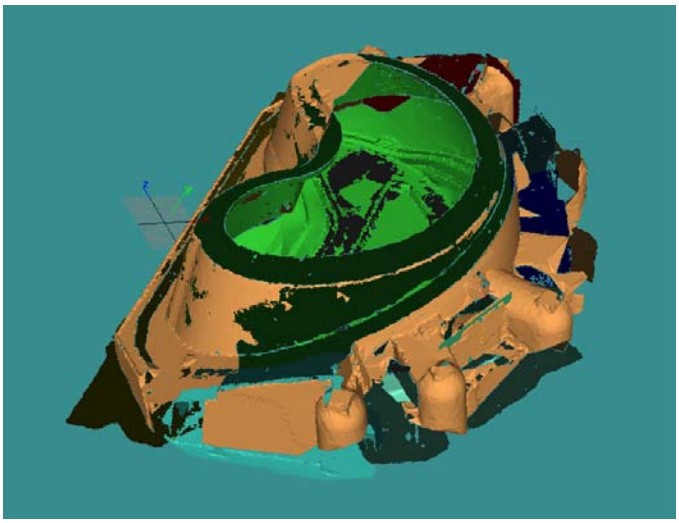
Drag: 258097 data points

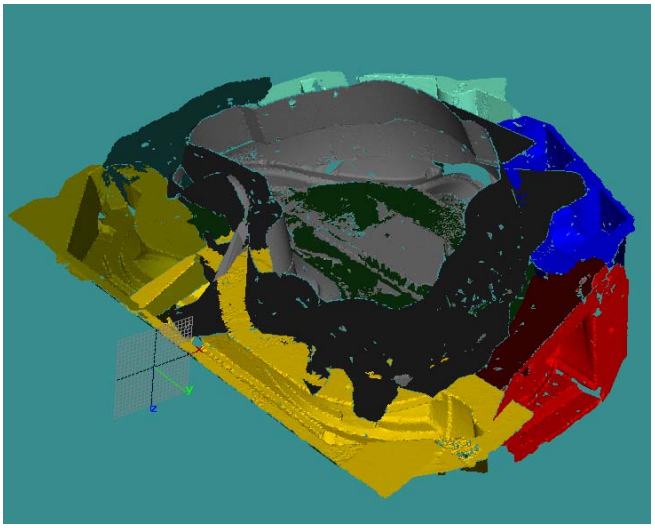


Polodial: 998922 data points





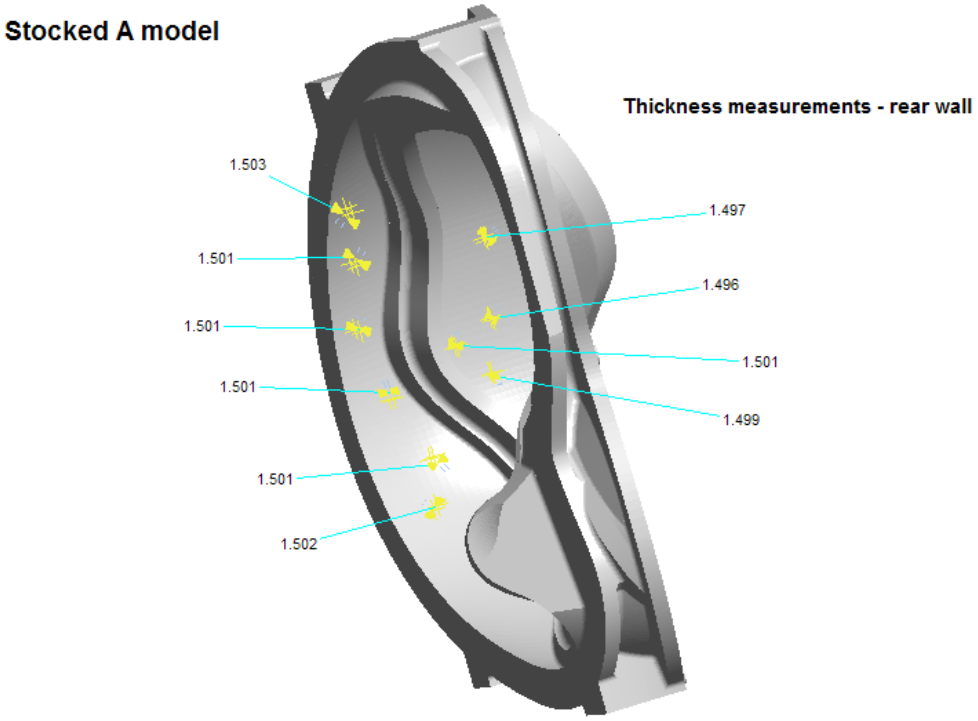




Disclaimer:

The results of this analysis are believed to be reliable but are not to be construed as providing a warranty, including any warranty of merchantability or fitness for purpose, or representation for which 3dScanCo assumes legal responsibility. Client should undertake sufficient verification and testing to determine the suitability of any information presented. It is the sole responsibility of the Client to review the results and make any determinations. Nothing herein is to be taken as permission, inducement or recommendation by 3dScanCo to practice any patented invention without a license or to in any way infringe upon the intellectual property rights of any other party.

Evaluation of stocked A model for adequate stock



Notes:

1. Measurements shown are through-wall thickness measurements of the stocked A model (no shrink) created by Lawton Patterns.

2. Measurements taken along wall where the A-1 casting is exhibiting thin wall conditions ranging down to 1.18”

3. Software used to verify wall thickness of model – Solid View/Pro 2003.1

4. Measurements taken on 8/2/05 by Roy Sheppard of EIO

Energy Industries of Ohio

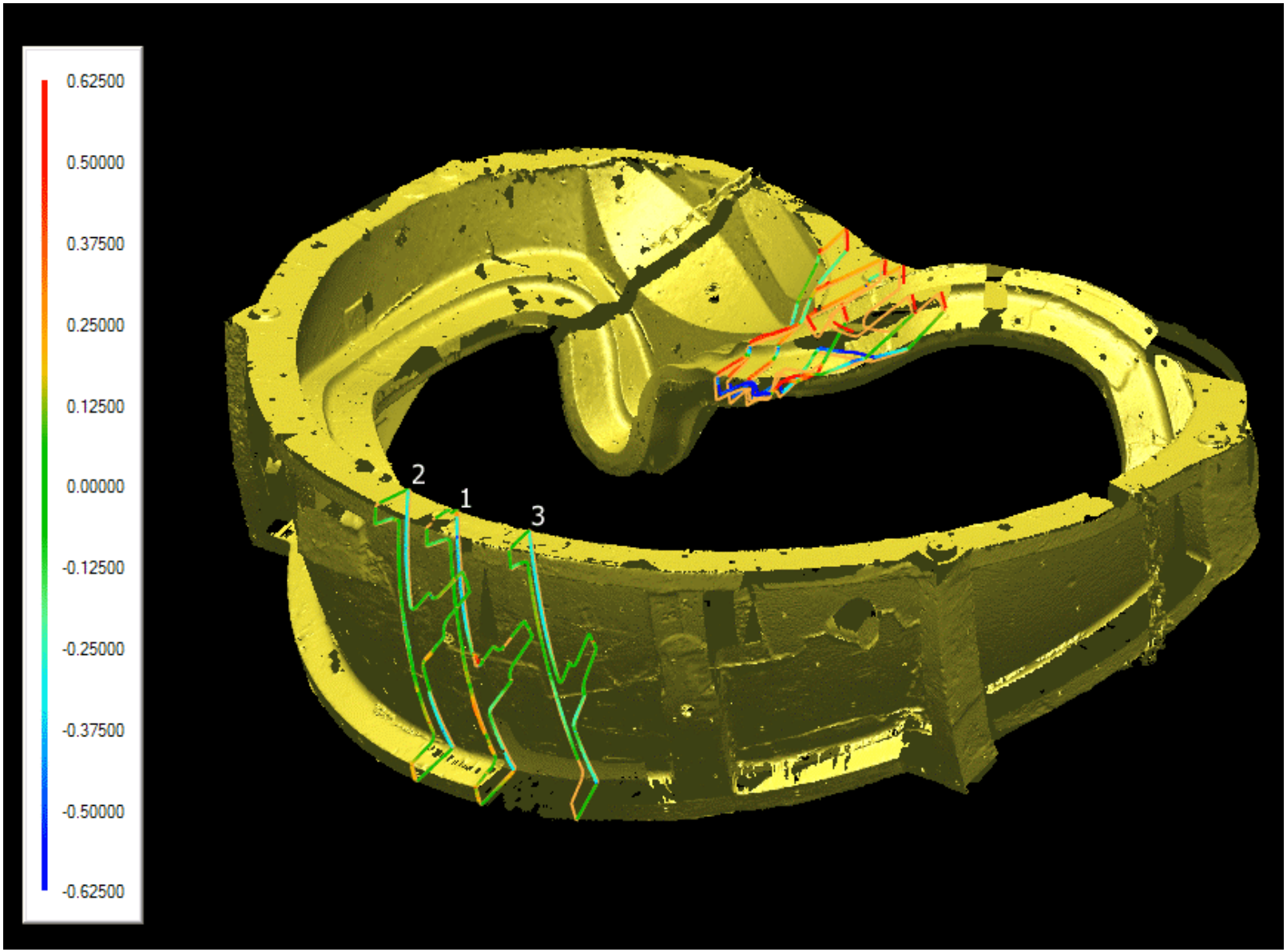
A-Coil Winding Form

Metrology Discussion – Pattern Verification

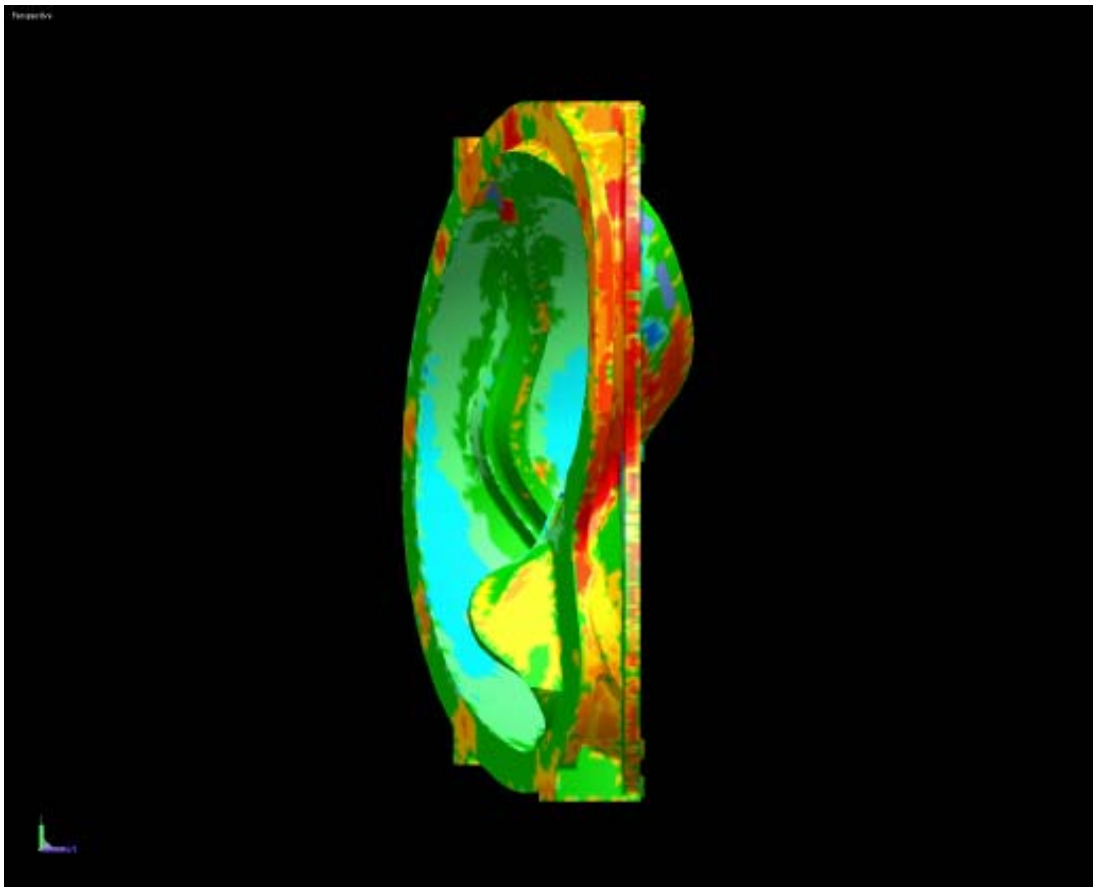
Issues

- Dimensional data supports a under tolerance condition exists on an area of the shell
  - Limited options on increasing thickness on A1
- 3D Scanco data correlates to physical measurements taken by MetalTek on the A1
  - MetalTek dimension taken from shell at cut-thru
- Dimensional data supports that the A-B alignment will be achieved at the flanges, but may not align shells (no interference issues)
  - Root cause not confirmed
- Dimensional changes to A1 part are all long time period changes and involve extensive work to part and matching work on pattern equipment
  - Quickest path forward may be FEA and Waiver

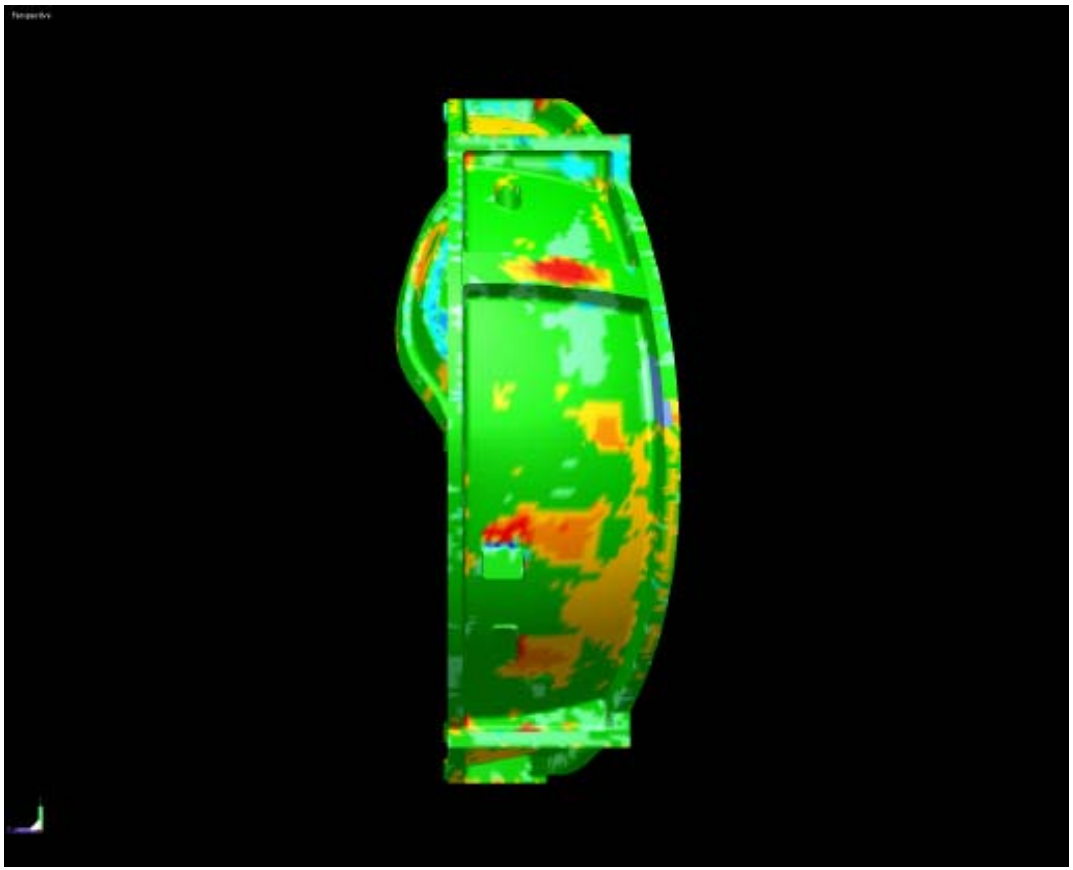
Location of 3 cross sections



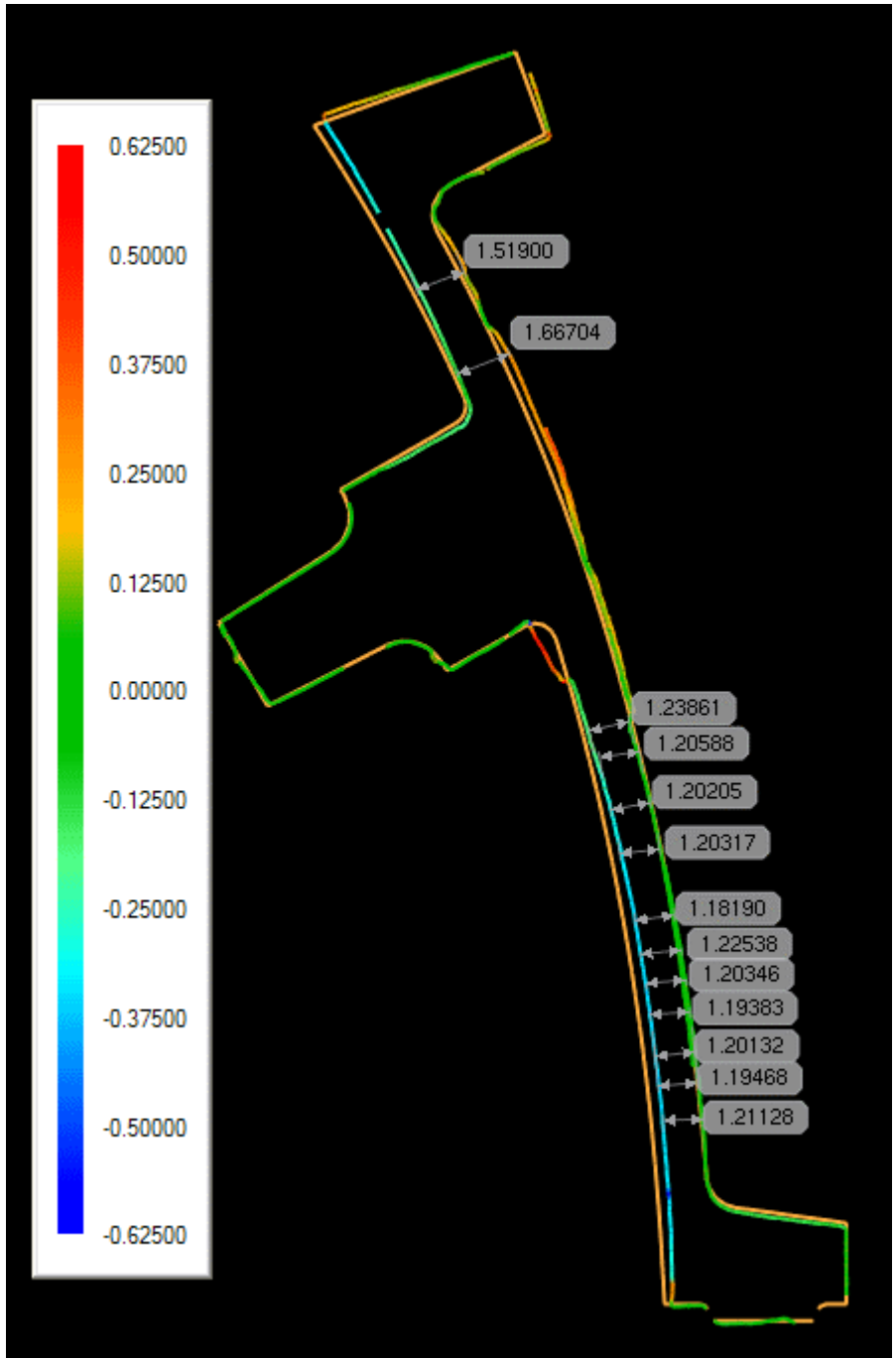
Left View



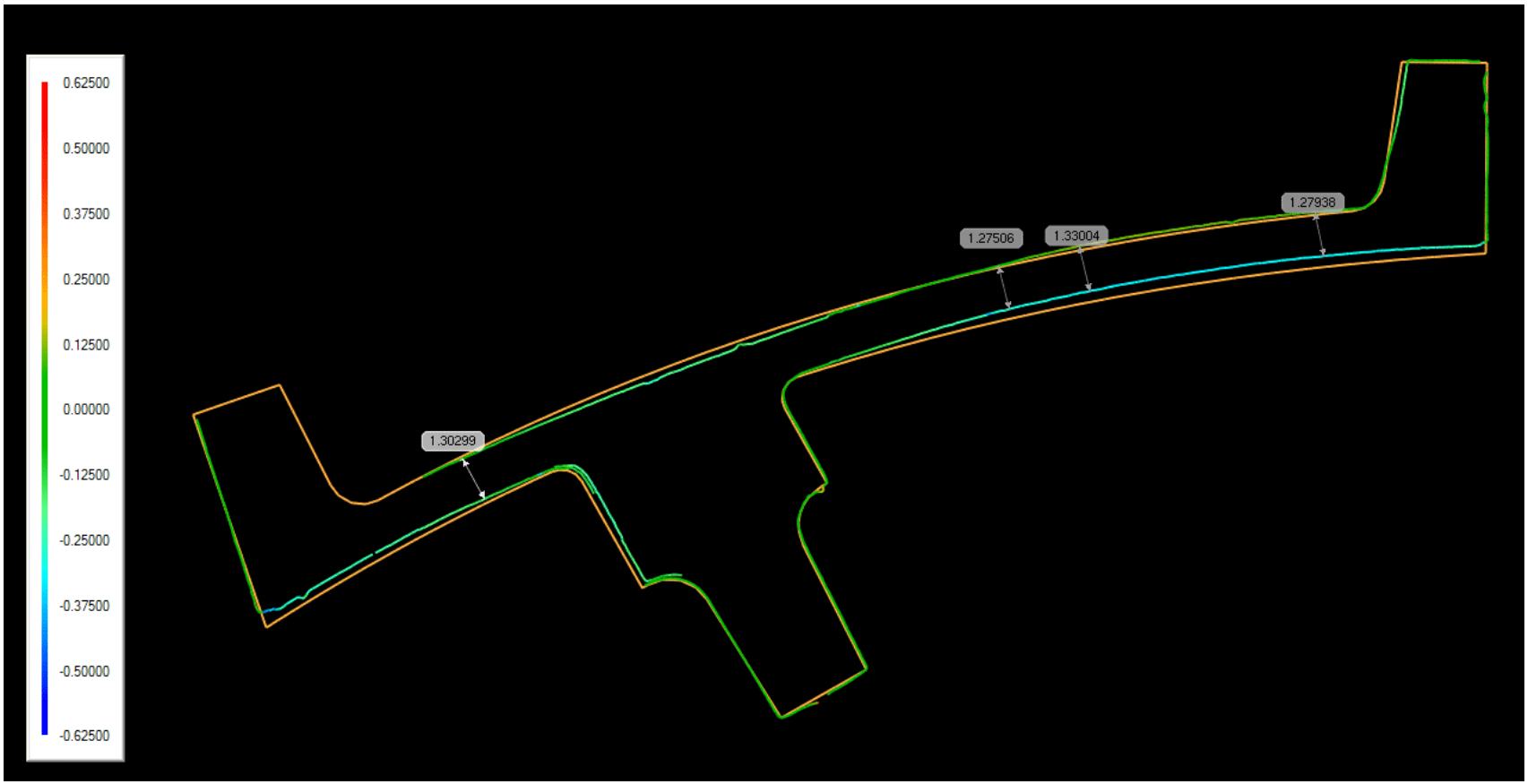
Right View



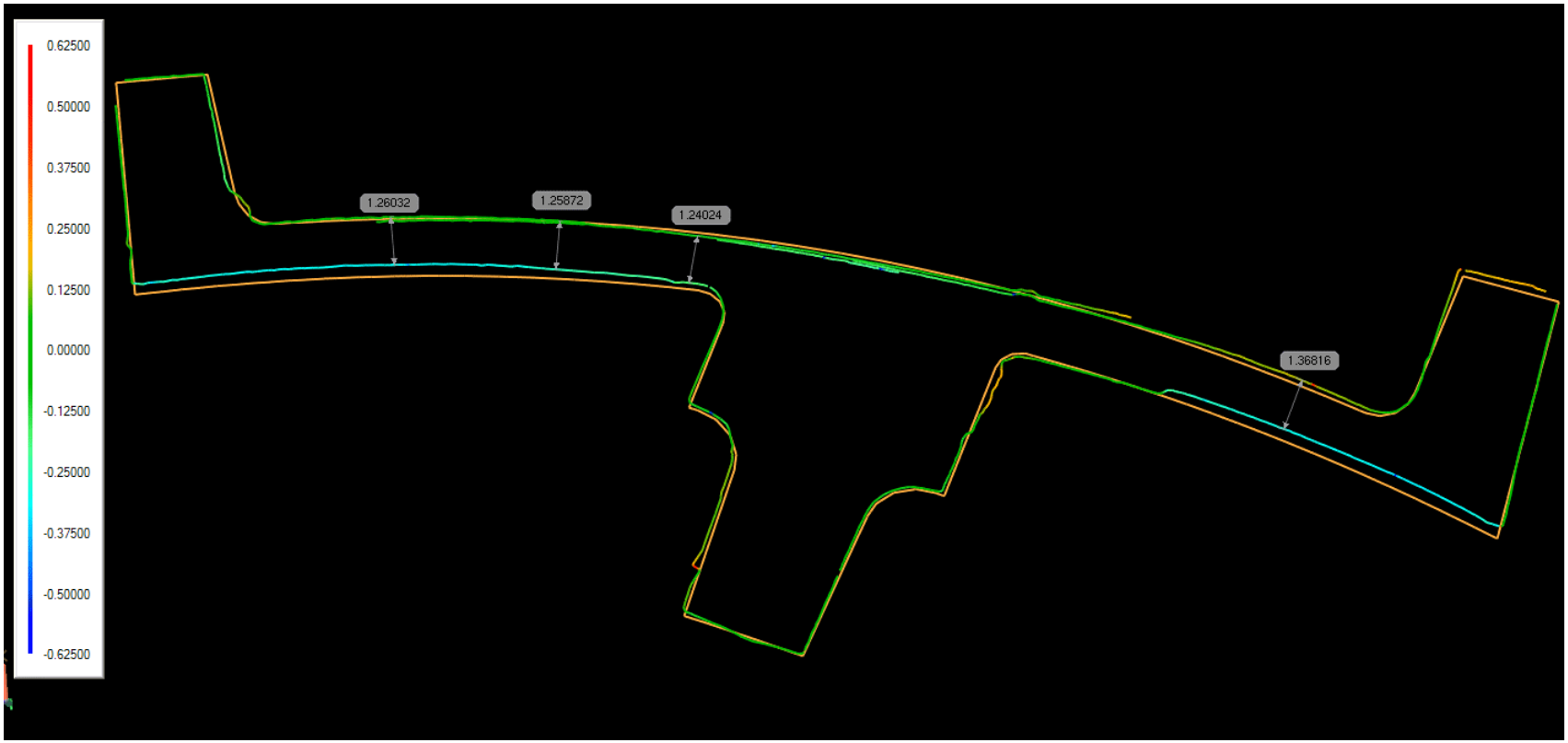
Cross Section 1



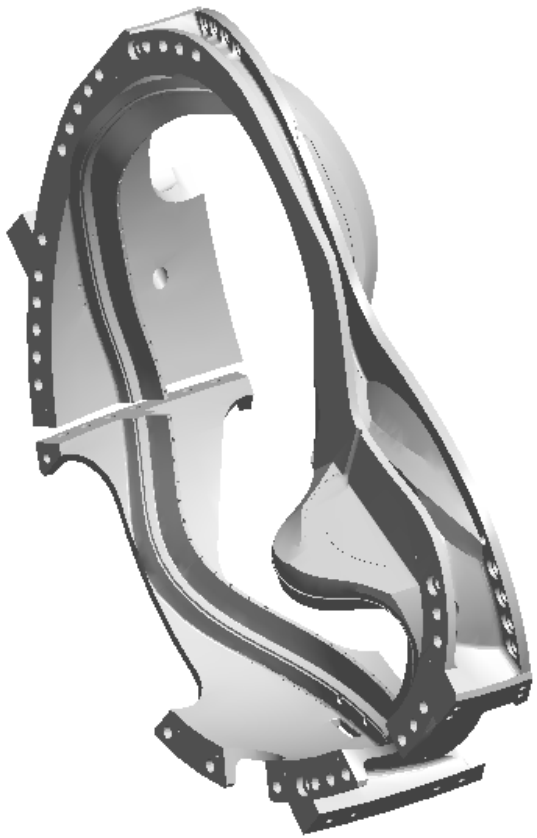
Cross section 2



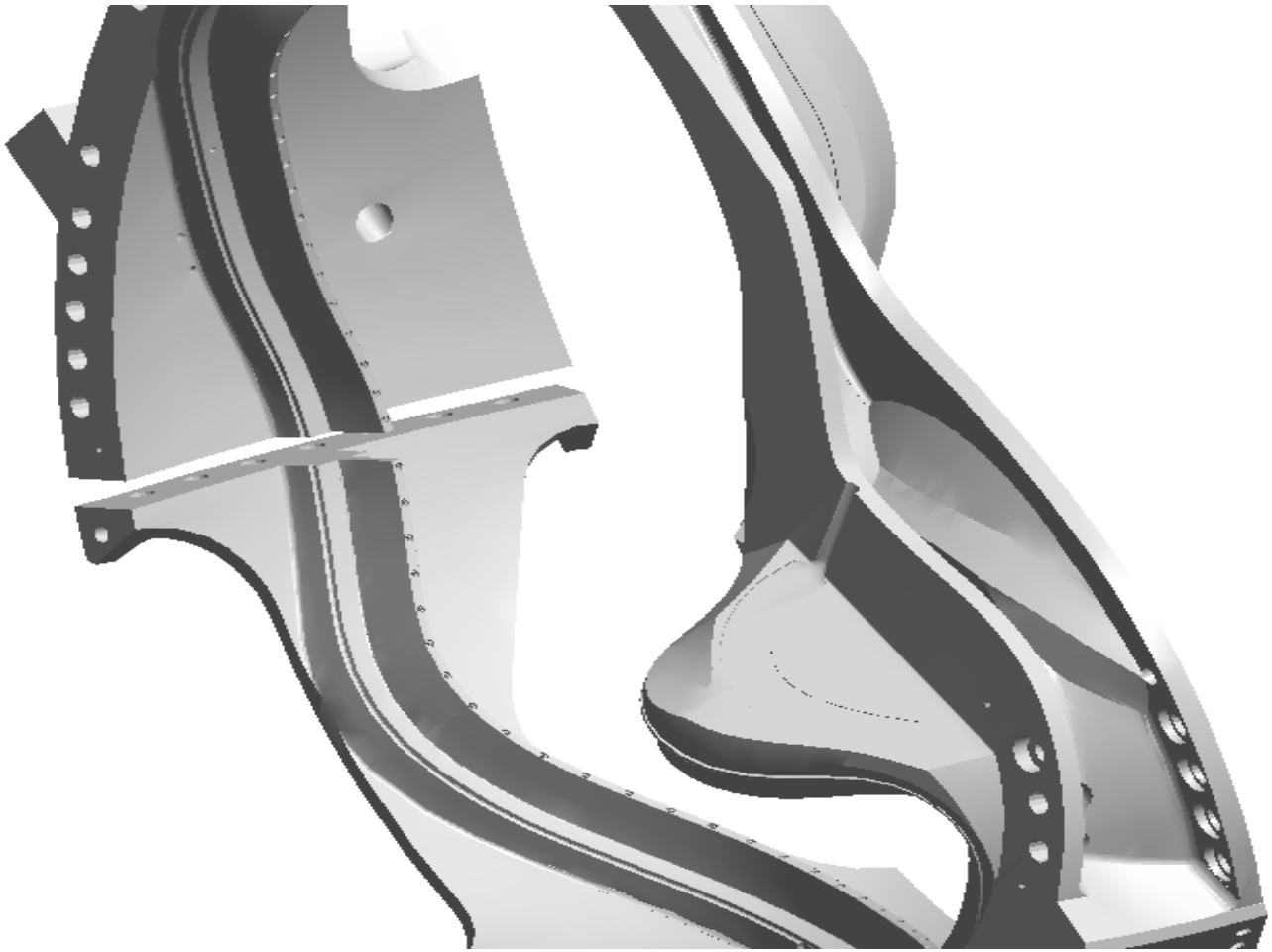
Cross Section 3



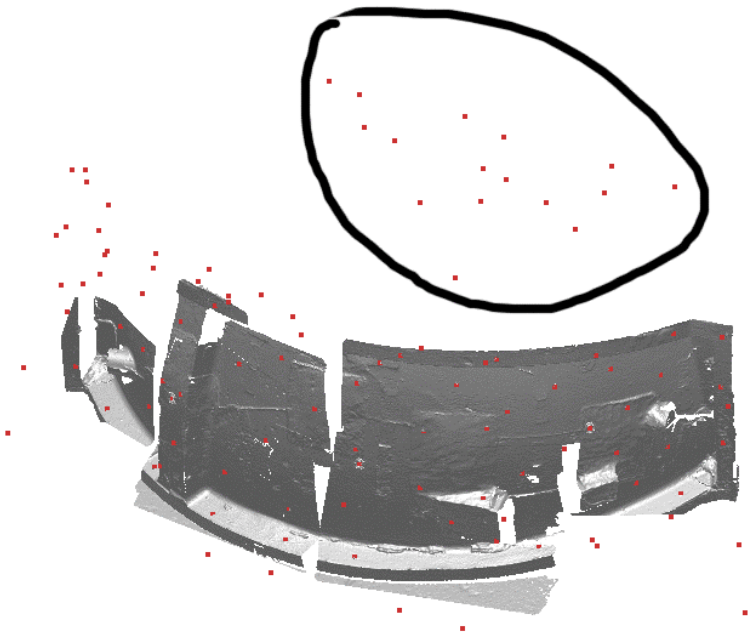
Machined Coil A



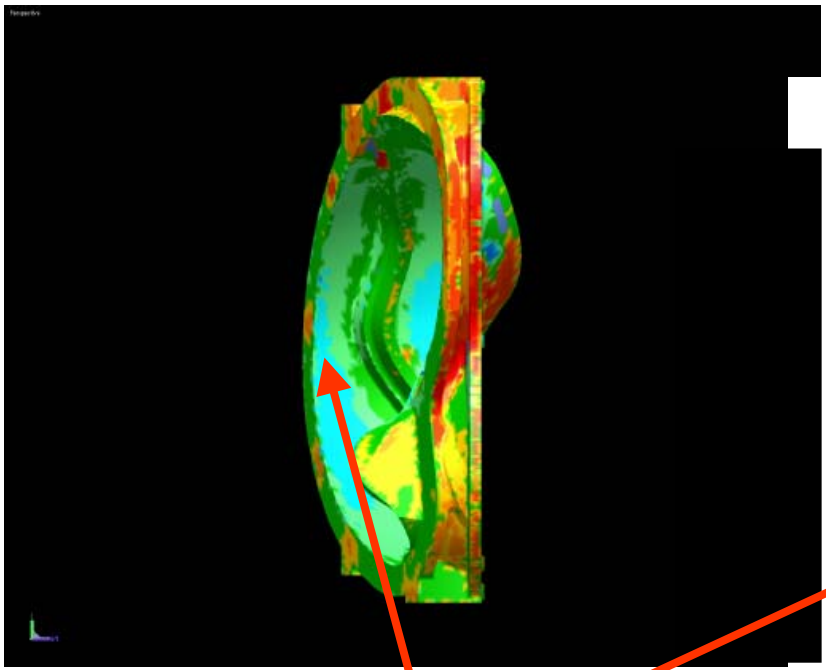
Back wall after machining

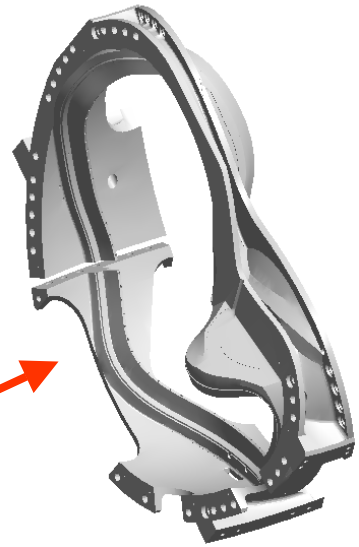


Additional points snagged for orientation



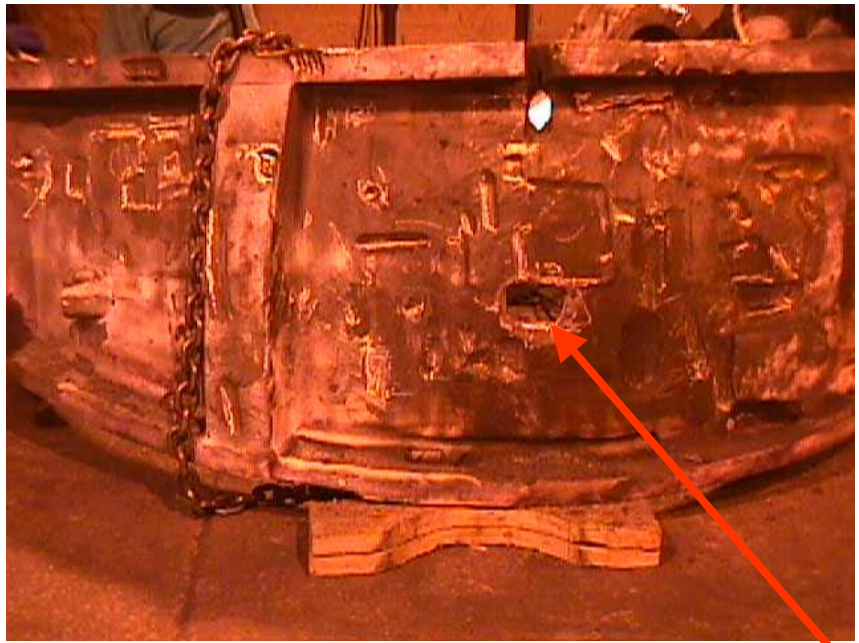
Comparison of Machined Part to 3DScanco Layout

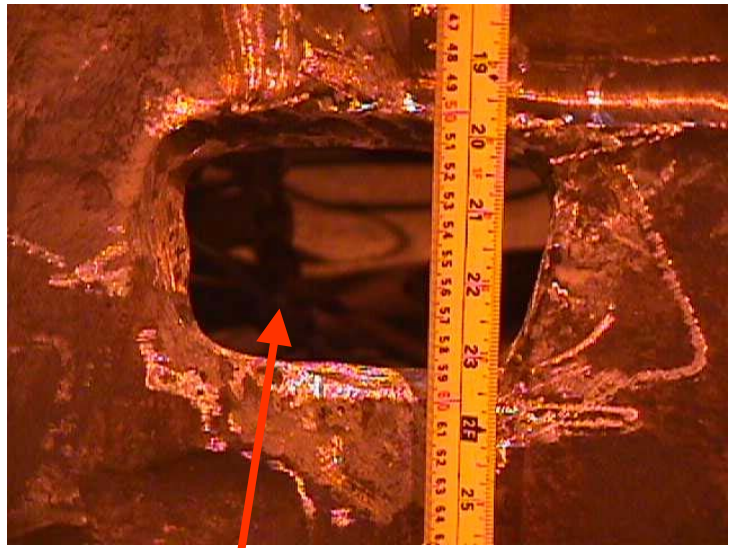




Views are slightly rotated. Use racetrack reference

MetalTek Verification





Excised hole for
dimensional verification
(1.24-1.27”)

Summary of Layout

- A substantial amount of the wall appears to be under the design thickness
- 3DScanco data is at 95% Confidence Level (Approx. 0.018” error per 3DS)
- MetalTek verified one area with direct measurements
- Remediation options are limited and have risk

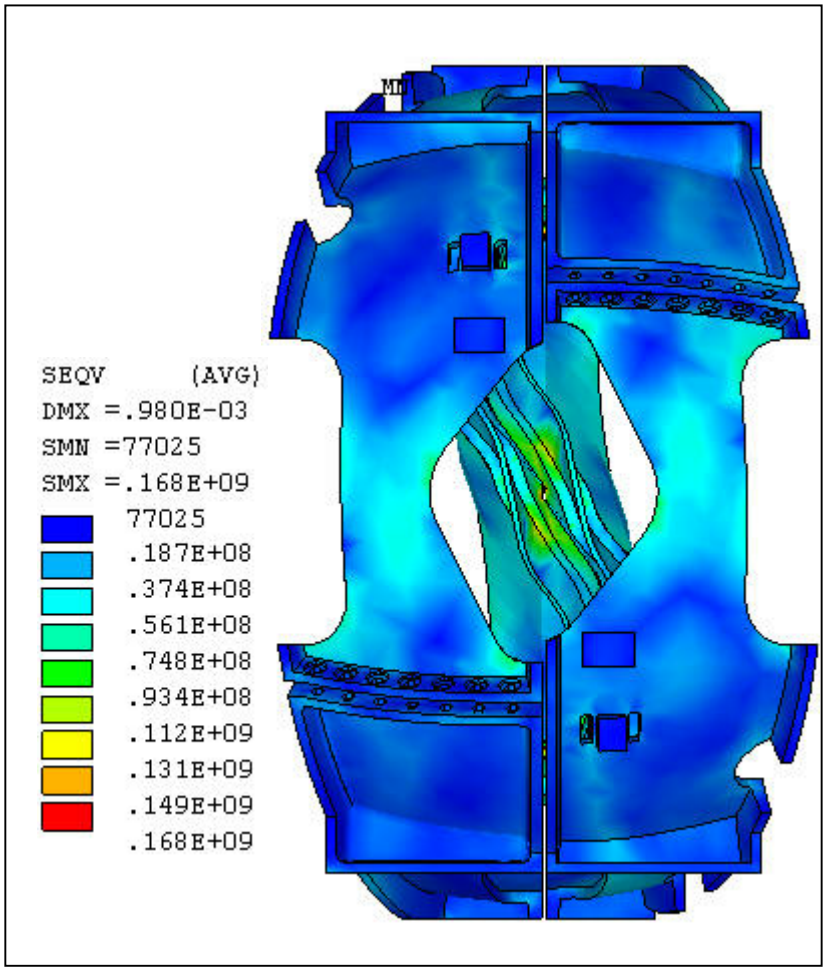
Remediation Options

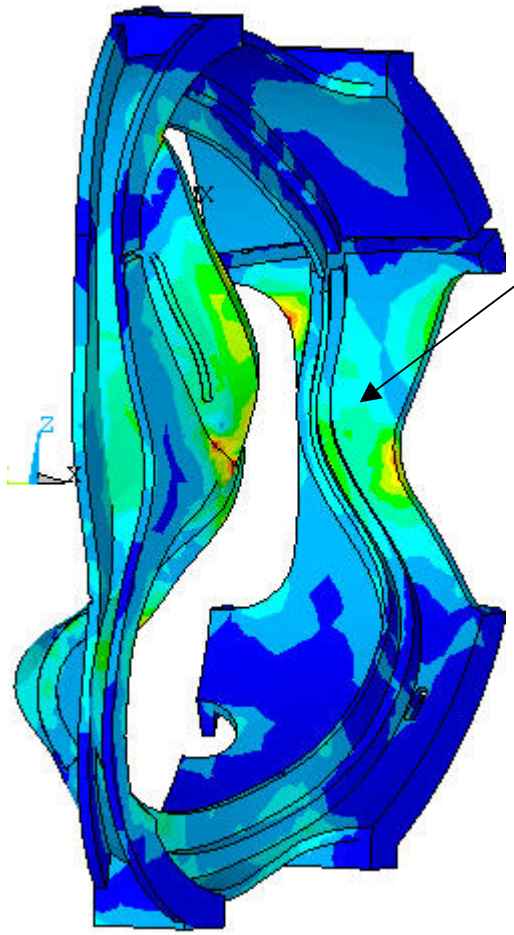
- Option 1 – Permanent Waiver
  - PPPL would need to assess part dimensions and FEA and assure that thin wall will not impact performance
  - Affects all A-coils
- Option 2 – Use-As-Is NCR
  - Would move A1 forward, but at risk of continued dimensional learning and schedule
  - Affects A1
- Option 3 – Weld Build Up
  - Would have to optimize part and identify areas for build up. Substantial shape risk on component. Large schedule impact.
- Option 4 – Remake
  - Would have schedule slip on both pattern and component in schedule. Would likely complete C coils and have production gap in program while B pattern completes and A is adapted.

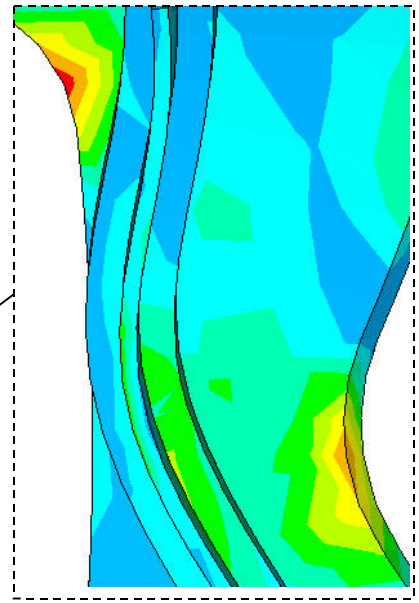
Request

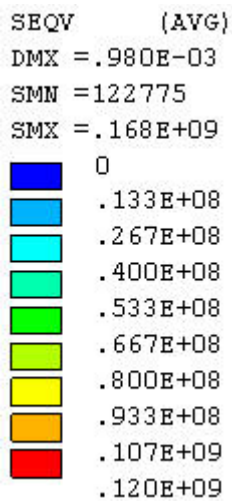
- Energy Industries of Ohio Team requests that PPPL analyze this and respond with preferred direction to move forward
  - MetalTek can offer additional laser scanning for verification of shape/dimension
  - Lawton has offered transfer measurement as a means for direct measurement of thickness, MetalTek has experience using similar technique
  - Component is on process hold pending resolution. Time is of the essence.

Stresses in Shell A1 for E=193 GPa

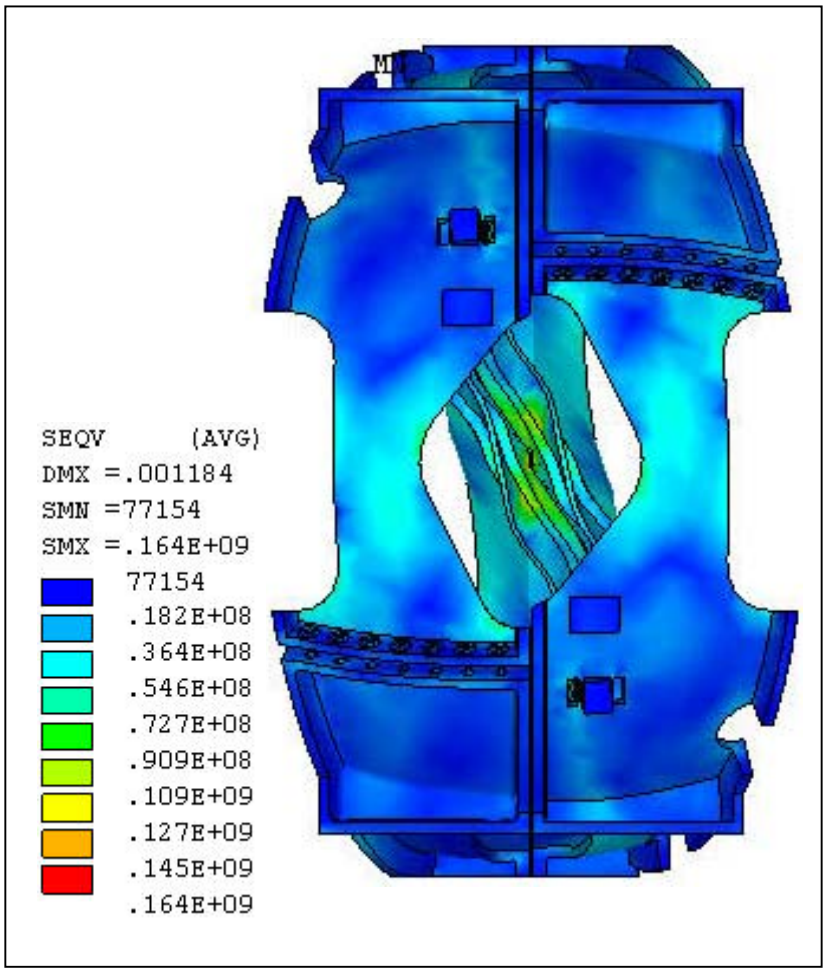


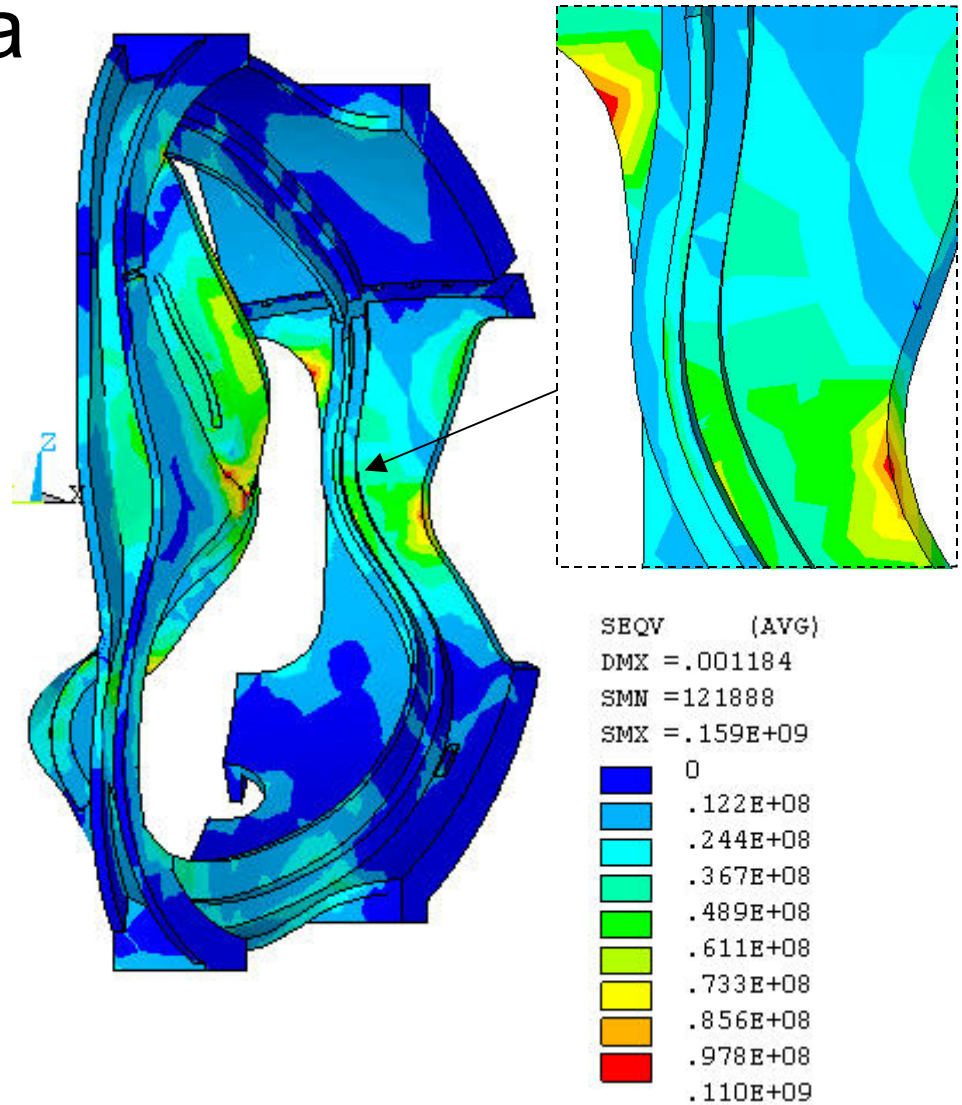




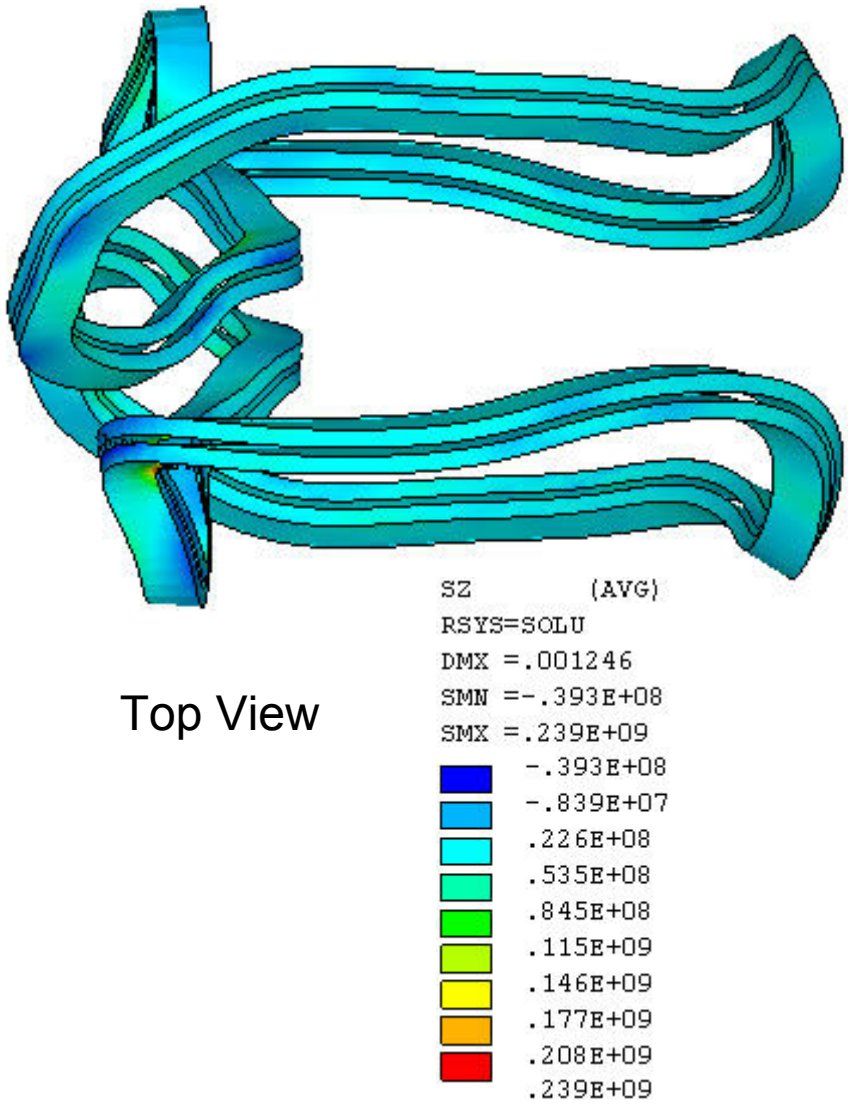


Stresses in Shell A1 for E(A)=152 GPa and E(B&C)=193 GPa

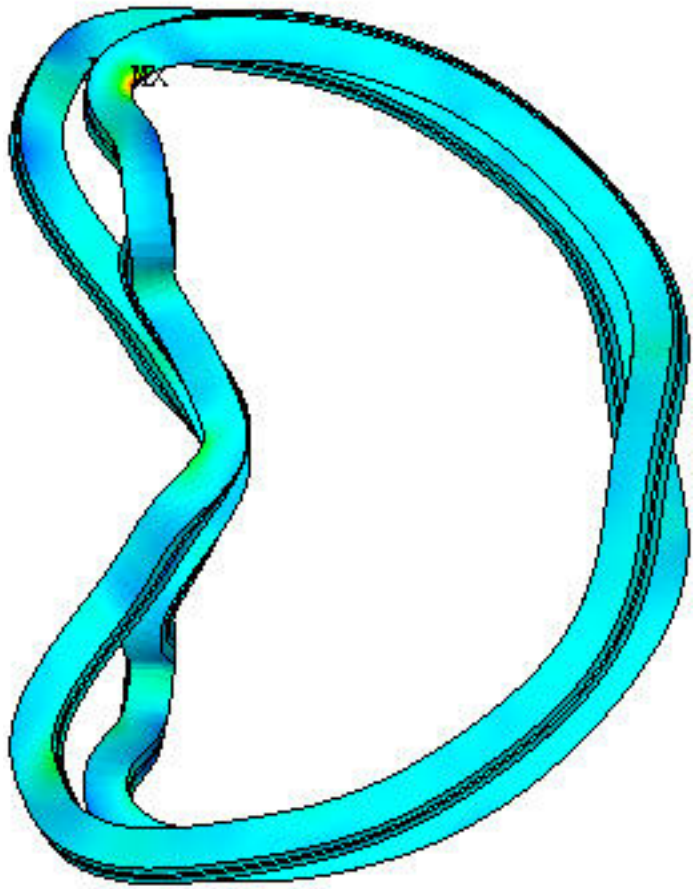




Stresses in Shell A1 for E=193 GPa

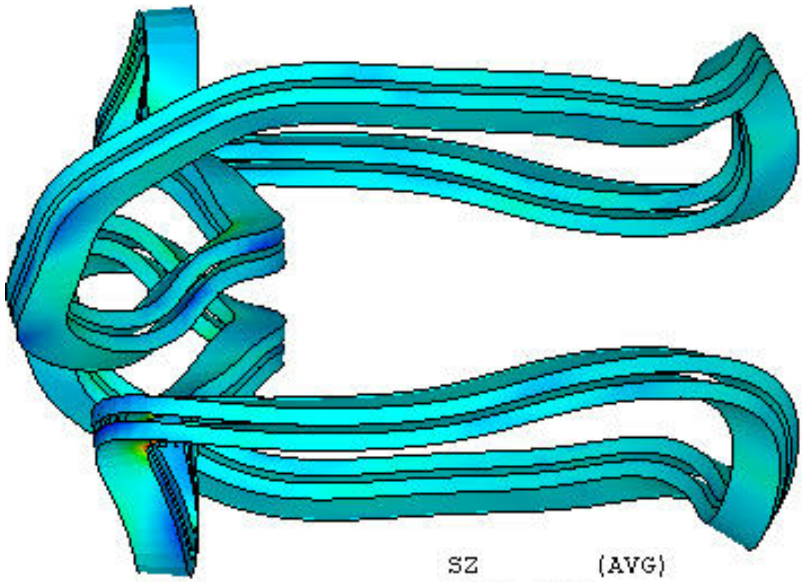


Top View

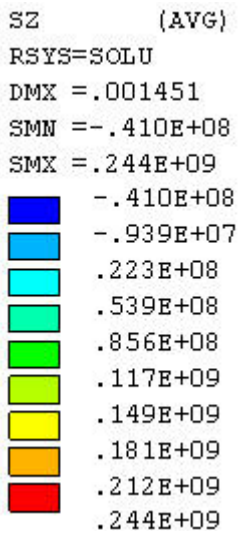


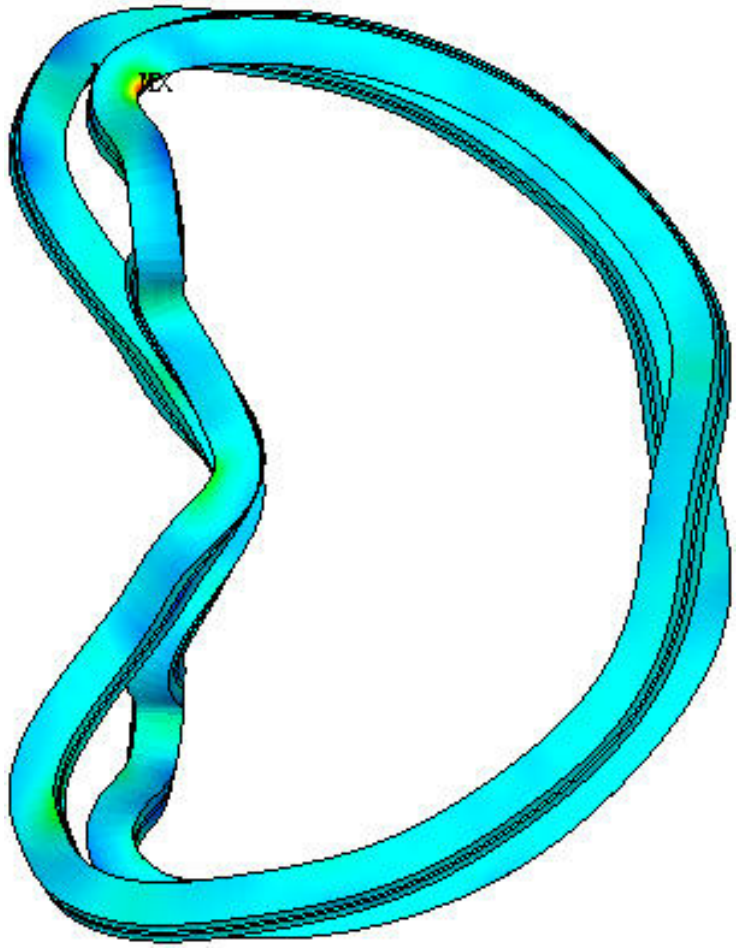
Side View

Stresses in Shell A1 for E(A)=152 GPa and E(B&C)=193 GPa



Top View





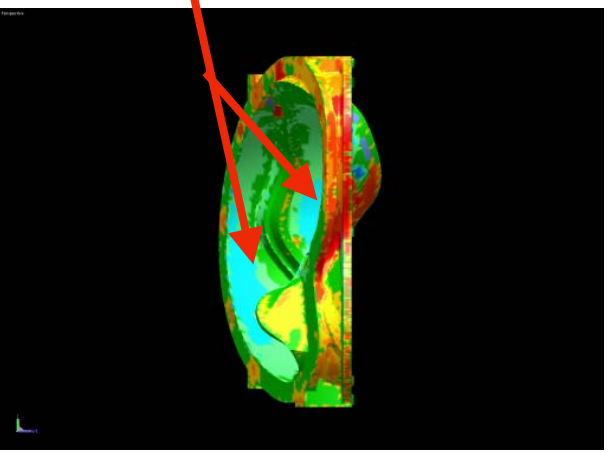
Side View

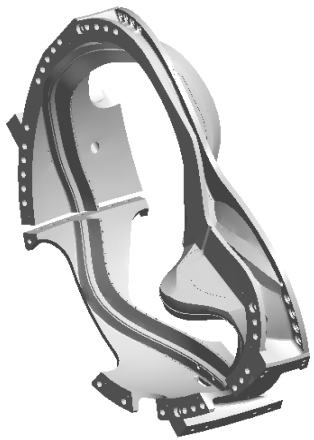
FEA Analyses Results of the A1 Casting with Thin Wall Regions

August 8, 2005

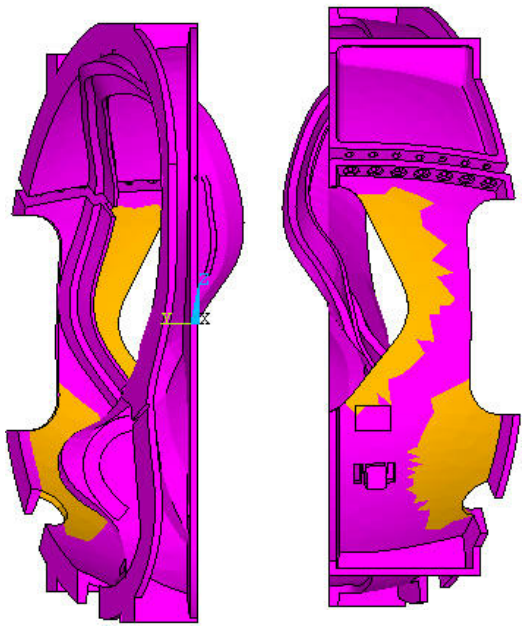
Thin Wall Areas in the A1 Casting

thin areas In light blue





Machined Casting



FEA model – thin areas are tan.

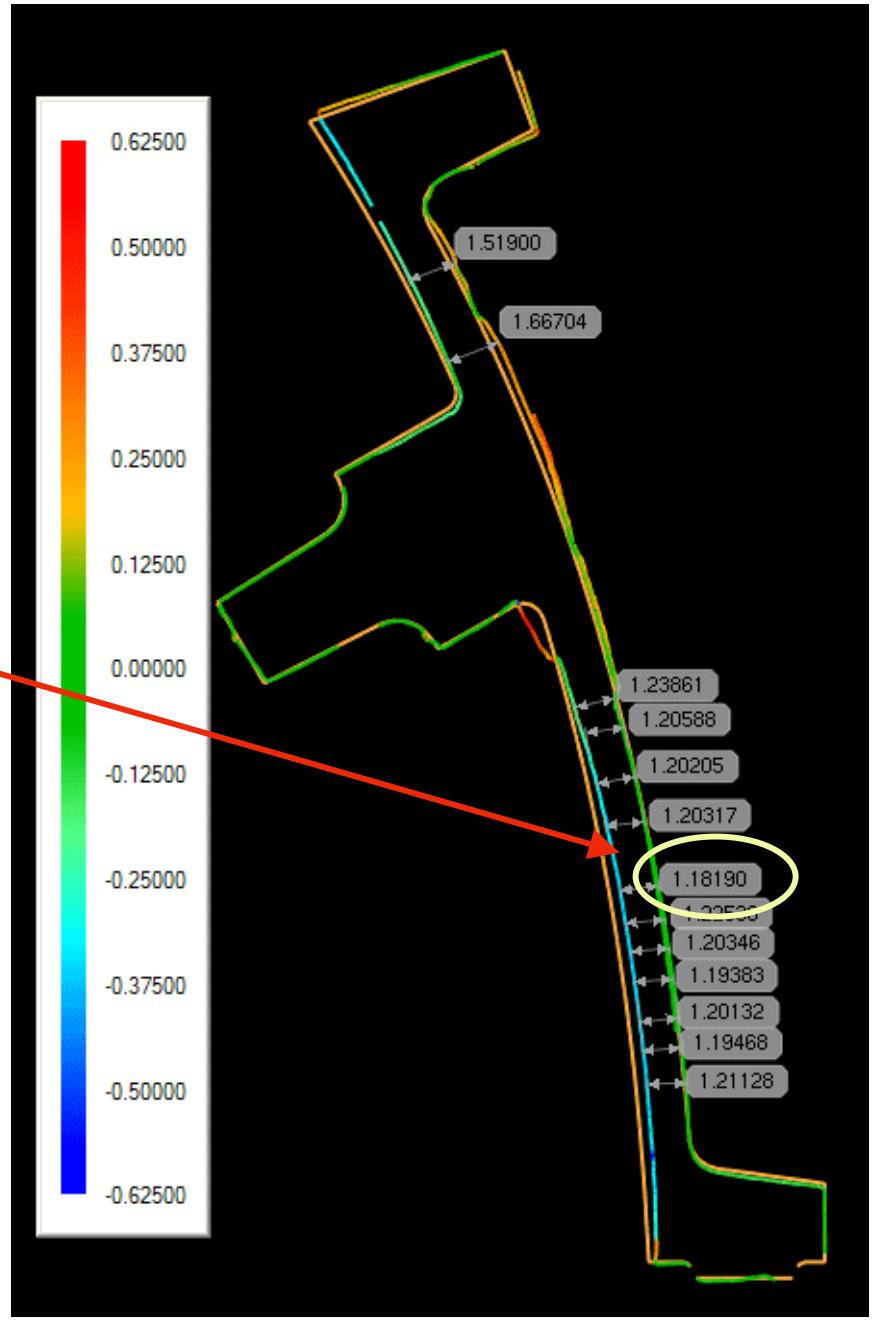
Note That Much Of the Thin Area is Machined Away, Lessening its Effect

SCANCO data well quantifies the actual wall thicknesses

Specified thickness is 1.375”
+0.25 / -0.00

Thinnest actual section is 1.18”.

“Guesstimate” is the thin area is 15% of the wall area.



FEA Studies for the Shell A Thin Wall Region:

- Run #1: ***Baseline Engineering Analysis used E for 316 SS.*** The E=193 GPa was based on data for 316 stainless steel as an interim value until E for cast "Stellalloy" was determined.

- Run #5: ***Analysis Corrected for the E of "Stellalloy".*** All shells having E=145 GPa, the value given by the specification for "Stellalloy".

- Run #6: ***This model reflects the updated E and also thin shell regions in A1 with wall thicknesses t=1.18".*** The E of shell A is modified by a thickness ratio of 1.18/1.375. The E of shell A become 124 GPa. (Note: In the FEA model, the affect of the thin wall is achieved by modifying the effective modulus, E, rather than actually changing the wall thickness in the model)

- Run #4: ***This model uses a corrected E and models All Type A Castings as Having A Thin Region Like A1 but 1.05"*** thick. E of shell is 145 GPa except in the shell A thin wall regions, where E=111 GPa

The slides which follow show that this is by far the most significant affect!

The Analyses Show That The Thin Region With Either Thickness Has a Very Minimal affect!

The Stress Allowable Based on the Spec. Minimum

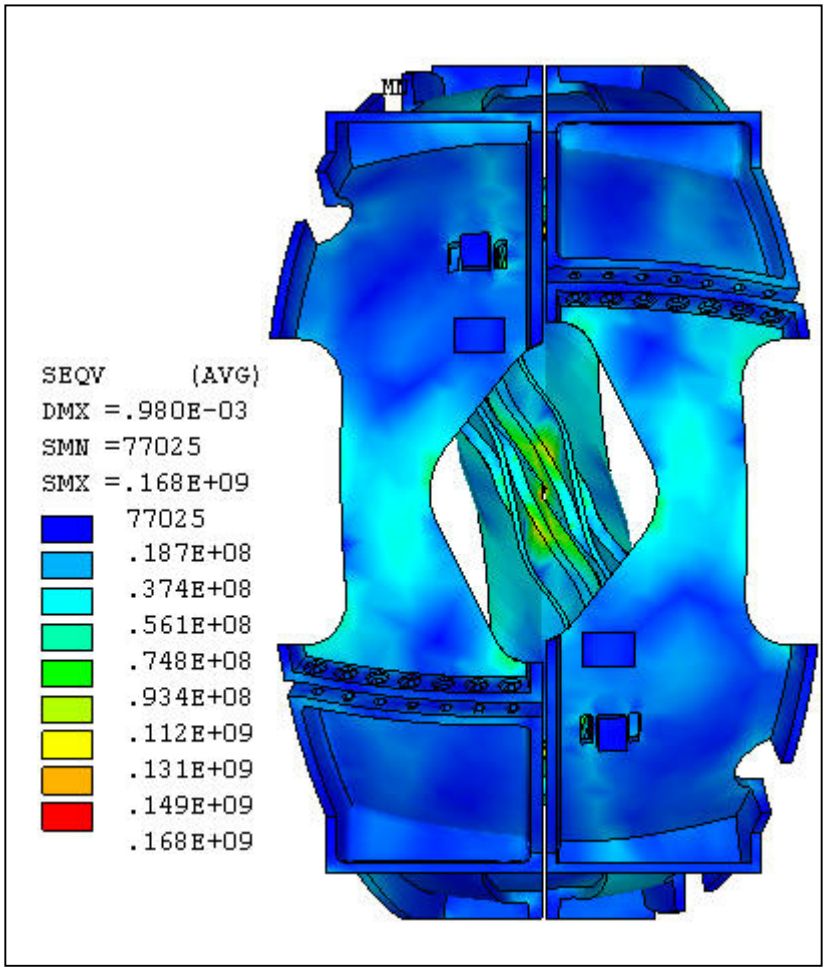
Property at 77 K			
Property	**Required**	**C-1 Casting Heat 27728 (averages)**	**LNM 4455 Electrode**
Elastic Modulus E	21 Msi (144.8 Gpa)	23.3	27.1
0.2% Yield Strength	72 ksi (496.4 Mpa)	98.4 124	126.3
Tensile Strength	95 ksi (655 Mpa)	170.2 170.2	187.7
Elongation	32%	55% 58.7%	33%
Charpy V – notch Energy	35 ft. lbs. (47.4 J)	78	51

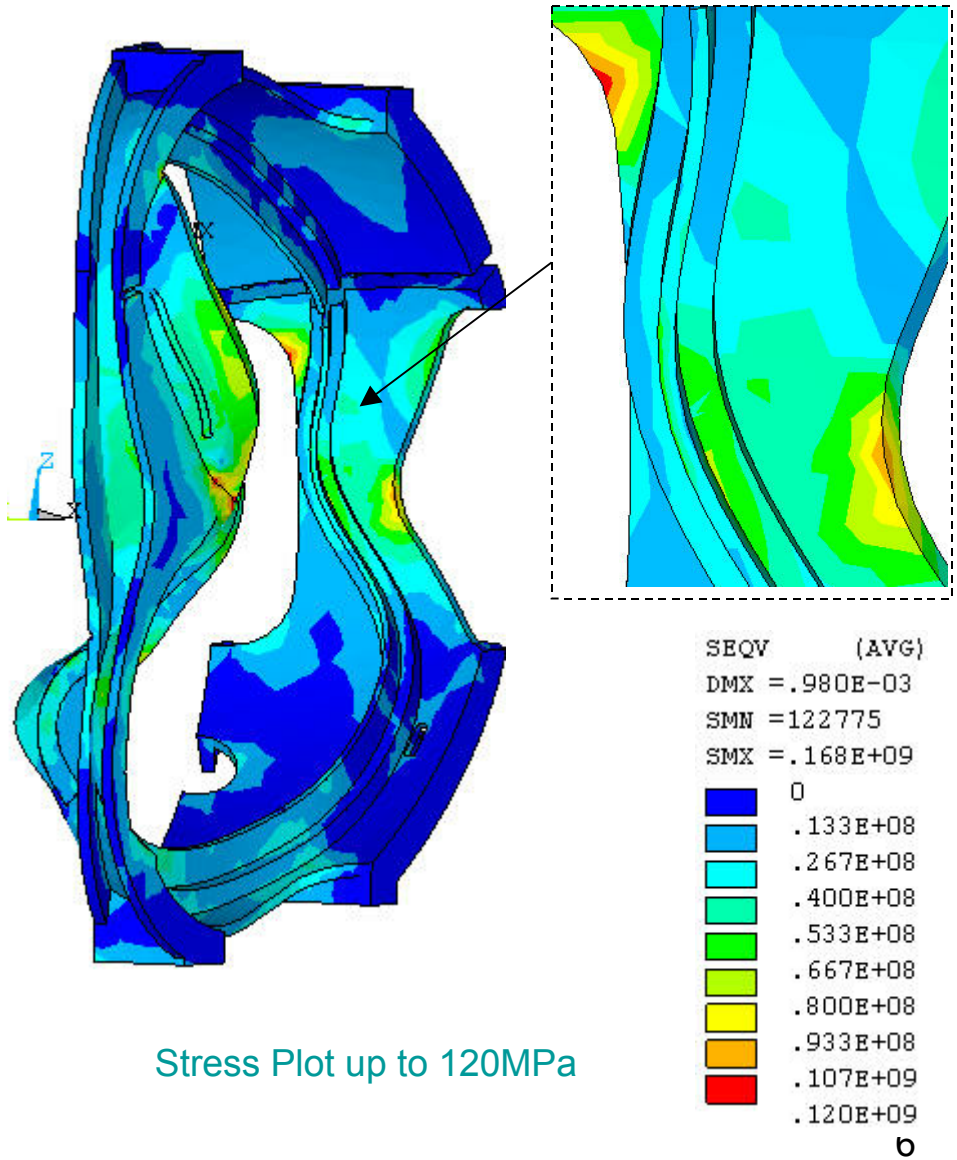
- The allowable is the lesser of ½ tensile strength or 2/3 yield.
- Using the spec minimum, this would be 322.5 MPa. (the lesser of 322.5 or 327.6)

The Baseline Analysis: Stresses in Shell Type A

(Run 1)

- E=193 GPa

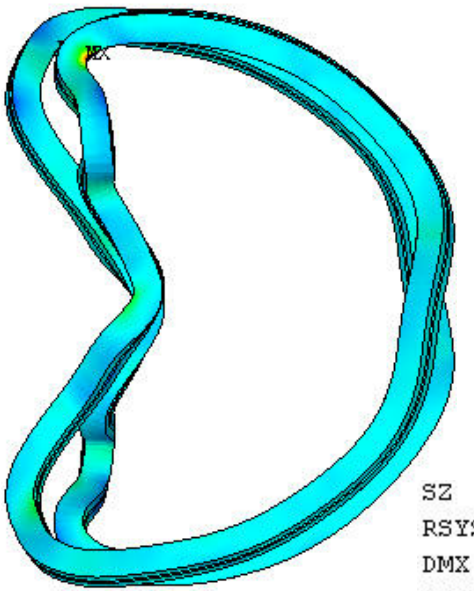




Stress Plot up to 120MPa

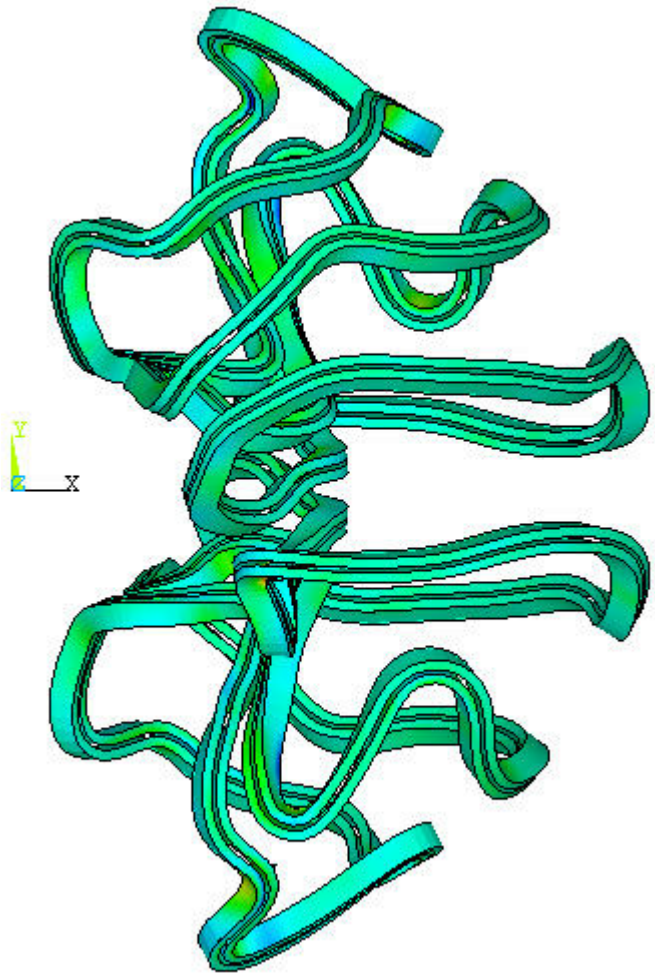
Baseline: Axial Stresses in Modular Coils for Run No. 1

- E=193 GPa



SZ (AVG)
RSYS=SOLU
DMX =.001246
SMN =-.393E+08
SMX =.239E+09
-.393E+08
-.839E+07
.226E+08
.535E+08
.845E+08
.115E+09
.146E+09
.177E+09
.208E+09
.239E+09

Coil Type A



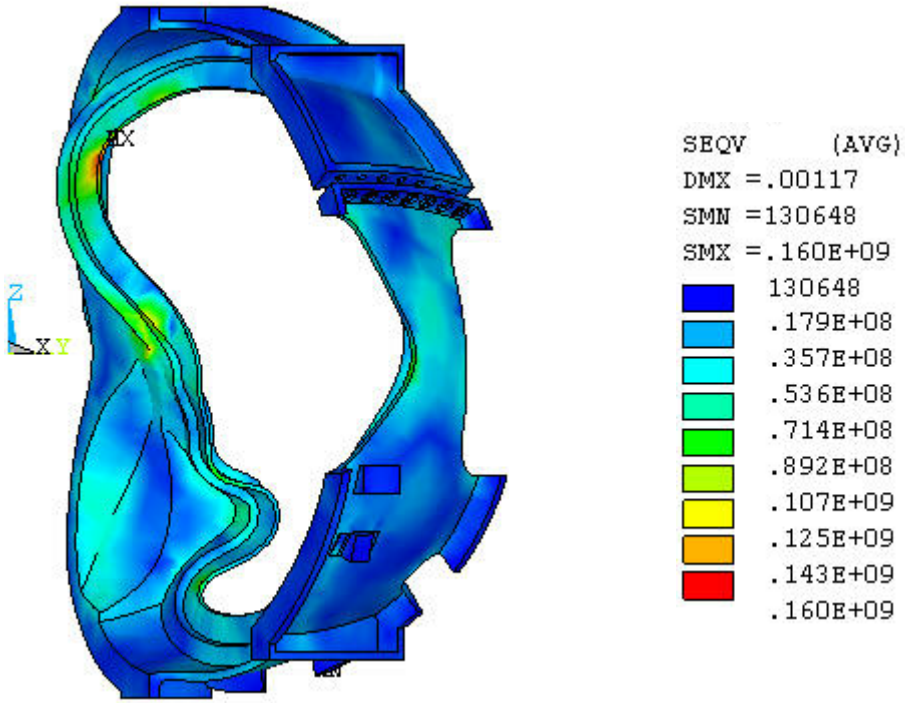
Top View

SZ (AVG)
RSYS=SOLU
DMX =.002711
SMN =-.895E+08
SMX =.239E+09
-.895E+08
-.530E+08
-.164E+08
.201E+08
.566E+08
.931E+08
.130E+09
.166E+09
.203E+09
.239E+09

Analysis Results with the E Updated for “Stellalloy”

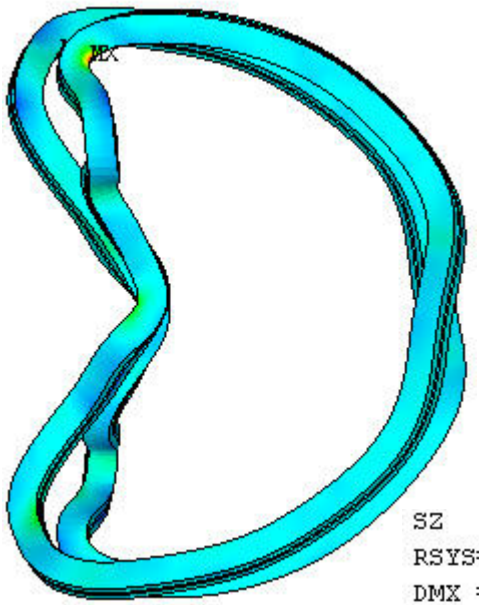
Stresses in Shell Type A for Run No. 5

- E=145 GPa



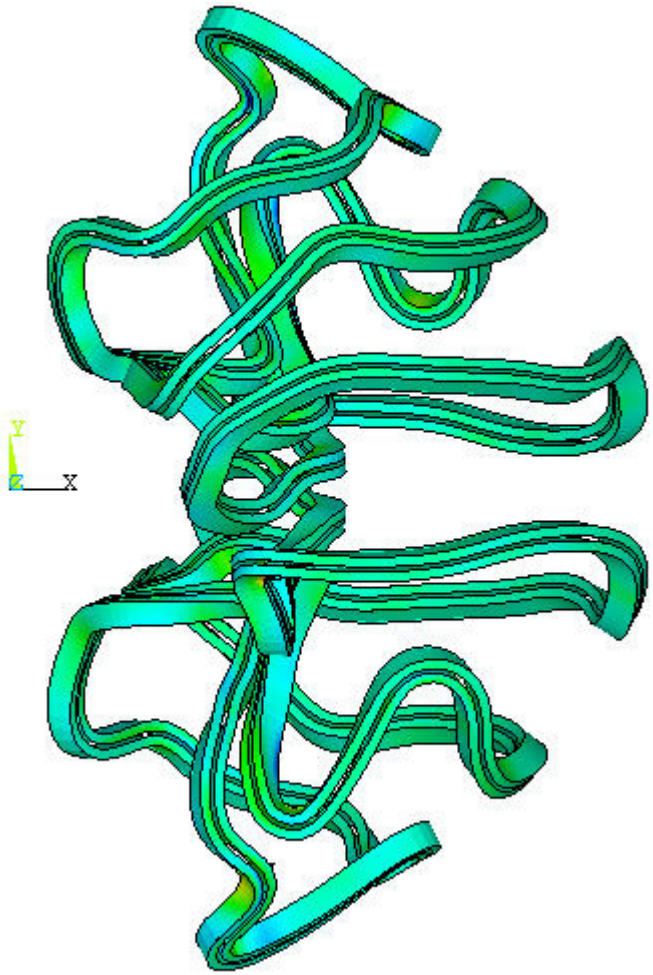
E Updated for “Stellalloy” Axial Stresses in Modular Coils for Run No. 5

- E=145 GPa



SZ (AVG)
RSYS=SOLU
DMX =.001513
SMN =-.425E+08
SMX =.248E+09
-.425E+08
-.102E+08
.221E+08
.544E+08
.868E+08
.119E+09
.151E+09
.184E+09
.216E+09
.248E+09

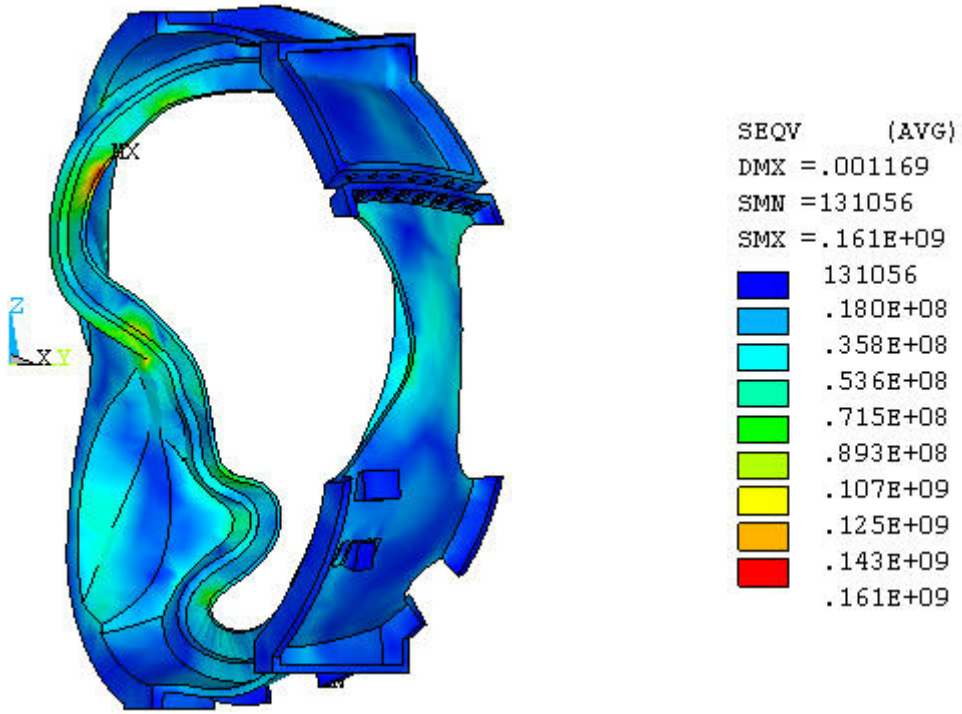
Coil Type A



SZ (AVG)
RSYS=SOLU
DMX =.002934
SMN =-.982E+08
SMX =.248E+09
-.982E+08
-.597E+08
-.212E+08
.173E+08
.558E+08
.943E+08
.133E+09
.171E+09
.210E+09
.248E+09

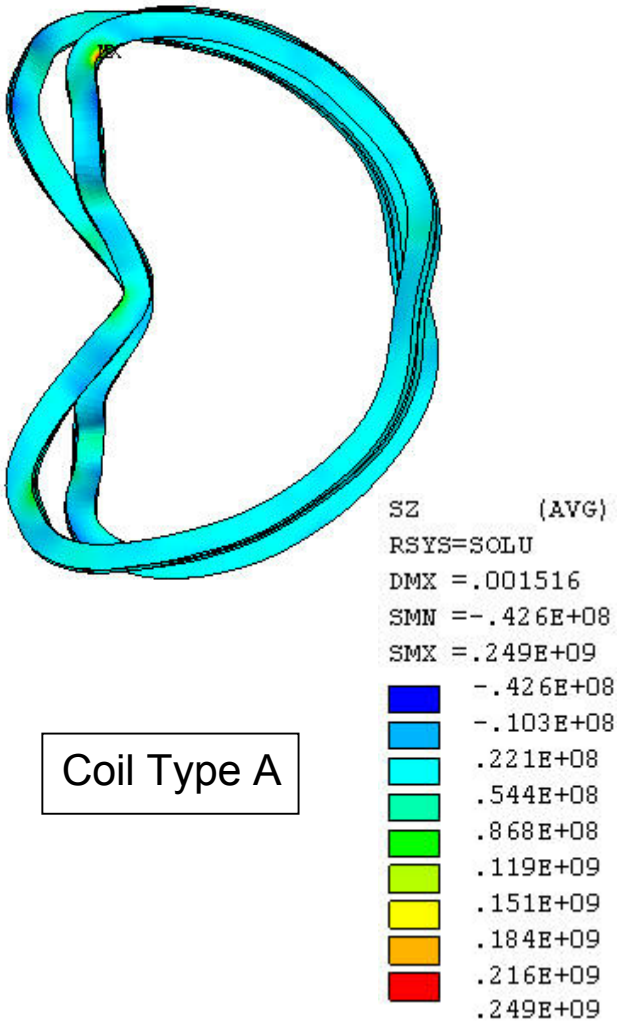
This model reflects the updated E and also thin shell regions in A1 with wall thicknesses t=1.18". Stresses in Shell Type A for Run No. 6

- E=145 GPa except E(thin wall region)=124 GPa

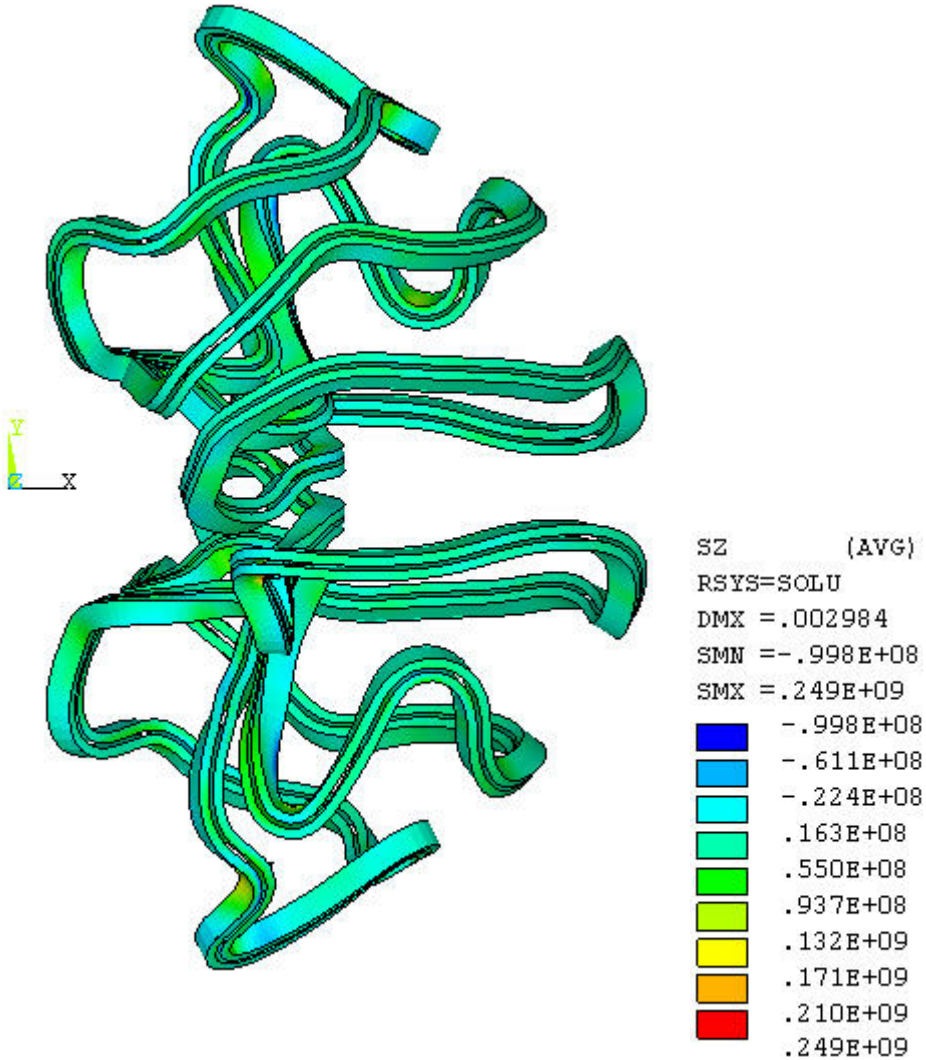


This model reflects the updated E and also thin shell regions in A1 with wall thicknesses t=1.18". Axial Stresses in Modular Coils for Run No. 6

- E=145 GPa except E(thin wall region)=124 GPa

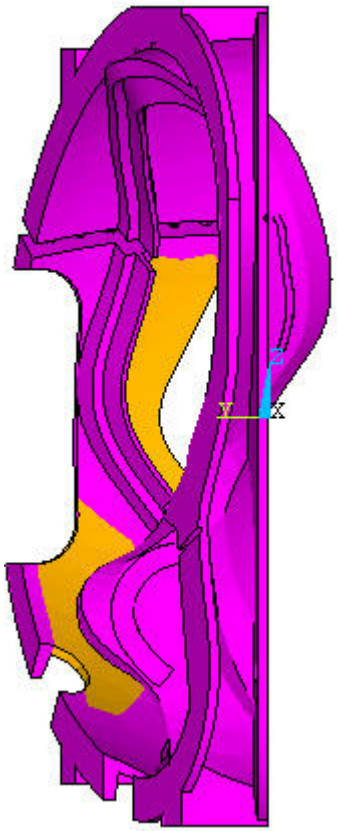


Coil Type A

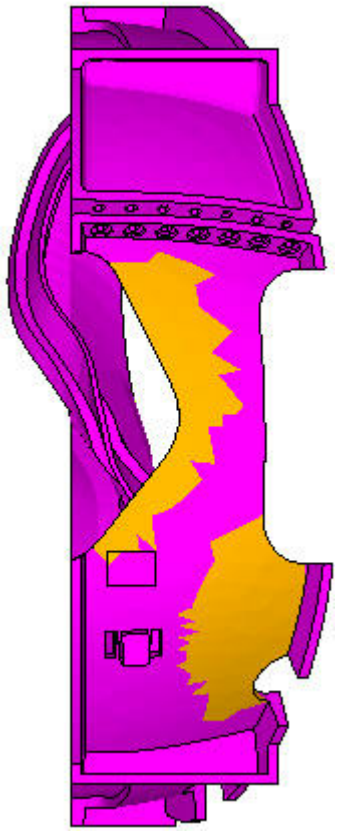


This model uses a corrected E and models All Type A Castings as Having A Thin Region Like A1 but t=1.05”

Modulus of Elasticity in Shell Type A for Run No. 4,



Left View



Right View

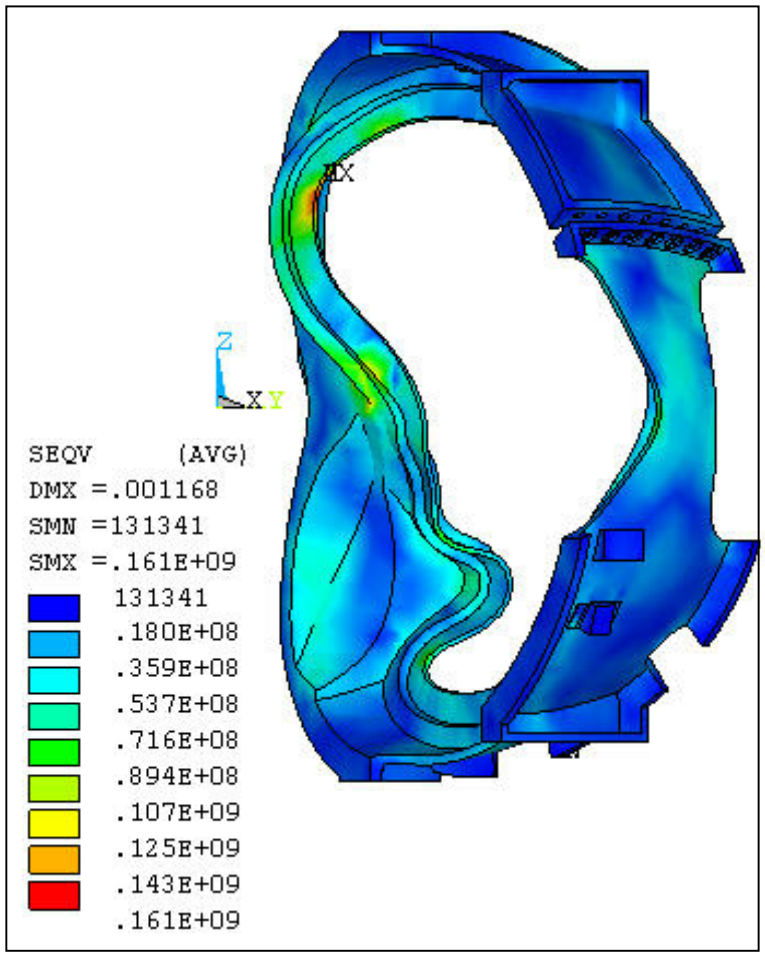
In the pink regions,
E = 145 GPa

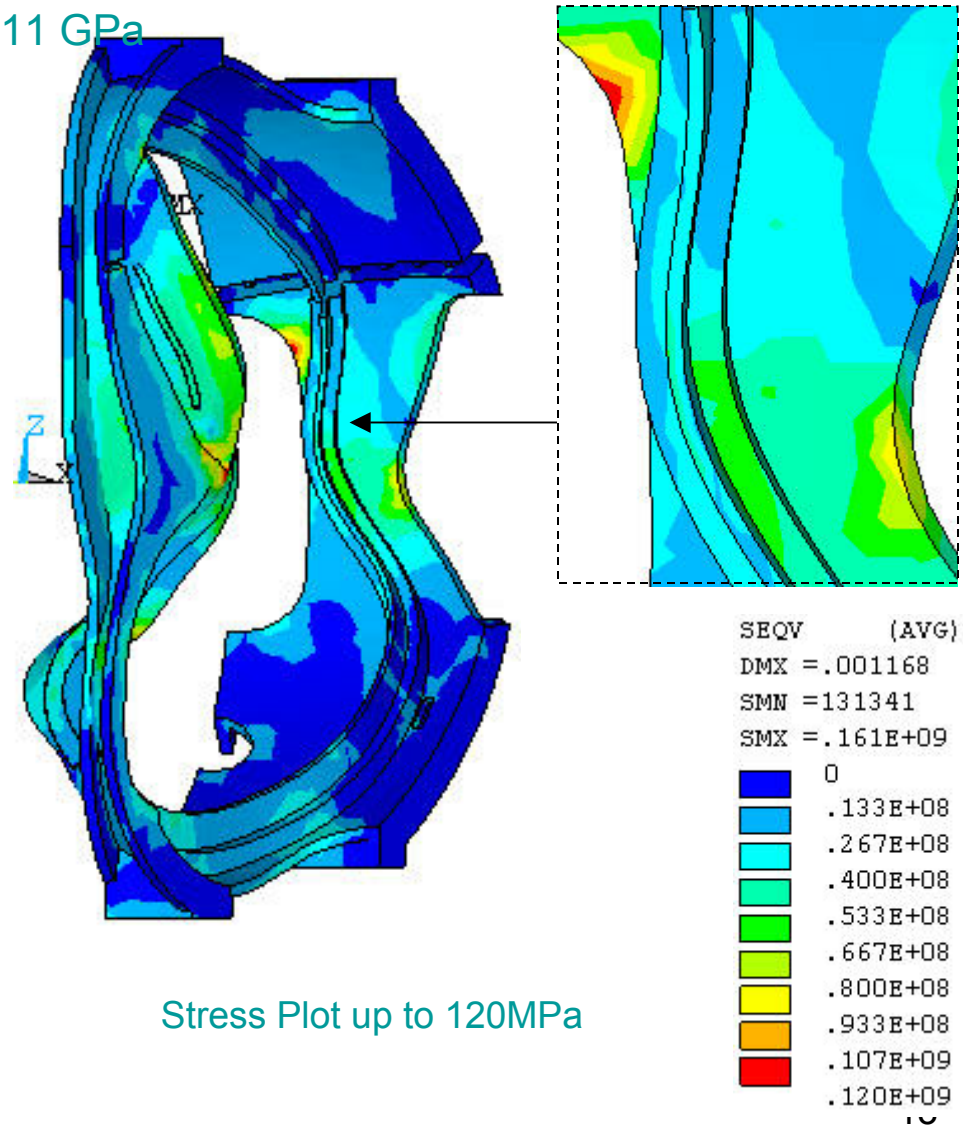
In the brown regions,
E=111 GPa to simulate a wall t=1.05”.

This model uses a corrected E and models All Type A Castings as Having A Thin Region Like A1 but t=1.05”

Stresses in Shell Type A for Run No. 4

- E=145 GPa except E(thin wall region)=111 GPa

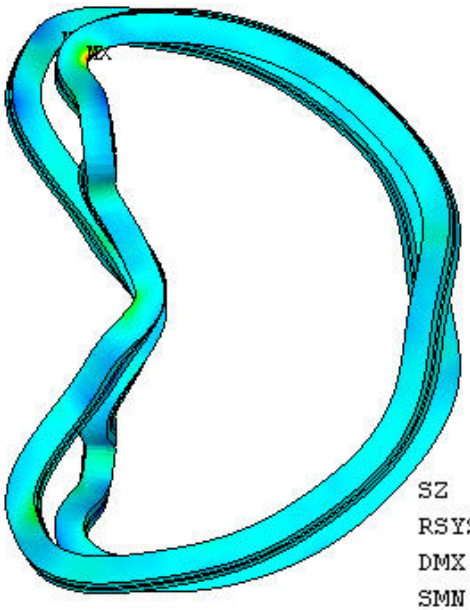




Stress Plot up to 120MPa

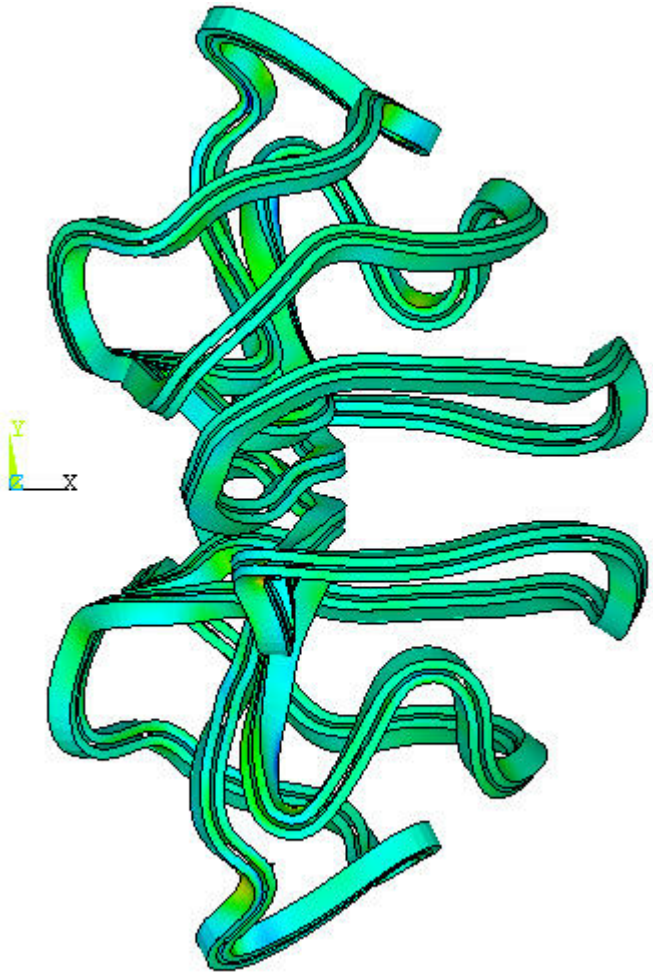
This model uses a corrected E and models All Type A Castings as Having A Thin Region Like A1 but t=1.05”

Axial Stresses in Modular Coils for Run No. 4
- E=145 GPa except E(thin wall region)=111



SZ (AVG)
RSYS=SOLU
DMX =.001517
SMN =-.426E+08
SMX =.248E+09
-.426E+08
-.103E+08
.220E+08
.544E+08
.867E+08
.119E+09
.151E+09
.184E+09
.216E+09
.248E+09

Coil Type A



Top View

SZ (AVG)
RSYS=SOLU
DMX =.002971
SMN =-.982E+08
SMX =.248E+09
-.982E+08
-.596E+08
-.211E+08
.174E+08
.559E+08
.944E+08
.133E+09
.171E+09
.210E+09
.248E+09

Summary:

- As the table below shows **the most significant effect is the updating of the modulus E to that of the "Stellalloy".**

- Thin shell areas like that of A1 **has an extremely minor affect on the stresses and displacements in ANY of the coils or shells** with the thickness being either 1.18" as for A1 or even with the thickness being 1.05" which MTK projects is the minimum if the shell is not changed. Reasons:

  a) The shape of the tee is not changed by this, and the tee provides most of of the bending stiffness

  b) Some EM forces are transferred to the shell B from the wing.

  c) The thin wall region is not the location for the peak stress and much of the area will be machined away.

		Shell Type A		Coil Type A		All Coils	
Run #	Configuration	Max. Displacement - mm	Max. Stress - Mpa	Max. Displacement - mm	Max. Stress - Mpa	Max. Displacement - mm	Max. Stress - Mpa
1	Baseline	0.98	168	1.246	239	2.711	239
5	Updated E	1.17	160	1.513	248	2.934	248
6	Updated E; thin sect. =1.18"	1.169	161	1.516	249	2.984	249
4	Updated E; thin sect. =1.05"	1.168	161	1.517	248	2.971	248

Consequently…

- Since the thin section of A1 has virtually no affect on stresses or deflections of either the coil or shell, the NCR for A1 with the thin region having a minimum thickness of 1.18” will be dispositioned to “Accept As Is”.
- Pending the root cause analysis and EIO’s recommendation, if necessary, based on these analyses, we have the flexibility to allow the wall thickness IN AN AREA SIMILAR TO A1 for all future Type A Castings to be a minimum of 1.050” and a maximum of 1.375 +0.250 =1.625” (which is the same as the upper limit currently specified).