Carondelet Division
8600 Commercial Blvd. • Pevely, MO 63070 USA
Phone: 636-475-2199 • Fax: 636-479-3399
E-Mail: Charles.Ruud@MetalTek.com

Draft Corrective Action 1671
Carondelet Division
Corrective Action Type NCR
Date 4-10-06
CA Originator C. Ruud
Applies to: A-6 Coil

Description of Defect / Non-Conformance
Test bar from zone 1 failed elongation at -320 F. Result was 20% versus a minimum of 32%. The original set of three bars, Z-1, Z-2 and Z-3 were sent for testing. Z-1 failed for elongation, 26% vs 32% minimum and Z-3 failed for elongation 19% vs 32% minimum. All other results were acceptable. Retests were ordered. The second results were similar. Z-1 failed for elongation, 25% vs 32% minimum and Z-3 failed for elongation 13% vs 32% minimum, but broke outside the gauge length. The third set of bars was tested. Z-3 passed and Z-1 failed for elongation, 20% vs 32% minimum, but broke outside the gauge length. All other test results were acceptable. See attached test reports.

Root Cause
We believe the failures are due to the test bars are located where the metal flowing into the casting is cooler and large grains form as a result. This has caused failures on C-5 and C-6 coils. We have ordered photo macrographs to see if this is the case.

Corrective Action
Use A-6 as is.

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Actual Completion Date
TBD

Signed: C. Ruud

CC: B. Craig, J. Edwards, E.J. Kubick, J. Markham, J. Galaske

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

March 9, 2006

CERTIFICATION

Section 1 of 1

WMT&R Report No. 6-23847
P.O. No. 19386
Requisition No. 7580

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: TENSILE

TENSILE RESULTS: ASTM E21-05
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: 0.003 in./in./min., 0.05 in./min./in.
MATERIAL: 316 S/S

DISPOSITION: Acceptable

Coil No.	Specimen	TestLog Number	Temp. °F	UTS ksi	0.2% YS ksi	Elong %	RA %	Modulus Msi	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
A6	Z2	D18313	-320	163.7	100.1	61	41	28.0	15730	9616	0.3498	0.2698	1.40	2.25	0.09610135	M9	A

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

TENSILE RESULTS: ASTM E21-05
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: 0.003 in./in./min., 0.05 in./min./in.
MATERIAL: 316 S/S

DISPOSITION: Unacceptable

Coil No.	Specimen	TestLog Number	Temp. °F	UTS ksi	0.2% YS ksi	Elong %	RA %	Modulus Msi	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
A6	Z1	D18312	-320	161.1	108.9	26	30	29.7	15470	10460	0.3497	0.2929	1.40	1.76	0.09604641	M9	U
A6	Z3	D18314	-320	157.5	111.2	19	28	30.9	15140	10690	0.3498	0.2959	1.40	1.67	0.09610135	M9	U

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

Roy E. Starr\Matt Wojton 3-9-06
Technical Services Manager\ Tensile Supervisor March 9, 2006

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ACCREDITED
621-01 & 621-02

Accredited Nadcap Materials Testing Laboratory

April 3, 2006

CERTIFICATION

Section 1 of 1

WMT&R Report No. 6-25662
P.O. No. 19386
Requisition No. 7580

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: TENSILE

TENSILE RESULTS: ASTM E21-05

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: 0.003 in./in./min., 0.05 in./min./in.

MATERIAL: Metaltek CF8MNMnMOD

DISPOSITION: Acceptable

Coil No.	Specimen	TestLog Number	Temp. °F	UTS ksi	0.2% YS ksi	Elong %	RA %	Modulus Msi	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
A6	Z2	D30719	-320	166.2	99.8	58	44	25.3	16120	9677	0.3514	0.2622	1.40	2.24	0.09698250	M9	A

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

TENSILE RESULTS: ASTM E21-05

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: 0.003 in./in./min., 0.05 in./min./in.

MATERIAL: Metaltek CF8MNMnMOD

DISPOSITION: Unacceptable

Coil No.	Specimen	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
A6	Z1	D30718	-320	166.1	108.1	25	26	27.6	—	16050	10450	0.3508	0.3024	1.40	1.75	0.09665160	M9	U
A6	Z3	D30720	-320	129.7	105.2	13	19	27.9	D	12540	10170	0.3508	0.3153	1.40	1.58	0.09665160	M9	U

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Requirements provided by MetalTek International

D - Ruptured outside middle half of gage length.

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

4-3-06
April 3, 2006

Westmoreland Mechanical Testing & Research, Inc.
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WMT&R is a technical leader in the material testing industry.

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621-01 & 621-02

Accredited Nadcap Materials Testing Laboratory

April 10, 2006

CERTIFICATION

Section 1 of 1
WMT&R Report No. 6-26780
P.O. No. 19386
Requisition No. 7580

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: TENSILE

TENSILE RESULTS: ASTM E21-05
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: 0.003 in./in./min., 0.05 in./min./in.
MATERIAL: Metaltek CF8MNMnMOD
DISPOSITION: Acceptable

Coil No.	Specimen	TestLog Number	Temp. °F	UTS ksi	0.2% YS ksi	Elong %	RA %	Modulus Msi	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
A6	Z2	D38883	-320	165.8	100.8	36	31	28.6	16070	9774	0.3513	0.2923	1.40	1.90	0.09692731	M9	A
A6	Z3	D38884	-320	160.9	93.7	44	41	25.5	15540	9049	0.3507	0.2686	1.40	2.02	0.09659650	M9	A

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TENSILE RESULTS: ASTM E21-05
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: 0.003 in./in./min., 0.05 in./min./in.
MATERIAL: Metaltek CF8MNMnMOD
DISPOSITION: Unacceptable

Coil No.	Specimen	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
A6	Z1	D38882	-320	134.7	100.2	20	23	26.0	D	13030	9700	0.3510	0.3084	1.40	1.68	0.09676184	M9	U

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Requirements provided by MetalTek International
D - Ruptured outside middle half of gage length.

Roy E. Starr\Matt Wojton
Technical Services Manager\Tensile Supervisor
4-10-06
April 10, 2006

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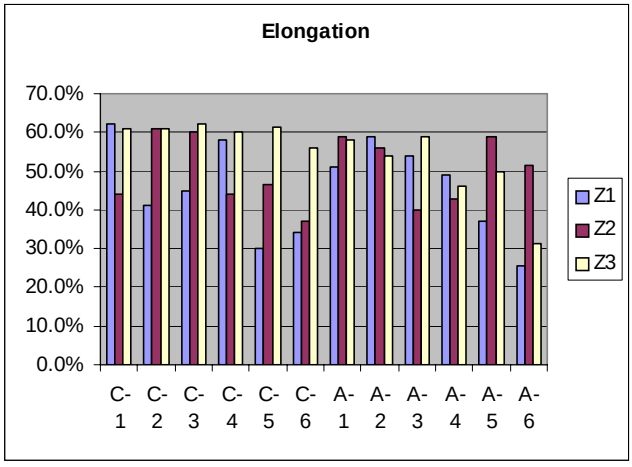
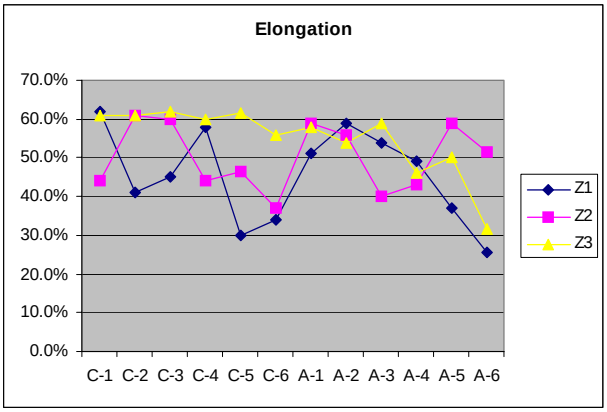
Disposition:

Casting A1 is accepted AS IS, and EIO is authorized to release this casting for shipment as soon as they feel it is appropriate. However, this NCR will be left open, pending MTK's final analysis of why the elongation test results for many of the A6 specimens were significantly below spec and previous results and varied so much. It is noted that the test values other than elongation are very good. The data below compares the elongation values for most of the castings produced to date. What is unusual about A6 is that the Z2 values are better than the values for many of the other castings. However, the values for Z1 and Z3 are lower than the others. MTK thinks this is due to the faster cooling rate at the cast on specimens. This first "slug" of alloy is cooled as it travels through the cold mold. However, the mold dryers are on for 12 hrs. or so prior to the pour, so the mold temperatures are not thought to vary very much. The third bar broke outside of the gauge length. The "valid" bars broke at 25 and 26%. One of the "good" bars failed at 19% (thought to be due to a defect); a substitute bar had a value of 44% elongation. The rule is if there is a defect in a test bar, it is appropriate to re-test.

Elongation	C-1	C-2	C-3	C-4	C-5	C-6	A-1	A-2	A-3	A-4	A-5	A-6
Z1	62.0%	41.0%	45.0%	58.0%	30.0%	34.0%	51.0%	59.0%	54.0%	49.0%	37.0%	25.5%
Z2	44.0%	61.0%	60.0%	44.0%	46.5%	37.0%	59.0%	56.0%	40.0%	43.0%	59.0%	51.3%
Z3	61.0%	61.0%	62.0%	60.0%	61.5%	56.0%	58.0%	54.0%	59.0%	46.0%	50.0%	31.5%





Approved by:

Phil Heitzenroeder

Digitally signed by Phil Heitzenroeder
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Tech. Rep.

Brad Nelson

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Implemented by:

EIO Representative(s