

TEST REPORT

Report Number 201620251 – Revision 4 (Updated grain flow analysis)

SUMMARY

One sample was received for visual inspection, mechanical testing, and metallurgical and chemical analysis.

6061
← confirmed

December 16, 2016

Gary Everest
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The sample **meets** the specified chemical requirements of UNS-A96061 for a wrought aluminum alloy, heat treatable.

The visual inspection, metallurgical, and hardness results are also reported.

PO Number
Credit Card

Date Received
November 4, 2016

Material
6061-T6 Aluminum

Material Identity
Aluminum Wheel

Specification(s)
UNS-A96061

VISUAL EXAM (AS-RECEIVED)

| Laboratory Number | Nicks/Dings | Scratches/Corrosion | Visual Wear or Abuse |
|-------------------|---------------|---------------------|----------------------|
| 20251-MET | None Observed | None Observed | None Observed |

Magnification(s): Visual

Method(s): E3-11

¹ One section was taken out of the fractured rim away from the fracture



Reviewed by

Technical Review

All procedures were performed in accordance with the Quality Manual, current revision, and related procedures; and the PWA MCL Manual E 23 and related procedures. The information contained in this test report represents only the material tested and may not be reproduced, except in full, without the written approval of [redacted] maintains a quality system in compliance with the ISO/IEC 17025 and is accredited by the American Association for Laboratory Accreditation (A2LA), certificate [redacted] form all testing in good faith using the proper procedures, trained personnel, and equipment to accomplish the testing requirements. The customer or any third party is limited at all times to the amount charged for the services provided. All samples will be retained for a minimum of 6 months and may be destroyed thereafter unless otherwise specified by the customer. The recording of false, fictitious, or fraudulent statements or entries on this document may be punished as a felony under federal statutes. [redacted] Test Labs is a GEAE S-400 approved lab (Supplier

Wheel
RTM

CHEMISTRY

| Element | 20251-CHM | UNS-A96061 |
|-----------------|-----------|--------------|
| Cr | 0.15 | 0.04 – 0.35 |
| Cu | 0.26 | 0.15 – 0.40 |
| Fe | 0.39 | 0.7 Maximum |
| Mg | 0.99 | 0.8 – 1.2 |
| Mn | 0.07 | 0.15 Maximum |
| Si | 0.61 | 0.40 – 0.8 |
| Ti | 0.03 | 0.15 Maximum |
| Zn | 0.08 | 0.25 Maximum |
| Ni | 0.02 | --- |
| Sn | <0.01 | --- |
| OE ¹ | <0.05 | 0.05 Maximum |
| OT ² | <0.15 | 0.15 Maximum |
| Al | Remainder | Remainder |

Results in weight percent unless otherwise indicated
 Method(s): ASTM E1251-11 (OES)
 Instruments(s): CSDR E-76
¹ Other elements, each / total

CONFIRMED 6061 METAL

ROCKWELL "E" HARDNESS TEST

| Laboratory Number | HREW ¹ | BHN Equiv. ² |
|-------------------|-------------------|-------------------------|
| 20251-2HRX | 89.5 | 82.0 HBW |

Method(s): ASTM E18-15

¹ Average of three readings

² Conversion based on ASTM E140-12b, Table 9; values are approximate and are given for reference only

Low hardness

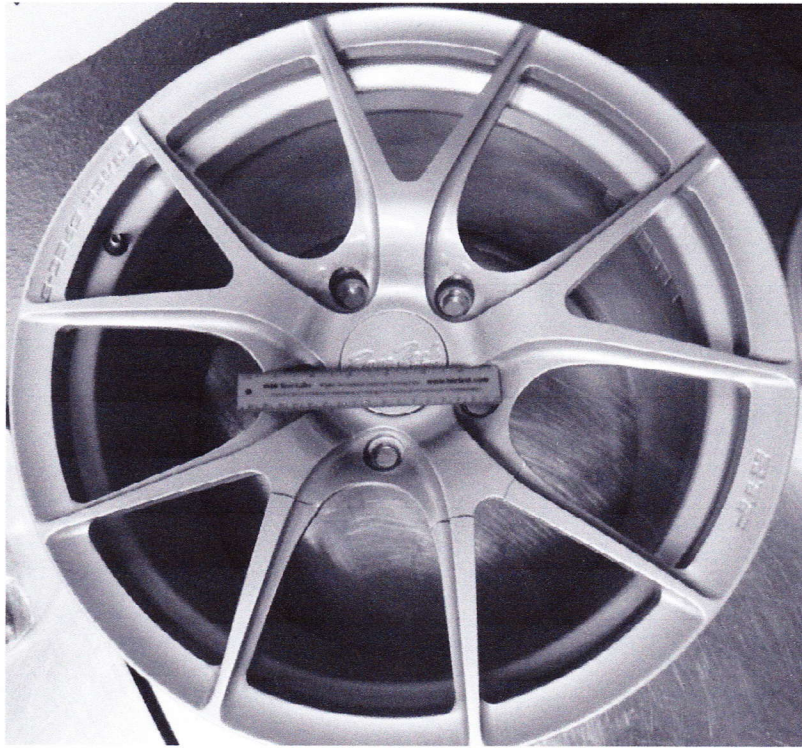
MICROSTRUCTURE EXAMINATION

A section from the Rear Wheel was mounted, metallographically prepared, etched using Weck's and examined at 500X magnification. The microstructure shows particles of MgSi in a matrix of aluminum solid solution. No grains were observed.

"Grain flow" appears in all forged monoblock wheels

GRAIN FLOW

* The sample was metallographically prepared and etched using Kroll's. No grain flow was observed. No reentrant grain flow was observed. The lack of grain flow is normally observed in cast metals. The part appears to have been machined after casting and shows no signs of forging.



Gary
Everest's
Wheel
with 3
broken
spokes

Figure 1: Macro photograph showing as received Fractured Sample.

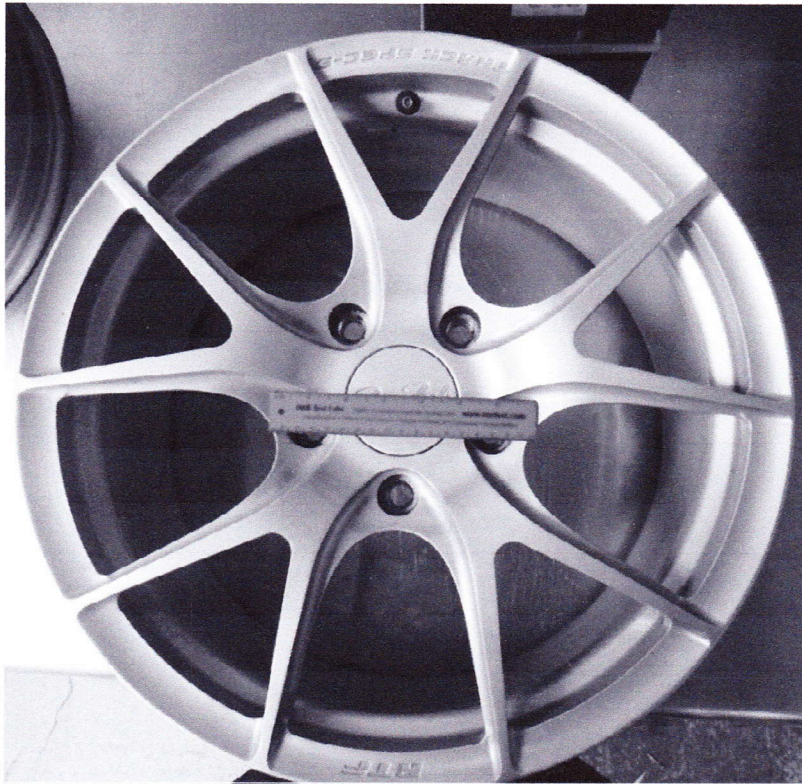
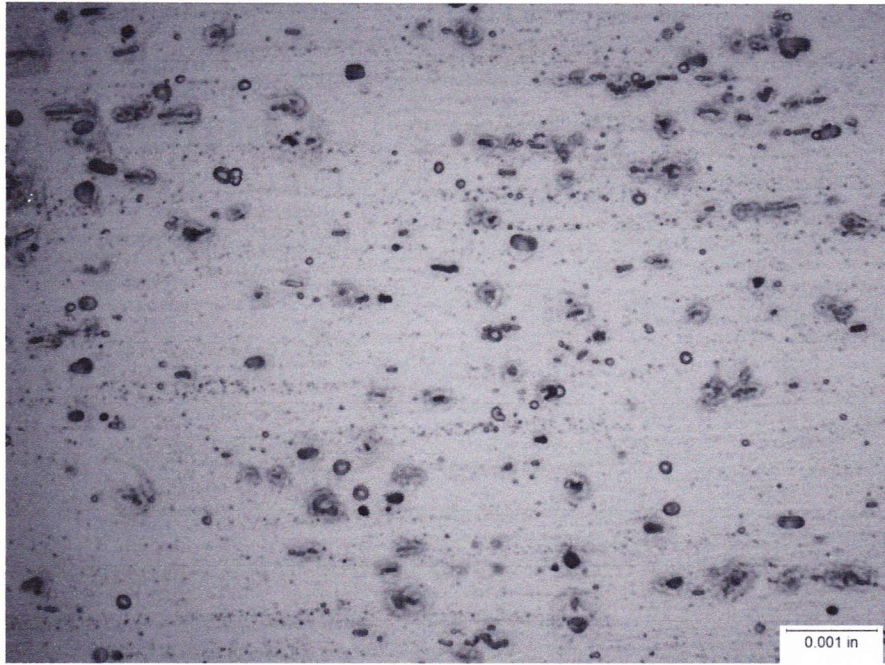


Figure 2: Macro photograph showing as received Non-Fractured Sample.



Manganese
and silicon
particles
in metal

Normal
for
6061

Figure 3: Representative photomicrograph of Rear Wheel (20251-MET) taken at the core. Weck's. Original magnification 500X.

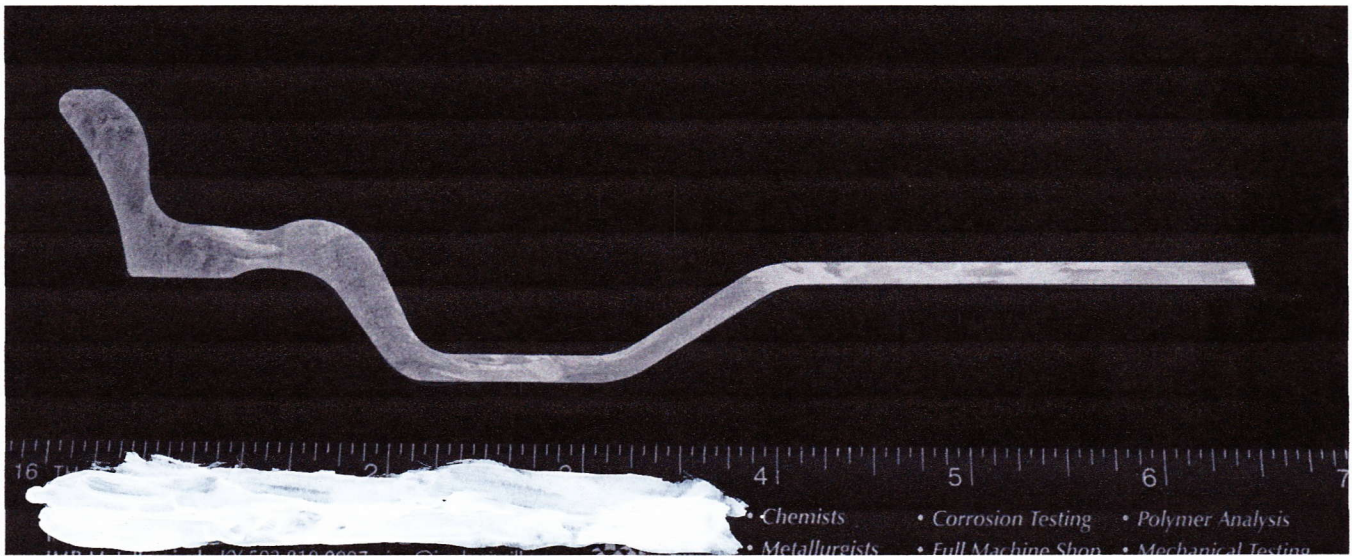


Figure 4: Macro photograph showing grain flow. Kroll's.

^
lack of