



Forged Aluminum Wheel Metallurgical Requirements

1 Scope

This standard covers metallurgical requirements for forged aluminum wheels.

1.1 Material Description. GMW15657M-AL-F-Mg1SiCu(6061)-T6 or GMW15657M-AL-F-Si1MgMn(6082)-T6 for Forged Aluminum Wheels.

1.2 Symbols. Not applicable.

1.3 Applicability. Forged aluminum alloy wheels for passenger cars, sport utility vehicles, and light duty pick-up trucks which have been manufactured with forged disc and forged rim or manufactured with forged disc and flow-form rim.

1.4 Remarks. This standard details the requirements for the materials, dye penetrant inspection, and conical seat steel bushings.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM B557M	CMVSS 120	FMVSS 110	ISO 6506-1
ASTM B594-13	Edict INMETRO 445/10	FMVSS 120	ISO 6892-1
ASTM B807	EN 473	GB/T 6519-2013	ISO 9712
ASTM B918	EN 10263-2	GB/T 9445-2008	ISO 9916
ASTM E165/E165M	EN 10277-3	ISO 209	SNT-TC-1A
CMVSS 110			

2.2 GM Standards/Specifications.

GMW3044	GMW3059	GMW15657	GMW16705
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2.3 Additional References.

CG1152 Wheel and Wheel Trim Statement of Requirements (SOR), Appendix B.

TMC003 Material Safety Data Sheet guidance documents (available at www.gmsupplypower.com).

3 Requirements

3.1 Chemical and Micro-Structure Requirements.

3.1.1 Chemistry. Forged aluminum chemistry per GMW15657M-AL-F-Mg1SiCu(6061)-T6 or GMW15657M-AL-F-Si1MgMn(6082)-T6.

To meet the mechanical property requirements, it may be necessary to restrict chemical composition ranges of specific elements and these restrictions must be approved by General Motors prior to Production Part Approval Process (PPAP). If range exceptions are used, these must be shown on the engineering part detail drawing.

Alloy designations and composition limits were obtained from Aluminum Association (AA) and ISO 209 reference standards.

Any chemical composition changes to GMW15657 alloy grades must be shown on the detail drawing.

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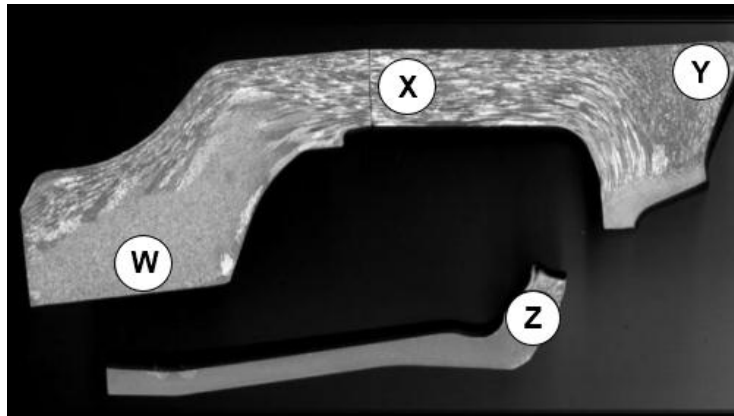
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3.1.2 Micro-Structure. Grain flow of the final wheel shall be documented by submission during validation at PPAP with at least one (1) full section view image through hub, spoke (additional image if unique spoke profiles), outboard flange, and inboard flange of the forging after flow-forming, but before machining. Refer to Figure 1. The image provided should be sufficiently etched to show grain flow. Grain flow in production wheels shall be equivalent to that used for validation at PPAP and shall be verified during production based on the sampling plan in the part control plan.

Figure 1: Full Section View Image through Hub (W), Spoke (X), Outboard Flange (Y), and Inboard Flange (Z)



3.1.3 Micrograph images shall be provided from fully processed wheels (after heat treatment, aging, and paint bake cycles). The micrograph images supplied shall be taken and documented from the outboard rim flange, hub, spoke, and inboard rim flange from a minimum of two (2) finished wheels that are representative of the wheels used for validation tests. The first tool and all subsequent tool micrograph images shall be measured at PPAP. Micro-structure in production wheels shall be equivalent to those used for validation at PPAP and shall be verified during production based on the sampling plan in the part control plan.

The images provided should contain a micron bar and show the etched micro-structure per the following:

- A 50x image should show approximately 2 mm² of the structure (typically taken with a 5x objective lens) and labeled as 50x. Refer to Figure 2.
- A 200x image should show approximately 0.5 mm² of the structure (typically taken using a 20x objective lens) and labeled as 200x. Refer to Figure 3.

Figure 2: Micrograph at 50x Magnification

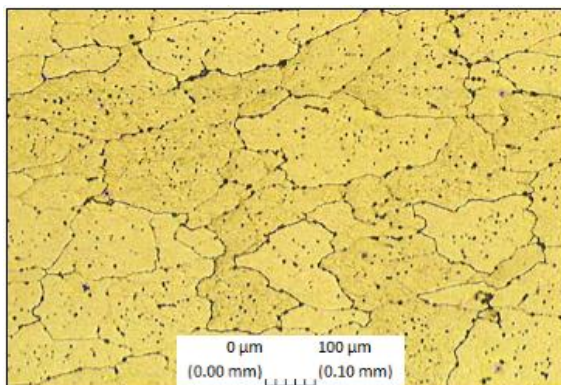
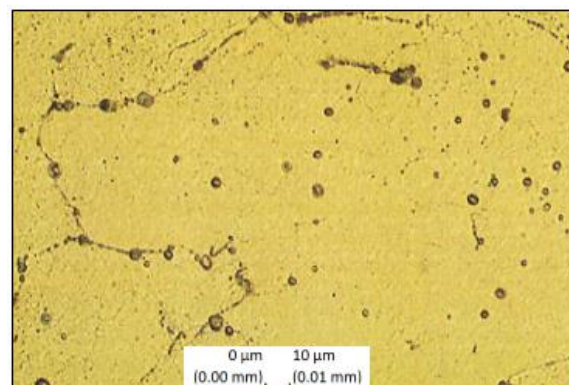


Figure 3: Micrograph at 200x Magnification



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Forgings shall be uniform in composition. Forgings shall be free of discontinuities detrimental to the performance or appearance of the part, such as blowholes, cracks, cold shuts, mis-runs, shrinks, laps, inclusions, or other discontinuities within mutually established acceptance limits. Fully processed wheels shall be free of these discontinuities.

Refer to Figure 4, Figure 5, and Table 1 for micrograph locations. Refer to Table 1 for micrograph sample sizes.

Figure 4: Schematic Cross Section of a Wheel Indicating the Approximate Location and Orientation for Mechanical Property Specimens and Micrographs

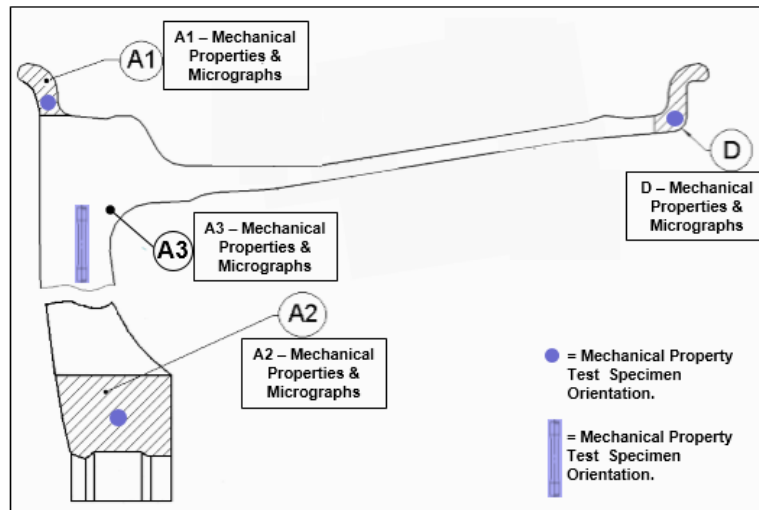


Figure 4 Legend for Wheel Areas:

- A1:** Outboard rim flange (Mechanical Properties & Micrographs).
- A2:** Hub (Mechanical Properties & Micrographs).
- A3:** Spoke (Mechanical Properties & Micrographs).
- D:** Inboard rim flange (Mechanical Properties & Micrographs).

Figure 5: Schematic Front View of a Wheel Indicating the Approximate Location and Orientation for Mechanical Property Specimens and Micrographs

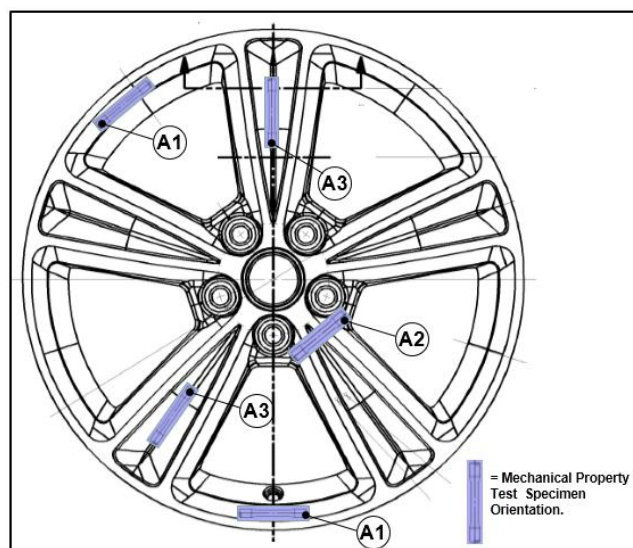


Figure 5 Legend for Wheel Areas:

- A1:** Outboard rim flange (Mechanical Properties & Micrographs).
- A2:** Hub (Mechanical Properties & Micrographs).
- A3:** Spoke (Mechanical Properties & Micrographs).

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