



ALUMINUM, HIGH TEMPERATURE. EUTECTIC SILICON COPPER NICKEL MAGNESIUM ALLOY

WSS-M2A137-B7

1. SCOPE

The material defined by this specification is a eutectic silicon aluminum alloy suitable for permanent mold casting, which contains copper, nickel and magnesium to enhance elevated temperature properties. This material is an anodizing grade.

2. APPLICATION

This material specification was released originally for automotive gasoline engine pistons where mechanical properties at elevated temperature, dimensional stability and wear resistance are required. This material should not be used in applications where any measurable amount of ductility is required. Due to the higher silicon content, this material will be more difficult to machine than standard structural aluminum alloys.

3. REQUIREMENTS

3.1 STANDARD REQUIREMENTS FOR PRODUCTION MATERIALS

Material suppliers and part producers must conform to the Company's Standard Requirements for Production Materials (WSS-M99P1111-A)

3.2 SAMPLING LOCATIONS

Sampling locations for requirements of this specification shall be as specified on Engineering Drawing, Engineering Specification or in supplier's control plan. For pistons, microstructure-sampling locations shall include the pin bore region, which is generally the slowest solidifying with the coarsest silicon particle size; and may also include ring groove(s) and skirt(s). Tensile test bars shall be taken from the crown region near the pin bore or other approved location.

3.3 CASTING QUALITY

(ASTM E 155 or Approved Alternate)

The finished component shall be free from laps, cold shuts, dross and sludge; and shall have minimal eutectic segregation/depletion. Shrinkage and gas porosity shall be kept to a minimum and any porosity present shall not adversely affect the function of the component. Radiographic assessment levels for gas and shrinkage porosity, if required, shall be according to methods of ASTM E 155 and requirements defined on the Engineering Drawing or Engineering Specification.

Date	Action	Revisions
2005 05 24	Activated	



Documents

R. Thomas

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3.4 CHEMICAL COMPOSITION (Weight Percent) (ASTM E 1479/ASTM E 1251)

Silicon	11.5 – 13.5
Copper	3.0 – 4.0
Iron	0.70 max.*
Magnesium	0.7 - 1.3
Nickel	1.7 – 2.5
Manganese	0.1 - 0.5
Zinc	0.3 max.
Titanium	0.25 max.
Chromium	0.10 max.
Sodium	0.002 max.
Strontium	0.002 max.
Calcium	0.002 max.
Phosphorus	**
Others Each	0.1 max.
Others Total	0.5 max.
Aluminum	Balance

* High performance pistons may require lower iron. Mn content, in the ratio Fe:Mn 2:1, must balance iron content, if casting process produces parts with beta iron phase (needle-like iron-rich phase) in the microstructure when Mn content is less than one-half the iron content.

** Primary silicon refinement 0.0025 – 0.0200% P typical

Supplied composition shall fall within above ranges; limits defined as part of control plan. Customer and supplier shall agree upon test method(s) for molten Aluminum and component chemical analysis determination. ASTM E1479 Inductively Coupled Argon Plasma Spectroscopy (ICP) is recommended for components and ASTM E 1251 Optical Emission Spectroscopy (OES) is recommended for molten aluminum. Control plan will also include any metal treatment practice (i.e., modification, refining elements, filtering, etc.) and processing detail.

3.5 MECHANICAL PROPERTIES (From Heat Treated Castings or Finished Components)

(ASTM E 8/E 8M/ASTM B 557; ASTM E 10/ISO 6505 and ASTM E 18/ISO R 80)

3.5.1	Tensile Strength, MPa, min.	260
	Yield Strength, MPa, min.	240
3.5.2	Hardness, HBW (500 kg load, 10 mm ball), or (250 kg load, 5 mm ball)	90 - 140

Rockwell F, Rockwell B or Rockwell K measurements may be used on the finished component in lieu of Brinell impressions. Hardness measurement requirements and locations shall be as specified on the engineering drawing.