



ALUMINUM, SILICON COPPER MAGNESIUM ALLOY

WSS-M2A137-B6

1. SCOPE

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

2. APPLICATION

This material specification was released originally for automotive pistons where mechanical properties at elevated temperature and wear resistance are required.

3. REQUIREMENTS

3.0 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 CHEMICAL COMPOSITION (Weight Percent)

Silicon	14.8 - 18.0
Copper	0.8 - 1.5
Iron	0.8 max*
Magnesium	0.8 - 1.3
Nickel	0.8 - 1.3
Manganese	0.2 max
Zinc	0.3 max
Titanium	0.25 max
Chromium	0.10 max
Others each	0.1 max
Total others	0.5 max
Sodium/Strontium	---
Phosphorus	**
Aluminum	Balance

* High performance pistons may require lower iron; iron content must be balanced by Mn content, 2:1 respectively, 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 - 0.02% typical

Supplied composition shall fall within the above ranges, and limits will be defined as part of the control plan. The control plan will also include modification, refining elements and processing detail.

Date	Action	Revisions
2003 09 12	Revised	Para 3.0 inserted; para 3.1, 3.6 and 4 deleted
2001 04 30	Revised	Revised 1, 2, 3 & updated
1999 07 22	Activated	



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3.3 MECHANICAL PROPERTIES

(From Heat Treated Castings)

Room Temperature

3.3.1 Tensile Strength, min 200 MPa
(ASTM E 8/ E 8M)

Test bars may be machined from any location, however, the engineering drawing may designate a higher value for test bars from specified locations within the component.

3.3.2 Hardness 90 - 130 HB
(ASTM E 10)

(500 Kg load, 10 mm ball), or
(250 Kg load, 5 mm ball)

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

3.4 MICROSTRUCTURE

(ASTM E 3)

Microstructure shall consist of primary silicon crystallites in an acicular aluminum silicon matrix containing uniformly distributed intermetallic compounds.

Silicon particles must be randomly distributed and generally average 10 to 50 microns in diameter, with no edge length of any particle to exceed 100 microns. High performance pistons may require finer silicon particle size. Surface depletion of primary silicon crystals should be kept to a minimum.

Microstructural field sampling area and locations shall be as specified in supplier's control plan. For pistons, sampling locations should include pin bore and ring groove.

3.5 HEAT TREATMENT (T5 or T6)

Cool from an elevated temperature casting process or solution heat treatment and then artificially age to improve mechanical properties and/or dimensional stability. Age for a minimum of 4 hours, typically 8 - 12 hours at temperatures selected between 195 - 240 °C. Maintain selected aging temperature to +/- 5 °C.

Specific heating/cooling and aging practice or any deviation to the above shall form part of the component control plan.