ALUMINUM ALLOY, CASTING
THERMALLY TREATED CONDITION

WSE-M2A151-A2
WSE-M2A151-A3
WSE-M2A151-A4

1. SCOPE

The material defined by these specifications is an aluminum-silicon-copper-magnesium casting alloy in a heat-treated condition.

2. APPLICATION

These specifications were originally released for materials used in manufacture of Precision Sand Cast **(PSC)** engine cylinder blocks. The A4 designation was originally released for **PSC** engine cylinder blocks manufactured with metal chills cast in contact with crankcase bulkheads and processed with T7 heat treatment temper.

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) (**ASTM E1479/ ASTM E1251 Suggested)**

Silicon	6.5 - 8.0
Copper	3.0 - 4.0
Iron	0.40 max
Magnesium	0.20 - **0.45**
Nickel	0.10 max
Manganese	0.30 max
Zinc	0.25 max
Titanium	0.25 max
Chromium	0.10 max
Lead	0.10 max
Tin	0.10 max
Strontium	0.002 max
Sodium	0.002 max
Calcium	0.002 max (See para 5.2)
Others (Each)	0.05 max
Others (Total)	0.50 max
Aluminum	Balance

Customer and supplier shall agree upon test method(s) for determining molten aluminum or cylinder block casting chemical analysis. It is suggested that ASTM E 1479 Inductively-Coupled Argon Plasma Spectroscopy (ICP) be used for castings and ASTM E 1251 Optical Emission Spectroscopy be used for sampling molten aluminum.

Date	Action	Revisions
2003 09 22	Revised	Para 3.0 inserted; para 3.1, 3.7, 3.8 and 4 deleted
2002 01 30	Revised	Revised 3.2, 3.5, 3.6, and 5.1 — R. Thomas
2000 02 14	Activated	G. Weber

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The composition shall be selected from within the above range in order to meet castability, soundness, machinability consistency, microstructural and strength requirements. The ratio of manganese to iron shall be maintained at a min of 1:2 respectively. The specific composition limits and foundry practice to meet performance and manufacturing requirements will form part of the Control Plan for each individual component geometry and supplier.

3.3 CASTING QUALITY
(ASTM E 155)

The finished block shall be free from laps, cold shuts, dross, and sludge, and shall have minimal eutectic segregation/depletion. Radiographic assessment levels for gas holes/porosity and shrinkage porosity shall be according to methods of ASTM E 155.

3.3.1 Porosity - Microscopic Evaluation

Metallographic samples for porosity evaluation shall be taken from locations as described in the Engineering Specification or on the Engineering Drawing. Critical areas shall be defined in the Engineering Specification or on the Engineering Drawing. The volume percent porosity shall be determined by image analysis over an area of 25 square millimeters, on contiguous fields of view, at a recommended magnification of 100X. The average shall be no greater than 1%, and no single area shall exceed 2%. The allowable pore size shall not exceed 0.75 mm in any dimension.

3.4 MICROSTRUCTURE
(ASTM E 3)

The microstructure shall consist of primary alpha aluminum, alpha aluminum-silicon eutectic, and intermetallic constituents. The silicon component of the eutectic may be rounded, which indicates modification. Needlelike intermetallics shall be less than 1% by volume, and shall not exceed 0.75 mm in length, as measured per the methods described above for porosity. Efforts should be made to minimize copper segregation.

3.4.1 Secondary Dendrite Arm Spacing (SDAS)

The Secondary Dendrite Arm Spacing (SDAS) shall be computed as the average of 10 primary dendrites, at 100X. In critical areas, the SDAS shall be a maximum of 50 micrometers, or as defined in the Engineering Specification or on the Engineering Drawing. No single primary dendrite shall exceed a SDAS of 60 micrometers. The measuring method used shall be described in the Supplier Control Plan.

3.5 MECHANICAL PROPERTIES
(As Heat-Treated Components)

In order to confirm Analytical Analysis calculations for new designs, the property specifications below shall be verified. Locations, frequency, and procedures of testing are outlined in the Engineering Specification and reflected in the Supplier Control Plan, which is agreed upon between Ford and the supplier.

All test samples shall be machined from the component casting in the designated location(s) per the Engineering Specification, and after the appropriate heat treatments as described in section 3.6.

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