ALUMINUM CASTING ALLOY, CYLINDER BLOCK, 11% SILICON **WSS-M2A165-A**
ALUMINUM CASTING ALLOY, CYLINDER BLOCK, 9.5% SILICON **WSS-M2A165-A2**
ALUMINUM CASTING ALLOY, CYLINDER BLOCK, 8.5% SILICON **WSS-M2A165-A3**

1. SCOPE

The materials defined by these specifications are aluminum-silicon-copper-magnesium casting alloys, heat treated to a stabilized condition.

2. APPLICATION

This specification was originally released for materials used in the manufacture of die-cast engine cylinder blocks with a T5 heat treatment temper.

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 CHEMICAL COMPOSITION (Weight Percent)
(ASTM E1479 / ASTM E1251)

	A	A2	A3
Silicon	9.5 - 12.0	8.0 – 11.0	7.5 – 9.5
Copper	1.5 - 3.5	2.0 – 4.0	2.0 – 4.0
Iron	0.60 - 1.30	0.60 - 1.30	0.60 - 1.30
Magnesium	0.55 max	0.55 max	0.55 max
Nickel	0.50 max	0.55 max	0.50 max
Manganese	0.55 max	0.55 max	0.55 max
Zinc	3.00 max	3.00 max	3.00 max
Titanium	0.25 max	0.25 max	0.25 max
Chromium	0.10 max	0.15 max	0.10 max
Lead	0.10 max	0.35 max	0.10 max
Tin	0.30 max	0.30 max	0.30 max
Antimony	0.10 max	0.10 max	0.10 max
Others (Each)	0.05 max	0.05 max	0.05 max
Others (Total)	0.50 max	0.50 max	0.50 max
Aluminum	Balance	Balance	Balance
%Fe + (2x%Mn) + (3x%Cr)	2.00 max	2.00 max	2.00 max

The composition shall be selected from within the above range. 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.

Ford and the supplier shall agree upon the test method(s) used for performing chemical analysis of molten aluminum or cylinder head castings. The recommended method is optical emission spectroscopy (OES) (ASTM E1251), but inductively-coupled argon plasma spectroscopy (ICP)

Date	Action	Revisions	Rev. 04
2014 08 29	Revised	See Summary of Revisions	G. Weber, NA
2014 04 23	Revised	See Summary of Revisions	G. Weber, NA
2002 01 31	Activated	WSS-M2A165-A	R. Thomas, NA

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(ASTM E1479) may be used for research and failure analysis. In case of dispute over OES results, ICP shall be used as an umpire method.

3.3 HEAT TREATMENT

(Ford W-HTX, ASTM B917)

To achieve specified requirements and dimensional stability, components shall be subjected to a T5 heat treatment consisting of artificial aging in the 200 – 240 °C temperature range for 1 to 4 hours duration at temperature prior to machining. The process parameters shall be fully specified on the Engineering Drawing and reflected in the Supplier Control Plan, which is agreed upon between Ford and the supplier.

Liquid media quenching after die-casting is permitted prior to T5 heat treatment, for in-process casting handling or for optimization of mechanical properties. The quench medium temperature and the time between part extraction from the die and application of the quench shall be controlled, and these parameters shall be reflected in the Supplier Control Plan, which is agreed upon between Ford and the supplier.

3.4 CASTING QUALITY

The finished block shall be free from cracks, laps, cold shuts, inclusions, blisters, and shall have minimal eutectic segregation/depletion. Radiographic and metallographic assessment for casting defects shall meet the general requirements defined below, and may be further restricted in the Engineering Specification. Evaluation locations shall be defined in the Engineering Specification.

3.4.1 Radiographic Assessment

(ASTM E505)

Radiographic assessment for voids, air entrapment, and shrinkage porosity shall be performed according to methods described in ASTM E505. Overall, an assessment of Severity Level 3 or better is required for all defect types, except in bulkheads, where an assessment of Severity Level 2 or better is required for all defect types.

3.4.2 Metallographic Evaluation

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, and shall meet the requirements stated below in critical areas. Critical areas on the casting shall be defined in the Engineering Specification. Maximum size, minimum spacing and maximum grouping shall be specified in the Engineering Specification.

The average volume percent porosity 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.

3.5 MICROSTRUCTURE

(ASTM E3)

The microstructure shall consist of primary alpha aluminum, alpha aluminum-silicon eutectic, and intermetallic constituents. Needlelike intermetallics shall be less than 1% by volume, and shall not exceed 0.75 mm in length, determined by image analysis over an area of 25 square millimeters, on contiguous fields of view, at a recommended magnification of 100X.

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