Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS5338A
Superseding AMS 5338
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STEEL CASTINGS, INVESTMENT
0.95Cr - 0.20Mo (0.35 - 0.45C)

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

2. APPLICATION: Primarily for small structural parts of intricate design which require heat treatment to minimum tensile strength of up to 175,000 psi.

3. COMPOSITION: Castings shall conform to the following:

	min	max
Carbon	0.35	0.45
Manganese	0.75	1.00
Silicon	--	1.00
Phosphorus	--	0.04
ø Sulfur	--	0.04
Chromium	0.80	1.10
Molybdenum	0.15	0.25
Nickel	--	0.25
Copper	--	0.35

4. CONDITION: Normalized and tempered, unless otherwise specified.

5. TECHNICAL REQUIREMENTS:

5.1 Casting: Castings shall be poured either from remelted metal from a master heat or master heat lot or directly from a master heat. In either case, metal for casting shall be qualified as in 5.3.
ø A master heat is refined metal of a single furnace charge. Gates, sprues, risers, and rejected castings shall be used only in preparation of master heats; they shall not be remelted directly, without refining, for pouring of castings.

5.1.1 Unless prohibited by purchaser, metal from two or more master heats may be blended to form a master heat lot provided that the composition of each master heat to be blended is within the
ø limits of Section 3 above and the total weight of metal in the master heat lot does not exceed 10,000 pounds. Ingot and pig may be blended together, shot may be blended, but shot shall not be blended with ingot or pig.

5.2 Normalizing and Tempering: Castings and tensile test specimens shall be normalized by heating to 1650 - 1700 F (898.4 - 926.7 C), holding at heat for not less than 1 hr, and cooling at a rate equivalent to that obtained in still air and shall be tempered at not lower than 900 F (482 C).

5.3 Master Heat Qualification: Each master heat and master heat lot shall be qualified by evaluation of chemical analysis and tensile test specimens conforming to 5.3.1 and 5.3.2, respectively. A master heat or master heat lot may be considered conditionally qualified if vendor's test results
ø show conformance to all applicable requirements of this specification. However, except when purchaser waives confirmatory testing, final qualification shall be based on purchaser's test results. Conditional qualification of a master heat or master heat lot shall not be construed as a guarantee of acceptance of castings poured therefrom.

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5.3.1 Chemical Analysis Specimens: Shall be of any convenient size, shape, and form for vendor's tests; ø when chemical analysis specimens are required by purchaser, specimens shall be cast to a size, shape, and form agreed upon by purchaser and vendor. Composition of specimens shall conform to Section 3.

5.3.2 Tensile Test Specimens: Shall be cast from remelted metal from each master heat or master heat lot except that when castings are poured directly from a master heat, the tensile test specimens shall also be poured directly from the master heat. Tensile test specimens shall be of standard proportions with ø 0.25 in. diameter at the reduced parallel section. They shall be cast to size or shall be cast oversize and subsequently machined to 0.25 in. diameter. Center gating may be used. When requested, representative specimens shall be supplied to the purchaser for confirmatory evaluation. Tensile test specimens shall conform to the following requirements:

5.3.2.1 Properties After Heat Treatment: Tensile test specimens produced in accordance with 5.3.2 and heat treated as in 5.2 shall conform to the following requirements when heated to 1550 F ± 10 (843.3 C ± 5.6), held at heat for 30 min., quenched in oil, and tempered at not lower than 900 F (482 C):

5.3.2.1.1 Tensile Properties:

Tensile Strength, psi	175,000 min
Yield Strength at 0.2% Offset or at 0.0075 in.	
ø in 1 in. Extension Under Load (E = 29,000,000), psi	160,000 min
Elongation, % in 4D	3 min
Reduction of Area, %	6 min

5.3.2.1.2 Hardness: Rockwell C 38 - 43 or equivalent.

5.4 Properties of Castings After Heat Treatment: When agreed upon by purchaser and vendor, tensile test specimens may be machined from castings selected at random from the shipment. Size and locations of ø such specimens, heat treatment conditions, and the required tensile properties shall be as shown on the drawing or as agreed upon by purchaser and vendor.

5.5 Resampling and Retesting: In event any test specimen fails to meet the specified requirements, at least two additional test specimens shall be tested for each non-conforming specimen. All such additional ø specimens shall conform to specified requirements. Failure of any retest specimen to conform to specified requirements shall be cause for rejection of the master heat or master heat lot in case of qualification test specimens, or of the castings from that shipment in the case of tests on castings or specimens cut from castings. Results of all tests shall be reported.

5.6 Decarburization: The carbon content shall be within the specification limits throughout the casting, except that within 0.003 in. of the surface the carbon content may be lower than specified in Section 3. The surface hardness of any casting chosen at random and which has been heat treated as in 5.2 and 5.3.2.1 ø shall be within the range of Rockwell Superficial 15N 78 - 83 or equivalent; no more than 0.0005 in. of material shall be removed to provide suitable area for testing. Unless otherwise agreed upon by purchaser and vendor, the heat treatments may be performed in a protective atmosphere to accomplish the carbon control required.

6. QUALITY:

6.1 Castings shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts. Castings shall have smooth surfaces and shall be well cleaned. Unless otherwise specified, metallic shot or grit shall not be used for final cleaning.

6.2 When castings are broken for fracture test, the fracture shall have uniform color and be substantially free from oxides and other defects.

6.3 Unless otherwise specified, castings shall be produced under radiographic control. This shall consist of radiographic examination of castings until proper foundry technique, which will produce castings free from harmful internal imperfections, is established for each part number and of production castings as necessary to ensure maintenance of satisfactory quality.

6.4 Inspection standards and procedures shall be as agreed upon by purchaser and vendor.

6.5 Castings shall not be repaired by plugging, welding, or other methods without written permission from purchaser.

7. REPORTS:

7.1 Unless otherwise specified, the vendor of castings shall furnish with each shipment three copies of a report of the results of tests for chemical composition of at least one casting from each master heat or master heat lot represented and the results of tests on each master heat or master heat lot to determine conformance to the technical requirements of this specification. The specific tempering temperature
Ø used to produce the tensile properties shall also be included in the report. When properties of test specimens cut from castings are specified, the report shall include the results of tests to determine conformance to such requirements. This report shall include the purchase order number, master heat or master heat lot number (and code symbol if used), material specification number and its revision letter, part number, and quantity from each master heat or master heat lot.

7.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of castings, part number, and quantity. When castings for making parts are produced or purchased by the parts vendor, that vendor shall inspect castings from each master heat or master heat lot represented to determine conformance to the requirements of this specification, and shall include in the report a statement that the castings conform, or shall include copies of laboratory reports showing the results of tests to determine conformance.

8. IDENTIFICATION: Unless otherwise specified, each casting shall be identified as to part number and master heat or master heat lot number or code symbol. Methods of applying identifying characters shall be as agreed upon by purchaser and vendor. Marking materials shall have no deleterious effect on the castings or their performance.

9. APPROVAL:

9.1 Sample castings from new or reworked master patterns and the casting procedure shall be approved by
Ø purchaser before castings for production use are supplied, unless such approval be waived.

9.2 Unless waived by purchaser, vendor shall establish, separately for tensile test specimens used for master heat qualification and for production of sample castings of each part number, the control factors of processing which will produce tensile test specimens meeting master heat qualification requirements and acceptable castings; these shall constitute the approved casting procedures and shall be used for producing subsequent master heat qualification specimens and production castings. If necessary to make any change in control factors of processing which could affect quality or properties of the castings, vendor shall submit for reapproval a statement of the revised operations and, when requested, sample test specimens, castings, or both. No production castings incorporating the revised operations shall be shipped prior to receipt of reapproval.