



AEROSPACE MATERIAL SPECIFICATION

AMS5376

REV. G

Issued 1948-07
Revised 2002-08
Reaffirmed 2013-08

Superseding AMS5376F

Alloy, Corrosion and Heat Resistant, Investment Castings
30Fe - 21Cr - 20Ni - 20Co - 3.0Mo - 2.5W - 1.0Cb - 0.15N
As Cast
(Composition similar to UNS R30155)

RATIONALE

AMS5376G has been reaffirmed to comply with the SAE 5-year review policy.

1. SCOPE:

1.1 Form:

This specification covers a corrosion and heat resistant iron alloy in the form of investment castings.

1.2 Application:

These castings been used typically for small parts, such as turbine blades and vanes, requiring high strength up to 1350 °F (732 °C) and oxidation resistance up to 1800 °F (982 °C), but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2013 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

SAE values your input. To provide feedback on this Technical Report, please visit <http://www.sae.org/technical/standards/AMS5376G>

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

- AMS 2248 Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
- AMS 2360 Room Temperature Tensile Properties of Castings
- AMS 2361 Elevated Temperature Tensile Properties of Castings
- AMS 2694 Repair Welding of Aerospace Castings
- AMS 2804 Identification, Castings
- AMS-STD-2175 Castings, Classification and Inspection of

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

- ASTM E 8 Tension Testing of Metallic Materials
- ASTM E 8M Tension Testing of Metallic Materials (Metric)
- ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
- ASTM E 21 Elevated Temperature Tension Tests for Metallic Materials
- ASTM E 354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys
- ASTM E 1417 Liquid Penetrant Examination
- ASTM E 1742 Radiographic Examination

SAENORM.COM : Click to view the full PDF of [ams5376g](#)

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Castings shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 354, by spectrochemical methods, or by other analytical methods acceptable to purchaser (See 8.2.1 and 8.2.2).

TABLE 1 – COMPOSITION

Element	min	max
Carbon	--	0.20
Manganese	1.00	2.00
Silicon	--	1.00
Phosphorus	--	0.04
Sulfur	--	0.03
Chromium	20.00	22.50
Nickel	19.00	21.00
Cobalt	18.50	21.00
Molybdenum	2.50	3.50
Tungsten	2.00	3.00
Columbium	0.75	1.25
Nitrogen	0.10	0.20
Tantalum	--	0.05
Iron	remainder	

3.1.1 Vendor may test for any element not listed in Table 1 and include this analysis in the report of 4.5. Limits of acceptability may be specified by purchaser (See 8.2.3).

3.1.2 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2248.

3.2 Melting Practice:

Castings and specimens shall be poured at the casting vendor's facility either from a melt (See 8.2.4) of a master heat or directly from a master heat (See 8.2.5).

3.2.1 Revert (gates, sprues, risers, and rejected castings) may be used only in the preparation of master heats; revert shall not be remelted directly without refining for pouring of castings. Melting of revert creates a new master heat.

3.2.2 Portions of two or more qualified master heats (See 3.4.2) may be melted together and poured into castings using a procedure authorized by purchaser (See 8.2.6).

3.2.3 If modifications, such as alloy additions or replenishments, are made by the vendor at remelt, vendor shall have a written procedure acceptable to purchaser which defines the controls, test, and traceability criteria for both castings and separately-cast specimens. Control factors of 4.4.2.2 shall apply.

3.3 Condition:

Castings shall be delivered in the as cast condition.

3.4 Test Specimens:

Specimens shall be either separately-cast, integrally-cast (See 8.2.7), or machined from a casting, and shall conform to 3.2.

3.4.1 If specimens are separately-cast, vendor shall have a written procedure acceptable to purchaser. Control factors of 4.4.2.2 shall apply.

3.4.2 Each master heat shall be qualified by evaluation of chemical, hardness, and tensile specimens.

3.4.2.1 If alloy additions or replenishments are made at remelt as in 3.2.3, the frequency of sampling and testing used by the vendor for qualification to 3.4.2 shall be acceptable to purchaser.

3.4.2.2 Tensile tests of 3.4.2 are not required if these tests are conducted using integrally-cast specimens (4.3.3.2) or specimens machined from a casting (4.3.3.3).

3.4.3 Chemical Analysis Specimens: Shall be of any convenient size and shape.

3.4.4 Tensile Specimens: Shall be of standard proportions in accordance with ASTM E 8 or ASTM E 8M (See 8.3) with 0.250-inch (6.35-mm) diameter at the reduced parallel gage section.

3.4.4.1 Separately-cast and integrally-cast specimens may be either cast to size or cast oversize and subsequently machined to 0.250-inch (6.35-mm) diameter.

3.4.4.2 When integrally-cast specimens or specimens machined from a casting are specified, specimen size and location shall be agreed upon by purchaser and vendor (See 8.2.8 and 8.5).

3.4.5 Hardness Specimens for Response to Heat Treatment: May be a representative specimen or a casting.

3.5 Response to Heat Treatment:

Casting shall have hardness not higher than 28 HRC after being heated to 1475 °F ± 10 (802 °C ± 6), held at heat for 50 hours ± 1, and cooled to room temperature.

3.6 Properties:

Conformance shall be based upon testing of separately-cast specimens unless purchaser specifies integrally-cast specimens or specimens machined from a casting. Properties for integrally-cast specimens and specimens machined from a casting shall be as specified by purchaser (See 8.5).

3.6.1 Room Temperature Tensile Properties: Shall be as specified in 3.6.1.1, determined in accordance with ASTM E 8 or ASTM E 8M (See 8.3). Properties other than those listed may be defined as specified in AMS 2360.

3.6.1.1 Separately-Cast Specimens: Shall be as shown in Table 2.

TABLE 2 - MINIMUM ROOM TEMPERATURE TENSILE PROPERTIES

Property	Value
Tensile Strength	80 ksi (552 MPa)
Yield Strength at 0.2% Offset	45.0 ksi (310 MPa)
Elongation in 4D	18%
Reduction of Area	15%

3.6.2 Elevated Temperature Tensile Properties at 1500 °F (816 °C): Shall be as specified in 3.6.2.1, determined in accordance with ASTM E 21 on specimens heated to 1500 °F ± 10 (816 °C ± 6), held at heat for 20 to 30 minutes before testing, and tested at 1500 °F ± 10 (816 °C ± 6) at a rate of 0.03 to 0.07 inch per inch per minute (0.03 to 0.07 mm/mm per minute). Properties other than those listed may be defined as specified in AMS 2361.

3.6.2.1 Separately-Cast Specimens: Shall be as shown in Table 3.

TABLE 3 - MINIMUM ELEVATED TEMPERATURE TENSILE PROPERTIES

Property	Value
Tensile Strength	45.0 ksi (310 MPa)
Elongation in 4D	15%

3.6.3 Hardness: Shall be as follows, determined in accordance with ASTM E 18.

3.6.3.1 Castings or representative specimens in the as-cast condition shall be not higher than 21 HRC.

3.7 Quality:

3.7.1 Castings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the castings. Castings shall be free of cracks, laps, hot tears, and cold shuts, and free of scale and other process-induced surface contamination which would obscure defects.

3.7.2 Castings shall be produced under radiographic control. This control shall consist of radiographic examination of each casting part number until foundry manufacturing controls in accordance with 4.4.2 have been established. Additional radiography shall be conducted in accordance with the frequency of inspection specified by purchaser, or as necessary to ensure continued maintenance of internal quality.

- 3.7.2.1 Radiographic inspection shall be conducted in accordance with ASTM E 1742 or another method specified by purchaser.
- 3.7.3 When specified, castings shall be subjected to fluorescent penetrant inspection in accordance with ASTM E 1417 or another method specified by purchaser.
- 3.7.4 Acceptance standards for radiographic, fluorescent penetrant, visual, and other inspection methods shall be as agreed upon by purchaser and vendor (See 8.2.8). AMS-STD-2175 may be used to specify acceptance standards (casting grade) and frequency of inspection (casting class).
- 3.7.4.1 When acceptance standards are not specified, Grade C of AMS-STD-2175 as applicable to steel castings shall apply for each applicable method of inspection.
- 3.7.5 Castings shall not be peened, plugged, impregnated, or welded unless authorized by purchaser.
- 3.7.5.1 When authorized by purchaser, welding in accordance with AMS 2694 or another welding program acceptable to purchaser may be used.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of castings shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the castings conform to specified requirements.

4.2 Classification of Tests:

- 4.2.1 Acceptance Tests: Composition (3.1), elevated tensile properties (3.6.2), as-cast hardness (3.6.3.1), and applicable requirements of quality (3.7) are acceptance tests and shall be performed as specified in 4.3.
- 4.2.2 Periodic Tests: Response to heat treatment (3.5), room temperature tensile properties (3.6.1), and radiographic soundness (3.7.2) are periodic tests and shall be performed at a frequency selected by vendor unless frequency of testing is specified by purchaser.
- 4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed on sample castings (4.3.2), when a change in control factors occurs (4.4.2.2), and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

The minimum testing performed by vendor shall be in accordance with the following:

- 4.3.1 One chemical analysis specimen or a casting from each master heat shall be tested for conformance with Table 1; if 3.4.2.1 applies, test frequency shall be acceptable to purchaser.
- 4.3.2 One preproduction casting in accordance with 4.4 shall be tested to the requirements of the casting drawing and to all technical requirements.
 - 4.3.2.1 Dimensional inspection sample quantity shall be as specified by purchaser.
- 4.3.3 Tensile tests shall be conducted to determine conformance with 3.6.1 and 3.6.2. Sampling and test frequency is dependent upon the type and origin of the specimen specified by purchaser (See 3.6) or selected by vendor (See 4.3.3.4). When 3.4.2.1 applies, test frequency shall be acceptable to purchaser.
 - 4.3.3.1 For separately-cast specimens, one specimen from each master heat shall be tested for conformance to 3.6.
 - 4.3.3.2 For integrally-cast specimens, two specimens shall be randomly selected from each lot and tested for conformance to 3.6.
 - 4.3.3.3 For specimens machined from a casting, one casting shall be randomly selected from each lot and tested at each location shown on the engineering drawing for conformance to 3.6.
 - 4.3.3.3.1 When size and location of specimens are not shown, two test specimens shall be tested, one from the thickest section and one from the thinnest section. Once established under 4.4.2.2, test locations may be changed only as agreed upon by purchaser and vendor.
 - 4.3.3.4 When acceptable to purchaser, specimens machined from a casting may be used in lieu of either separately-cast or integrally-cast specimens, and integrally-cast specimens may be used in lieu of separately-cast specimens. In each case, the resultant properties must conform to the requirements of 3.6 or to alternative requirements specified by purchaser (See 8.5).
 - 4.3.3.4.1 When specimens are selected for test as in 4.3.3.4 from an origin other than that specified by purchaser, vendor shall include in the report of 4.5 a description of the origin of the specimen that was tested.
 - 4.3.3.5 When casting size, section thickness, gating method, or other factors do not permit conformance to 4.3.3.2 or 4.3.3.3, sampling and testing shall be as agreed upon by purchaser and vendor.
 - 4.3.4 Castings shall be inspected in accordance with 3.7 to the methods, frequency, and acceptance standards specified by purchaser.

- 4.3.5 One casting or representative specimen from each master heat shall be tested for hardness to determine conformance with 3.6.3.1.
- 4.4 Approval:
- 4.4.1 Sample casting(s) from new or reworked master patterns produced under the casting procedure of 4.4.2 shall be approved by purchaser before castings for production use are supplied, unless such approval be waived by purchaser.
- 4.4.2 For each casting part number, vendor shall establish parameters for process control factors that will consistently produce castings and test specimens meeting the requirements of the casting drawing and this specification. These parameters shall constitute the approved casting procedure and shall be used for production of subsequent castings and test specimens. If necessary to make any change to these parameters, vendor shall submit a statement of the proposed changes for purchaser reapproval. When requested, vendor shall also submit test specimens, sample castings, or both to purchaser for reapproval.
- 4.4.2.1 Production castings produced prior to receipt of purchaser's approval shall be at vendor's risk.
- 4.4.2.2 Control factors for producing castings and separately-cast test specimens include, but are not limited to, the factors shown below. Supplier's procedures shall identify tolerances, ranges, and/or control limits, as applicable. Control factors for separately-cast specimens must generally represent, but need not be identical to, those factors used for castings (See 3.2.3 and 3.4.1).

Composition of ceramic cores, if used
Arrangement and number of patterns in the mold (including integrally-cast specimens, if applicable)
Size, shape, and location of gates and risers
Mold refractory formulation
Grain refinement methods, if applicable
Mold back up material (weight, thickness, or number of dips)
Type of furnace, atmosphere, and charge for melting
Mold preheat and metal pouring temperatures
Fluxing or deoxidation procedure
Replenishment and alloy addition procedures, if applicable
Time molten metal is in furnace
Solidification and cooling procedures
Cleaning operations (mechanical and chemical)
Straightening
Final inspection methods
Location and size of integrally-cast specimens and specimens machined from a casting, if applicable.

- 4.4.2.2.1 Any of the control factors for which parameters are considered proprietary by vendor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.