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Superseding AMS5387C

Alloy, Corrosion and Heat Resistant, Investment Castings  
60Co - 29Cr - 4.5W  
As Cast

(Composition similar to UNS R30006)

## RATIONALE

AMS5387D updates referenced documents and is a Five Year Review and update of this specification.

### 1. SCOPE

#### 1.1 Form

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

#### 1.2 Application

These castings have been used typically for parts such as nozzles, rubbing seals, rollers, guides and supports requiring wear and/or erosion resistance in combination with corrosion and oxidation resistance for use up to 1600°F (870 °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 cancelled and no superseding document has been specified, the last published issue of that document shall apply.

#### 2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AMS2175	Castings, Classification and Inspection of
AMS2269	Chemical Check Analysis Limits, Nickel, Nickel Alloys, and Cobalt Alloys
AMS2694	In-Process Welding of Castings
AMS2804	Identification, Castings

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## 2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, [www.astm.org](http://www.astm.org).

- ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of 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 Testing
- ASTM E 1444 Magnetic Particle Testing
- ASTM E 1742 Radiographic Examination

## 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).

Element	min	max
Carbon	0.90	1.40
Manganese	--	1.00
Silicon	--	1.50
Phosphorus	--	0.04
Sulfur	--	0.04
Chromium	27.00	31.00
Tungsten	3.50	5.50
Nickel	--	3.00
Molybdenum	--	1.50
Iron	--	3.00
Cobalt	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 AMS2269.

### 3.2 Melting Practice

Castings and specimens shall be poured at 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 (See 8.2.10), are made by the vendor at remelt, vendor shall have a written procedure acceptable to purchaser which defines the controls, tests, 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 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.

### 3.4.3 Chemical Analysis Specimens

Shall be of any convenient size and shape.

### 3.5 Heat Treatment

Not applicable.

### 3.6 Properties

#### 3.6.1 Hardness of Castings

Shall be not lower than 37 HRC, or equivalent (See 8.3), determined in accordance with ASTM E 18.

### 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, additional nondestructive testing shall be performed as follows:

3.7.3.1 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 agreed upon by purchaser and vendor (See 8.2.8). AMS2175 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 AMS2175 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 AMS2694 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), hardness of castings (3.6.1), and the applicable requirements of quality (3.7) are acceptance tests and shall be performed as specified in 4.3.

###### 4.2.2 Periodic Tests

Radiographic soundness (3.7.2) is a periodic test and shall be performed as in 3.7.2.

###### 4.2.3 Preproduction Tests

All technical requirements are preproduction tests and shall be performed on specimens or sample castings (4.3.2), when a change in control factors occurs (4.4.2.2), or 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 applicable technical requirements.

4.3.2.1 Dimensional inspection sample quantity shall be as specified by purchaser.

4.3.3 Castings shall be inspected in accordance with 3.7 to the methods, frequency, and acceptance standards specified by purchaser.

4.3.4 Castings for delivery shall be tested for hardness to determine conformance to 3.6.1. Unless otherwise specified by purchaser, the number of castings from each lot shall be in accordance with Table 2.

TABLE 2 - HARDNESS TEST SCHEDULE

Lot Size	Sample Size
1 to 8	All
9 to 50	8
51 to 90	13
91 to 150	20
151 to 280	32
281 to 500	50
501 to 1200	80
1201 to 3200	125
3201 and over	200

4.3.4.1 If a single casting from the inspection lot fails to meet the specified requirement, the entire lot shall be 100% inspected.

#### 4.4 Approval

4.3.5 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.

4.3.6 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 change for purchaser reapproval. When requested, vendor shall also submit test specimens, sample castings, or both to purchaser for reapproval.

4.3.6.1 Production castings produced prior to receipt of purchaser's approval shall be at vendor's risk.

4.3.6.2 Control factors for producing castings and separately-cast 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)

Welding procedure, if applicable

Straightening

Final inspection methods.

4.3.6.2.1 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.

4.3.6.2.1.1 Unless otherwise agreed upon by purchaser and vendor, purchaser shall be entitled to review proprietary control factor details and coding at vendor's facility.

#### 4.4 Reports

The vendor of castings shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, master heat identification, AMS5387D, part number, and quantity.

#### 4.5 Resampling and Retesting

If the results of a valid test fail to meet the requirements, two additional specimens in accordance with 4.3 from the same master heat, modified melt (See 3.2.3), or lot, as applicable, shall be tested for each nonconforming characteristic. The results of each additional test, and the average of the results of all tests (original and retests) shall meet the specified requirements; otherwise, the master heat or lot shall be rejected. Results of all tests shall be reported.

4.5.1 A test may be declared invalid if failure is due to specimen mispreparation, test equipment malfunction, or improper test procedure.

### 5. PREPARATION FOR DELIVERY

#### 5.1 Identification

Unless otherwise specified by purchaser, individual castings shall be identified in accordance with AMS2804.

##### 5.1.1 Traceability

Individual castings shall be traceable to their conditions of manufacture and inspection up to and including the point of acceptance by purchaser.

#### 5.2 Packaging

Castings shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the castings to ensure carrier acceptance and safe delivery.

### 6. ACKNOWLEDGMENT

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

### 7. REJECTIONS

Castings not conforming to this specification or to modifications authorized by purchaser will be subject to rejection.

### 8. NOTES

8.1 A change bar ( I ) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

8.2 Terms used in this AMS are defined as follows. Other terms not specifically defined are clarified in ARP1917.

#### 8.2.1 "Acceptable to Purchaser"

Does not require prior written approval from purchaser, but allows vendor to make a decision and purchaser the right to disapprove the decision.

#### 8.2.2 "Purchaser"

The cognizant engineering organization responsible for casting design and fitness for use, or the designee of this engineering organization.