



AEROSPACE MATERIAL SPECIFICATION	AMS5662™	REV. P
	Issued 1965-09 Reaffirmed 2009-06 Revised 2022-08	
Superseding AMS5662N		
Nickel Alloy, Corrosion- and Heat-Resistant, Bars, Forgings, Rings, and Stock for Forgings and Rings 52.5Ni - 19Cr - 3.0Mo - 5.1Cb (Nb) - 0.90Ti - 0.50Al - 18Fe Consumable Electrode or Vacuum Induction Melted 1775 °F (968 °C) Solution Heat Treated, Precipitation-Hardenable (Composition similar to UNS N07718)		

RATIONALE

AMS5662 is the result of a Five-Year Review and update of the specification. The revision updates the title to match the scope, clarifies sizes and size limits (1.1, 3.5.1.2, Tables 2 and 3), updates composition and reporting requirements (3.1, 3.1.1), updates cooling rate requirements (3.5.1.2), adds strain rate control (3.5.1.2.1.6), clarifies transverse testing requirement (3.5.1.2.1.4), updates allowable size range for testing (3.5.1.2.3.1), prohibits unauthorized exceptions (3.5.1.4 3.9, 4.4.1.1, 4.4.2, 5.2.1.1, 8.5), updates forging stock ordering options (4.4.3, 8.6), and allows prior revisions (8.4).

1. SCOPE

1.1 Form

This specification covers a corrosion- and heat-resistant nickel alloy in the form of bars, forgings, flash welded rings in the solution heat treated condition. Product covered by this specification is limited to 10.00 inches (254 mm) and under in nominal diameter or maximum cross-sectional dimension between parallel sides (thickness) and nominal cross sectional area of 78.54 in² (503 cm²) in cross-sectional area. Stock for forging, ring, or heading may be of any size.

1.2 Application

These products have been used typically for parts requiring high resistance to creep and stress-rupture up to 1300 °F (704 °C) and oxidation resistance up to 1800 °F (982 °C), particularly those parts which are formed or welded and then precipitation heat treated to develop required properties, 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.

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<https://www.sae.org/standards/content/AMS5662P/>

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2261	Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire
AMS2269	Chemical Check Analysis Limits, Nickel, Nickel Alloys, and Cobalt Alloys
AMS2371	Quality Assurance Sampling and Testing, Corrosion- and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS2374	Quality Assurance Sampling and Testing, Corrosion- and Heat-Resistant Steel and Alloy Forgings
AMS2750	Pyrometry
AMS2806	Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion- and Heat-Resistant Steels and Alloys
AMS2808	Identification, Forgings
AMS7490	Rings, Flash Welded, Corrosion- and Heat-Resistant Austenitic Steels, Austenitic-Type Iron, Nickel, or Cobalt Alloys, or Precipitation-Hardenable Alloys
ARP1313	Determination of Trace Elements in High-Temperature Alloys
AS6279	Standard Practice for Production, Distribution, and Procurement of Metal Stock
AS7766	Terms Used in Aerospace Metals Specifications

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.

ASTM E8/E8M	Tension Testing of Metallic Materials
ASTM E10	Brinell Hardness of Metallic Materials
ASTM E21	Elevated Temperature Tension Tests of Metallic Materials
ASTM E103	Rapid Indentation Hardness Testing of Metallic Materials
ASTM E112	Determining Average Grain Size
ASTM E139	Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
ASTM E140	Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness
ASTM E292	Conducting Time-for-Rupture Notch Tension Tests of Materials
ASTM E354	Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM E354, by spectrochemical methods, by the methods of ARP1313 for lead, bismuth, and selenium, or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	--	0.08
Manganese	--	0.35
Silicon	--	0.35
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	17.00	21.00
Nickel	50.00	55.00
Molybdenum	2.80	3.30
Columbium (Niobium)	4.75	5.50
Titanium	0.65	1.15
Aluminum	0.20	0.80
Cobalt	--	1.00
Boron	--	0.006
Copper	--	0.30
Lead	--	0.0005 (5 ppm)
Bismuth	--	0.00003 (0.3 ppm)
Selenium	--	0.0003 (3 ppm)
Iron	remainder	

3.1.1 Producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection, unless limits of acceptability are specified by the purchaser.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.2 Melting Practice

Alloy shall be multiple melted using consumable electrode practice in the remelt cycle or shall be induction melted under vacuum. If consumable electrode remelting is not performed in vacuum, electrodes which have been produced by vacuum induction melting shall be used for remelting.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars

Hot or cold finished, solution heat treated, and descaled except as specified in 3.3.1.1 and 3.3.1.2.

3.3.1.1 Hot finished round bars shall be ground or turned; all other hot finished bars shall be as hot finished.

3.3.1.2 Cold finished round bars shall be ground or as cold finished; all other cold finished bars shall be as cold finished.

3.3.1.3 Bars shall not be cut from plate (also see 4.4.1.1).

3.3.2 Forgings and Flash Welded Rings

Solution heat treated and descaled.

3.3.2.1 Flash welded rings shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, rings shall be manufactured in accordance with AMS7490.

3.3.3 Stock for Forging, Flash Welded Rings, or Heading

As ordered by the forging, flash welded ring, or heading manufacturer.

3.4 Heat Treatment

Bars, forgings, and flash welded rings shall be solution heat treated by heating to a temperature within the range 1725 to 1850 °F (941 to 1010 °C), holding at the selected temperature within ± 25 °F (± 14 °C) for a time commensurate with cross-sectional thickness, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS2750.

3.4.1 If forgings are not to be machined all over, heat treatment shall be performed in a suitable protective atmosphere or, when permitted by purchaser, a suitable protective coating may be applied to the forgings in lieu of using a protective atmosphere.

3.5 Properties

The product shall conform to the following requirements:

3.5.1 Bars, Forgings, and Flash Welded Rings

3.5.1.1 As Solution Heat Treated

3.5.1.1.1 Hardness

Shall be not higher than 277 HB, or equivalent (see 8.2), determined in accordance with ASTM E10 or ASTM E103.

3.5.1.1.2 Average Grain Size

Shall be as follows, determined by the comparative method of ASTM E112. In case of disagreement, the intercept (Heyn) procedure shall be used.

3.5.1.1.2.1 Bars and flash welded rings under 9.00 in² (58 cm²) in nominal cross-sectional area shall exhibit an average grain size of ASTM No. 5 or finer. Up to 20% of the cross section of the product may have an average grain size of ASTM No. 3 to 5, determined by the intercept method of ASTM E112, due to the presence of non-recrystallized grains.

3.5.1.1.2.2 Bars and flash welded rings 9.00 to 78.54 in² (58 to 503 cm²), inclusive, in nominal cross-sectional area and all forgings shall exhibit an average grain size of ASTM No. 4 or finer. Up to 20% of the product cross section may have an average grain size of ASTM No. 2 to 4, determined by the intercept method of ASTM E112, due to the presence of non-recrystallized grains.

3.5.1.1.3 Microstructure

Product shall be free of Laves phase. Banding of acicular phase and amount of acicular phase shall conform to standards acceptable to purchaser.

3.5.1.2 Response to Heat Treatment

Product 10.00 inches (254 mm) and under in nominal diameter or thickness (see 1.1) shall meet the requirements of 3.5.1.2.1, 3.5.1.2.2, and 3.5.1.2.3 after being precipitation heat treated by heating to 1325 °F ± 15 °F (718 °C ± 8 °C), holding at heat for not less than 8 hours, cooling at a rate of 100 °F ± 15 °F (56 °C ± 8 °C) per hour to 1150 °F ± 15 °F (621 °C ± 8 °C), holding at 1150 °F ± 15 °F (621 °C ± 8 °C) for not less than 8 hours, and cooling in air or at an equivalent rate. Instead of the 100 °F (56 °C) per hour cooling rate to 1150 °F ± 15 °F (621 °C ± 8 °C), product may be furnace cooled at any rate, provided the time at 1150 °F ± 15 °F (621 °C ± 8 °C) is adjusted to give a total precipitation heat treatment time of not less than 18 hours.

3.5.1.2.1 Tensile Properties

3.5.1.2.1.1 At Room Temperature

Shall be as shown in Table 2, determined in accordance with ASTM E8/E8M.

Table 2A - Minimum room temperature tensile properties, inch/pound units

Specimen Orientation	Diameter or Thickness, Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %	Reduction of Area %
Longitudinal	Up to 10.00, incl	185	150	12	15
Long-Transverse (Forgings)	Up to 5.00, incl	180	150	10	12
	Over 5.00 to 10.00, incl	180	145	10	12
Transverse (Bars)	Up to 5.00, incl	180	150	6	8
	Over 5.00 to 10.00, incl	180	145	6	8

Table 2B - Minimum room temperature tensile properties, SI units

Specimen Orientation	Diameter or Thickness, Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D %	Reduction of Area %
Longitudinal	Up to 254.0, incl	1276	1034	12	15
Long-Transverse (Forgings)	Up to 127.0, incl	1241	1034	10	12
	Over 127.0 to 254.0, incl	1241	1000	10	12
Transverse (Bars)	Up to 127.0, incl	1241	1034	6	8
	Over 127.0 to 254.0, incl	1241	1000	6	8

3.5.1.2.1.2 At 1200 °F (649 °C)

Shall be as specified in Table 3, determined in accordance with ASTM E21 on specimens heated to 1200 °F ± 5 °F (649 °C ± 3 °C), held at heat for not less than 20 minutes before testing, and tested at 1200 °F ± 5 °F (649 °C ± 3 °C).

Table 3A - Minimum tensile properties at 1200 °F, inch/pound units

Specimen Orientation	Diameter or Thickness, Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %	Reduction of Area %
Longitudinal	Up to 5.00, incl	145	125	12	15
	Over 5.00 to 10.00, incl	145	122	12	15
Long-Transverse (Forgings)	Up to 5.00, incl	140	125	10	12
	Over 5.00 to 10.00, incl	140	122	10	12
Transverse (Bars)	Up to 5.00, incl	140	125	6	8
	Over 5.00 to 10.00, incl	140	122	6	8

Table 3B - Minimum tensile properties at 649 °C, SI units

Specimen Orientation	Diameter or Thickness, Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D %	Reduction of Area %
Longitudinal	Up to 127.0, incl	1000	862	12	15
	Over 127.0 to 254.0, incl	1000	841	12	15
Long-Transverse (Forgings)	Up to 127.0, incl	965	862	10	12
	Over 127.0 to 254.0, incl	965	841	10	12
Transverse (Bars)	Up to 127.0, incl	965	862	6	8
	Over 127.0 to 254.0, incl	965	841	6	8

- 3.5.1.2.1.3 Longitudinal requirements of 3.5.1.2.1.1 and 3.5.1.2.1.2 apply to specimens taken with the axis approximately parallel to the grain flow, to specimens taken in the radial direction and in the tangential direction at the rim of disc forgings, and to specimens taken in the circumferential direction from flash welded rings. All other specimens shall be considered to be in the transverse direction.
- 3.5.1.2.1.4 Product from which a specimen 2.50 inches (63.5 mm) in length cannot be extracted in the transverse direction do not require transverse testing.
- 3.5.1.2.1.5 Specific locations of specimens from forgings and flash welded rings shall be as agreed upon by purchaser and producer.
- 3.5.1.2.1.6 Unless otherwise specified, the strain rate for all room and elevated temperature tensile tests, shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ± 0.002 in/in/min (0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.5.1.2.2 Hardness

Shall be not lower than 331 HB, or equivalent (see 8.2), determined in accordance with ASTM E10 or ASTM E103. Product shall not be rejected on the basis of hardness if the tensile property requirements of 3.5.1.2.1.1, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness, are acceptable.

3.5.1.2.3 Stress-Rupture Properties at 1200 °F (649 °C)

Shall be as follows; testing of notched specimens and of combination smooth-and-notched specimens shall be performed in accordance with ASTM E292 and testing of smooth specimens shall be performed in accordance with ASTM E139.

3.5.1.2.3.1 A standard cylindrical combination smooth-and-notched specimen conforming to ASTM E292, maintained at $1200\text{ }^{\circ}\text{F} \pm 3\text{ }^{\circ}\text{F}$ ($649\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) while a load sufficient to produce an initial axial stress of 100 ksi (689 MPa) or higher is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. Rupture shall occur in the smooth section and elongation of this section after rupture, measured at room temperature, shall be not less than 4% in 4D for product 10.00 inches (127 mm) and under in nominal diameter or distance between parallel sides.

3.5.1.2.3.2 As an alternate procedure, separate smooth and notched specimens, machined from adjacent sections of the same piece, with gage sections conforming to the respective dimensions shown in ASTM E292 may be tested individually under the conditions of 3.5.1.2.3.1. The smooth specimen shall not rupture in less than 23 hours and elongation after rupture, measured at room temperature, shall be as specified in 3.5.1.2.3.1. The notched specimen shall not rupture in less time than the companion smooth specimen but need not be tested to rupture.

3.5.1.2.3.3 The tests of 3.5.1.2.3.1 and 3.5.1.2.3.2 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 100 ksi (689 MPa) or higher shall be used to rupture or for 23 hours, whichever occurs first. After the 23 hours and at intervals of 8 hours, minimum, thereafter, the stress shall be increased in increments of 5.0 ksi (34.5 MPa). Time to rupture, rupture location, and elongation requirements shall be as specified in 3.5.1.2.3.1.

3.5.1.3 After Re-Solution and Precipitation Heat Treatment

The product shall meet the requirements of 3.5.1.2.1, 3.5.1.2.2, and 3.5.1.2.3 after being re-solution heat treated by heating to $1750\text{ }^{\circ}\text{F} \pm 25\text{ }^{\circ}\text{F}$ ($954\text{ }^{\circ}\text{C} \pm 14\text{ }^{\circ}\text{C}$), holding at heat for not less than 60 minutes, and cooling at a rate equivalent to an air cool or faster and precipitation heat treated as in 3.5.1.2.

3.5.1.4 Mechanical property requirements for product outside of the range covered by 3.5.1 shall be agreed upon between purchaser and producer and reported per 4.4.2.

3.5.2 Forging Stock

When a sample of stock is forged to a test coupon, heat treated as in 3.4 and 3.5.1.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.5.1.2.1, 3.5.1.2.2, and 3.5.1.2.3. If specimens taken from the stock after heat treatment as in 3.4 and 3.5.1.2 conform to the requirements of 3.5.1.2.1, 3.5.1.2.2, and 3.5.1.2.3, the tests shall be accepted as equivalent to tests of a forged coupon. Stock shall also meet these requirements after solution heat treatment and re-solution and precipitation heat treatment as in 3.5.1.3.

3.5.3 Stock for Flash Welded Rings or Heading

Specimens taken from the stock after heat treatment as in 3.4 and 3.5.1.2 shall conform to the requirements of 3.5.1.2.1, 3.5.1.2.2, and 3.5.1.2.3.

3.6 Quality

The product, 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 product. Grain flow of die forgings, except in areas which contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.7 Tolerances

Bars shall conform to all applicable requirements of AMS2261.

3.8 Production, Distribution, and Procurement

Production, distribution, and procurement of metal stock shall comply with AS6279.

3.9 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.2.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer'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 product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

The following requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.1.1 Composition (3.1) of each heat.

4.2.1.2 Hardness (3.5.1.1.1) and average grain size (3.5.1.1.2) of each lot of bars, forgings, and flash welded rings as solution heat treated.

4.2.1.3 Room-temperature tensile properties (3.5.1.2.1.1), hardness (3.5.1.2.2), and stress-rupture properties (3.5.1.2.3) of each lot of bars, forgings, and flash welded rings after precipitation heat treatment.

4.2.1.4 Microstructure (3.5.1.1.3) of each lot.

4.2.1.5 Tolerances (3.7) of bars.

4.2.2 Periodic Tests

The following requirements are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser:

4.2.2.1 Tensile properties at 1200 °F (649 °C) (3.5.1.2.1.2) of bars, forgings, and flash welded rings after precipitation heat treatment.

4.2.2.2 Tensile Properties (3.5.1.2.1), hardness (3.5.1.2.2), and stress-rupture properties (3.5.1.2.3) of bars, forgings, and flash welded rings after resolution and precipitation heat treatment (3.5.1.3).

4.2.2.3 Ability of forging stock (3.5.2) and of stock for flash welded rings or heading (3.5.3) to develop required properties.

4.2.2.4 Grain flow (3.6.1) of die forgings.

4.3 Sampling and Testing

Shall be as follows:

4.3.1 Bars, Flash Welded Rings, and Stock for Forging, Flash Welded Rings, or Heading

In accordance with AMS2371.

4.3.2 Forgings

In accordance with AMS2374.

4.4 Reports

4.4.1 The producer of bars, forgings, and flash welded rings shall furnish with each shipment a report showing the producer's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations) and the results of tests for composition of each heat and the results of tests on each lot to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, heat and lot numbers, AMS5662P, solution heat treatment temperature used, size, and quantity. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.

4.4.1.1 Report the nominal metallurgically worked size and cut size, if different (see 3.3.1.3).

4.4.2 When material produced to this specification is beyond the sizes allowed in the scope or tables, or other exceptions are taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS5662P(EXC) because of the following exceptions:" and the specific exceptions shall be listed (also see 5.2.1.1).

4.4.3 The producer of stock for forging, flash welded rings, or heading shall furnish with each shipment a report showing the producer's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations) the results of tests for composition of each heat and any additional property requirements imposed by 8.7. This report shall include the purchase order number, heat number, AMS5662P, size, and quantity.

4.5 Resampling and Retesting

Shall be as follows:

4.5.1 Bars, Flash Welded Rings, and Stock for Forgings, Flash Welded Rings, or Heading

In accordance with AMS2371.

4.5.2 Forgings

In accordance with AMS2374.

5. PREPARATION FOR DELIVERY

5.1 Sizes

Except when exact lengths or multiples of exact lengths are ordered, straight bars will be acceptable in mill lengths of 6 to 24 feet (1.8 to 7.3 m), but not more than 25% of any shipment shall be supplied in lengths of 6 to 9 feet (1.8 to 2.7 m), except that for bars weighing over 25 lb/ft (37 kg/m), short lengths down to 2 feet (610 mm) may be supplied.

5.2 Identification

Shall be as follows:

5.2.1 Bars

In accordance with AMS2806.

5.2.1.1 When technical exceptions are taken (see 4.4.2), the material shall be identified with AMS5662P(EXC).

5.2.2 Forgings

In accordance with AMS2808.

5.2.3 Flash Welded Rings and Stock for Forging, Flash Welded Rings, or Heading

As agreed upon by purchaser and producer.

5.3 Packaging

The product 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 product to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT

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

7. REJECTIONS

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

8. NOTES

8.1 Revision Indicator

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 Hardness conversion tables for metals are presented in ASTM E140.

8.3 Dimensions and properties in inch/pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.4 Unless otherwise specified, the material producer shall work to the revision of this specification (AMS5662) in effect on the date of order placement. Unless otherwise specified, material manufactured and certified to the immediately previous revision of this specification (AMS5662) may be procured and used until inventory is depleted.

8.5 It is the purchaser's obligation to ensure that product they procure or resell as AMS5662P has any exceptions approved by their subsequent purchaser.

8.6 Purchase documents should specify not less than the following:

AMS5662P

Product form and size or part number of product desired

Quantity of product desired

If applicable, specific location of tensile specimens from forgings and flash welded rings (see 3.5.1.2.1.5)

If forging stock, specify any additional property requirements beyond those reported in 4.4.3 and provide details of how to obtain the desired samples