INCH-POUND

MIL-PRF-32802
22 October 2025

PERFORMANCE SPECIFICATION

AUSTENITIC CHROMIUM-NICKEL STAINLESS STEEL, CORROSION-RESISTANT, LASER POWDER BED FUSION, ADDITIVELY MANUFACTURED

This specification is approved for use by the Naval Sea Systems Command and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers materials made from additively manufactured (AM) corrosion-resistant austenitic chromium-nickel stainless steel using the laser powder bed fusion (LPBF) process. The chemical composition in table I is wide enough to accommodate the powder material classes defined in MIL-PRF-32801 (see also 6.1).

1.2 Classification. Material is of the following grades, as specified (see 6.2).

1.2.1 Grades.

a. Grade A – Material manufactured in compliance with S9074-A2-GIB-010/AM-PBF.

b. Grade B – Material manufactured in compliance with manufacturer or industry standards (see 6.3).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-32801 - Powder Feedstock, Austenitic Chromium-Nickel Stainless Steel, Corrosion-Resistant, for Use in Laser Powder Bed Fusion, Additive Manufacturing

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1684 - Control of Heat Treatment

(Copies of these documents are available online at https://quicksearch.dla.mil.)

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A AREA AMPR

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9074-A2-GIB-010/AM-PBF - Requirements for Metal Powder Bed Fusion Additive Manufacturing

(Copies of this document are available online via Model Based Product Support (MBPS) at https://mbps.navsea.navy.mil/Windchill. To gain access to MBPS, obtain an account with National Help Desk Service Management (NHDSM) at https://nhdsm.navair.navy.mil (a valid CAC is required to access this website) and submit a SAAR-N Request. Refer questions, inquiries, or problems to (888) 292-5919.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM A751	-	Standard Test Methods and Practices for Chemical Analysis of Steel Products
ASTM A1080/A1080M	-	Standard Practice for Hot Isostatic Pressing of Steel, Stainless Steel, and Related Alloy Castings
ASTM E3	-	Standard Guide for Preparation of Metallographic Specimens
ASTM E8/E8M	-	Standard Test Methods for Tension Testing of Metallic Materials
ASTM E353	-	Standard Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E562	-	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
ASTM E1019	-	Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Inert Gas Fusion Techniques
ASTM E1086	-	Standard Test Method for Analysis of Austenitic Stainless Steel by Spark Atomic Emission Spectrometry
ASTM E1245	-	Standard Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis
ASTM E1479	-	Standard Practice for Describing and Specifying Inductively Coupled Plasma Atomic Emission Spectrometers
ASTM F3637	-	Standard Guide for Additive Manufacturing of Metal – Finished Part Properties – Methods for Relative Density Measurement

(Copies of these documents are available online at www.astm.org.)

SAE INTERNATIONAL

SAE AMS2750 - Pyrometry

(Copies of this document are available online at www.sae.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Powder feedstock. Powder used as a feedstock shall be in accordance with MIL-PRF-32801.

3.2 Chemical composition. The chemical composition of the fabricated material shall conform to the percentages by weight specified in table I.

TABLE I. Chemical composition (weight-percent).

	Minimum (%)	Maximum (%)
Carbon	---	0.030
Manganese	---	2.00
Phosphorus	---	0.020 1/
Sulfur	---	0.020 1/
Silicon	---	1.00
Chromium	16.00	19.00
Nickel	10.00	15.00
Molybdenum	2.00	3.00
Oxygen	---	0.10
Nitrogen	---	0.10
Cobalt	---	2/
Other Elements, each 3/	---	0.10
Other Elements, total 3/	---	0.50
Iron	---	Remainder

NOTES:

1/ Combined phosphorus and sulfur content shall not exceed 0.020 weight-percent.

2/ When specified (see 6.2), cobalt content shall be limited to the maximum quantity specified in the contract or order.

3/ Other Elements: Determination not required for routine acceptance except for Al, B, Cu, Mg, Ti, and Zr, which shall be measured and reported for information individually. They shall also be reported collectively, with any other measured elements, as "Other Elements, Total." Boron content shall be determined using analytical methods with sufficient sensitivity to report results to the nearest 10 parts per million (ppm).

3.3 Heat treatment. Material shall be heat treated. Heat treatment shall be carried out under vacuum or an inert argon atmosphere. The furnaces shall be in accordance with the pyrometry requirements of SAE AMS2750 class 5 or better. When specified (see 6.2), heat treatment shall be in accordance with MIL-STD-1684. Material shall be heated to 1875±25 °F, held for a minimum of 120 minutes, or 1 hour per inch of maximum part thickness (see 6.10.2), whichever is greater, and cooled under an inert atmosphere to below 800 °F at a rate greater than or equal to 18 °F per minute.

3.3.1 Hot isostatic pressing. When specified (see 6.2), material shall undergo hot isostatic pressing instead of, or in addition to, the specified heat treatment (see 3.3). Hot isostatic pressing shall be carried out under an inert argon atmosphere in accordance with ASTM A1080/A1080M. Hot isostatically pressed material shall be heated to 1875±25 °F and pressurized to not less than 20 ksi, held for a minimum of 120 minutes at temperature and pressure, or 1 hour per inch of maximum part thickness, whichever is greater, and cooled under an inert atmosphere to below 800 °F at a rate greater than or equal to 18 °F per minute.

3.4 Tensile properties. The tensile properties of all material shall meet or exceed the values specified in table II. Reduction of area shall be measured and reported for information.

TABLE II. Tensile property requirements.

Property	Minimum value
Ultimate tensile strength (ksi)	75
Yield strength, 0.2% offset (ksi)	45
Elongation (%)	30
Reduction of area (%)	Information only

3.5 Relative density. The relative density of the material shall be not less than 99.8 percent.

3.6 Weld repair. Unless otherwise specified (see 6.2), weld repair shall be prohibited.

3.7 Additional mechanical properties. Additional mechanical properties shall be as specified (see 6.2).

3.8 Detrimental material controls. When needed, detrimental material controls shall be as specified (see 6.2).

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Conformance inspection (see 4.2).

4.2 Conformance inspection. Conformance inspection shall include the examinations and the tests of table III.

TABLE III. Conformance inspections.

Examinations and tests	Requirement	Conformance inspection	Sampling requirements
Powder feedstock	3.1	4.9	---
Chemical composition	3.2	4.5	4.4.1 and 4.4.4
Heat treatment	3.3	4.9	---
Tensile properties	3.4	4.6	4.4.2, 4.4.4, and 4.4.5
Relative density	3.5	4.7	4.4.3, 4.4.4, and 4.4.5
Weld repair	3.6	4.9	---
Additional mechanical properties	3.7	4.8	---
Detrimental material controls	3.8	4.9	---

4.3 Lot size. Unless otherwise specified (see 6.2), for the purposes of inspections and tests, material subjected to selective melting to form a solid component in the same build cycle and heat treatment shall constitute a lot.

4.4 Sampling.

4.4.1 Chemical composition. A minimum of one sample shall be taken from each lot in its final heat treated condition.

4.4.2 Tensile properties. A minimum of two tensile specimens shall be taken from each lot in its final heat treated condition. Tensile specimens shall be machined from bulk deposition or near-net shape blanks. Tensile specimens shall conform to ASTM E8 standard round specimen size 3 or larger with a gage length four times the

diameter. At least one specimen shall be oriented with its length in the Z axis and at least one shall be oriented with its length in the XY plane (see 6.10.1 for orientation definitions). See 4.4.5 for additional sampling requirements for multi-laser LPBF systems. See 6.5 for recommendations regarding specimen location on the build platform. See 6.6 for recommendations regarding interrogating build interruptions. See 6.7 for recommendations regarding specimen quantity for high criticality applications.

4.4.3 Relative density. A minimum of one representative sample shall be taken from each lot for analysis. The sample cross-section shall be representative of the sample and oriented to capture the build direction. The sample or samples shall include at least one external surface in addition to interior material. Sample dimensions shall be such that metallographic imaging covers a continuous minimum sample area of 0.25 square inch. The relative density sample shall be tested in the final heat treated condition. See 4.4.5 for required additional sampling of multi-laser LPBF systems.

4.4.4 Resampling and retesting. Test results that do not meet this specification may be addressed by testing two additional samples taken from the same lot as the original sample. The average of all test results shall meet the specified requirements for lot acceptance. If any two samples of any type of test fail to meet the acceptance criteria, then the lot shall be rejected. When specified (see 6.2), any lot may be rejected based on a single tensile or relative density test.

4.4.5 Sampling of multi-laser systems. Conformance to the requirements for tensile properties and relative density shall be demonstrated for each laser used in production. To reduce testing burden, more than one laser may optionally be used to produce any given conformance inspection sample. To demonstrate conformance for any individual laser, at a minimum, one fifth (20 percent) of the tested volume (e.g., gauge region of a tensile bar or sample area inspected for relative density) of the conformance sample shall have been processed by that laser. See 6.8 for examples.

4.5 Chemical composition. Chemical analysis shall be performed in accordance with ASTM A751, ASTM E353, ASTM E1086, ASTM E1479, or ASTM E1019, or other validated analytical methods (see 6.2). Phosphorus content shall be determined using Inductively Coupled Plasma Atomic Emission Spectrometers (ICP-AES) in accordance with ASTM E1479 or a validated equivalent method with verified interference correction, as specified (see 6.2). Carbon, sulfur, oxygen, and nitrogen content shall be determined in accordance with ASTM E1019.

4.6 Tensile testing. The tensile specimens shall be tested in accordance with ASTM E8/E8M and shall meet the requirements of table II (see 3.4).

4.7 Relative density. The relative density shall be measured according to ASTM F3637 metallography guidance. Metallography shall be performed in accordance with ASTM E3. Image acquisition shall utilize a method conforming to ASTM E562 or ASTM E1245, with a minimum magnification of 10X; higher magnifications are permitted. Support structures shall be excluded from imaging and measurement. Images shall be processed to a grayscale or binary image and pixels counted using a histogram in accordance with ASTM E1245. See 6.9 for reporting recommendations.

4.8 Additional mechanical properties. Test methods for additional mechanical testing shall be as specified (see 6.2).

4.9 Certificate of conformance. Unless otherwise specified (see 6.2), a certificate of conformance (COC) shall be provided for each lot of material offered for acceptance in accordance with the lot definition specified in 4.3. The COC shall include the following:

a. Statement that each lot has been sampled, tested, and inspected in accordance with the requirements specified herein.

b. Statement whether a weld repair has been performed (see 3.6), including a complete record of all repaired defects with location, weld repair inspection results, post weld heat treatment (if any), and associated weld procedure approvals.

c. When detrimental material controls are required (see 6.2), statement certifying that requirements have been met (see 3.8).

d. Statement that powder feedstock is in accordance with the requirements specified in MIL-PRF-32801 (see 3.1).

e. Identification of the Government, manufacturer, or industry standard used for LPBF qualification (see 6.3) and accompanying approval or certification documentation to demonstrate compliance thereof.

f. A complete record of all heat treatments, including time, temperatures, atmosphere, and heating and cooling rates (see 3.4).

g. A complete record of testing used to demonstrate compliance with this specification, including any failed tests.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Laser powder bed fusion 316L AM material is intended for NAVSEA applications that would otherwise incorporate materials such as Gr. CF3M and CF8M (ASTM A351/A351M, ASTM A743/A743M, ASTM A744/A744M), Gr. CF8M (MIL-C-24707/3), and Gr. F 304L and F 316L (ASTM A182/A182M). It should be noted that many commercial specifications incorporate requirements that are out of scope for this material specification, including but not limited to surface roughness minimums or additional evaluation techniques (e.g., hydrostatic tests). This specification only purports to address material properties and no other product characteristics. This material is intended for use in applications with a maximum operating temperature of 550 °F where general corrosion or pitting may be a problem. This material is suitable for welded applications.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Grade required (see 1.2).

c. When a cobalt maximum is required and what the maximum value is (see table I).

d. When heat treatment control in accordance with MIL-STD-1684 is required (see 3.3).

e. When material should undergo hot isostatic pressing instead of, or in addition to, a heat treatment (see 3.3.1).

f. When weld repair is permitted (see 3.6).

g. Additional mechanical properties and corresponding acceptance criteria (see 3.7).

h. When needed, detrimental material control requirements (see 3.8).

i. Variable lot size when required (see 4.3).

j. When tests that do not meet this specification are not allowed to be repeated by additional samples taken from the original lot (see 4.4.4).

k. Acceptable chemical analysis methods that are different than those already specified (see 4.5).

l. Acceptable chemical analysis method(s) for measuring phosphorus content (see 4.5).

m. Additional mechanical property test methods (see 4.8).

n. When a certificate of conformance is not required (see 4.9).

o. Packaging requirements (see 5.1).

p. Surface finish requirements (see 6.4).

q. Additional sampling for build interruptions, when required (see 6.6).

r. Number of samples, orientation, and test type if other than specified (see 6.7).

6.3 LPBF qualification. Grade B material requires the disclosure of a process qualification standard. Appropriate industry standards include SAE AMS7003, AWS D20.1/D20.1M, or other standards that provide a framework to prove that the LPBF process is capable of producing material of consistent quality.

6.4 Surface finish. Material produced using LPBF may have a rough surface finish that is associated with performance debits, particularly for corrosion resistance and fatigue life. Material is often post-processed via machining, grinding, electrical discharge machining, polishing, and so forth to achieve desired surface finish. This specification does not address material performance in anything but the machined condition. Surface finish requirements should be as specified (see 6.2).

6.5 Specimen location. Specimens should be located near the component and placed in a representative location that is known to produce material of lower performance. Performance can vary across the build area, given recoating direction and gas flow. This is often on a platform-to-platform basis and should be determined during qualification.

6.6 Specimen for interrogating build interruptions. The vertical tensile coupon may extend through the height of the build to interrogate a build interruption in the case of such an event. Build interruption specimens should be as specified (see 6.2).

6.7 Specimen quantity. Specimen quantity and test type may be increased for a component of high criticality. For instance, additional tensile tests, or other tests including fatigue are encouraged for high criticality parts, when those properties are relevant to the application. For additional tests, the method, geometry, orientation, testing state (as-built or heat treated), surface condition, and acceptance criteria should be specified. Increased sampling should be as specified (see 6.2).

6.8 Conformance testing for multi-laser systems. This discussion gives an example of how conformance for mechanical properties and relative density may be shown for a system that uses more than one laser. Note that chemical composition is to be measured per lot, not per laser, and so is not included in this discussion. Conformance is only required for those lasers used to produce material under this specification. The following example uses a four-laser system, but the discussion applies equally to systems with any number of lasers:

a. In the case of regional lasers (lasers confined to a specific corner or region of the build area), the producer may use the left two lasers to produce one set of conformance samples and the right two lasers to produce a second set in their respective overlap regions. Optionally, the front and back lasers may be similarly combined in their overlap region.

b. In the case of global lasers (lasers that span and are commonly used across the whole or majority of the build area), a single set of conformance samples may be produced. These samples could be located anywhere on the build plate. See 6.5 for location recommendations.

c. If the producer opts not to use multiple lasers to produce conformance samples, each individual laser is required to produce a complete set of tensile and relative density conformance samples.

d. In all cases where producers use more than one laser to produce a conformance sample, the contribution of each laser used in production is required to meet the 20 percent threshold (see 4.4.5). Conformance to this requirement may be stated via the COC. For example, in the case of the four-laser machine where all four lasers are producing one set of conformance samples, each laser should be shown to have produced at minimum one fifth of the gage section of each sample.

6.9 Relative density reporting. It is recommended that the processed image(s) and captured image(s) be reported together. If multiple images are analyzed, a stereological confidence interval may be computed from the images in accordance with ASTM E562 or ASTM E1245. The lower limit of the confidence interval will serve as the relative density measurement.

6.10 Definitions.

6.10.1 LPBF build orientations. The Z axis is perpendicular to the build platform. The XY plane is parallel to the build platform. See ISO/ASTM 52921, “Standard Terminology for Additive Manufacturing—Coordinate Systems and Test Methodologies,” for further clarification.

6.10.2 Part thickness. The part thickness is the diameter of the largest sphere that can be inscribed in any cross-section of the part.

6.11 Subject term (key word) listing.

316L
3-D Printing
Casting Substitute
CF8M
CRES
Metal Powder Printing
Metal Printing
Powdered Metal

CONCLUDING MATERIAL

Custodians:
Army – MR
Navy – SH

Preparing activity:
Navy – SH
(Project AMPR-2025-002)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.