

Beryllium Sheet and Plate  
98Be

(Composition similar to UNS R19801)

#### RATIONALE

AMS7902F is a Five Year Review and update of this specification.

#### 1. SCOPE

##### 1.1 Form

This specification covers beryllium in the form of sheet and plate produced by hot rolling beryllium block.

##### 1.1.1 Sheet

Thickness 0.020 to 0.250 inch (0.51 to 6.35 mm), inclusive.

##### 1.1.2 Plate

Thickness over 0.250 inch (6.35 mm).

#### 1.2 Application

These products have been used typically for parts requiring high strength-to-weight ratio and high modulus of elasticity, but usage is not limited to such applications.

#### 1.3 Classification

There are three sheet and plate classifications based on flatness tolerances (See 3.5.5).

#### 1.4 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards that may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

##### 1.4.1 WARNING

Inhaling dust or fumes containing beryllium may cause chronic beryllium disease, a serious chronic lung disease, in some individuals. Over time, lung disease can be fatal. Read the product specific Material Safety Data Sheet (MSDS) for additional environmental, health and safety information before working with beryllium or beryllium-containing materials.

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## 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 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AMS2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys

AMS-STD-2154 Inspection, Ultrasonic, Wrought Metals

### 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 8 / E 8M Tension Testing of Metallic Materials

ASTM E 1417 Liquid Penetrant Testing

ASTM E 1742 Radiographic Examination

### 2.3 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007, 2300, Tel: 973-882-1170, [www.asme.org](http://www.asme.org).

ASME B46.1 Surface Texture, Surface Roughness, Waviness and Lay

ASME Y14.5M Dimensioning and Tolerancing

## 3. TECHNICAL REQUIREMENTS

### 3.1 Composition

Shall conform to the percentages by weight shown in Table 1; beryllium oxide shall be determined by gas fusion; aluminum, iron, magnesium, and silicon and other elements by spectrochemical methods; and carbon by combustion. Beryllium shall be determined by difference. In case of disputes between analyses by different spectrochemical methods, emission spectroscopy shall govern.

TABLE 1 - COMPOSITION

Element	min	max
Beryllium Oxide	--	2.0
Aluminum	--	0.16
Carbon	--	0.15
Iron	--	0.18
Magnesium	--	0.08
Silicon	--	0.08
Other elements, each (3.1.1)	--	0.04
Beryllium	98.0	--

3.1.1 Determination is not required for routine acceptance.

### 3.2 Condition

Hot rolled from a block of consolidated beryllium powder, stress relieved, ground, and etched.

3.2.1 The product shall be furnished with a machined surface. The standard surface finish shall be no greater than 55 Ra (63 microinches (3  $\mu\text{m}$ )) for sheet and 110 Ra (125 microinches (6  $\mu\text{m}$ )) for plate up to 0.600 inch (15.24 mm) in thickness, determined in accordance with ASME B46.1.

### 3.3 Properties

The product shall conform to the following requirements:

#### 3.3.1 Tensile Properties

Shall be as specified in Table 2, determined at room temperature in accordance with ASTM E 8 / E 8M.

TABLE 2A - MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Normal Thickness Inch	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 1 Inch %
0.020 to 0.250, incl	70	50.0	10
Over 0.250 to 0.450, incl	65	45.0	4
Over 0.450 to 0.600, incl	60	40.0	3
Over 0.600	40.0	30.0	1

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Normal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 25.4 mm %
0.51 to 6.35, incl	483	345	10
Over 6.35 to 11.43, incl	448	310	4
Over 11.43 to 15.24, incl	414	276	3
Over 15.24	276	207	1

### 3.4 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.

3.4.1 The product shall be free from cracks and internal defects, determined as in 3.4.1.1, 3.4.1.2, 3.4.1.3, and 3.4.1.4.

#### 3.4.1.1 Visual

No restrictions to size or number of visual imperfections if they do not hold fluorescent penetrant dye.

#### 3.4.1.2 Fluorescent Penetrant Inspection

Shall be performed in accordance with ASTM E 1417, Type 1, Level 2. The maximum allowable size and number of indications per side in a 12-inch (305-mm) square area shall be as shown in Table 3:

TABLE 3A - FLUORESCENT PENETRANT INSPECTION REQUIREMENTS, INCH/POUND UNITS

Indication Size Inch	Maximum Acceptable Number of Indications
Up to 0.003, incl	Not counted unless in a cluster where visible with no magnification
Over 0.003 to 0.005, incl	5 - no more than two in a 2-inch diameter circle.
Over 0.005 to 0.010, incl	3 - at least 2 inches apart.
Over 0.010	0

TABLE 3B - FLUORESCENT PENETRANT INSPECTION REQUIREMENTS, SI UNITS

Indication Size Millimeters	Maximum Acceptable Number of Indications
Up to 0.08, incl	Not counted unless in a cluster where visible with no magnification
Over 0.08 to 0.13, incl	5 - no more than two in a 51-mm diameter circle.
Over 0.13 to 0.25, incl	3 - at least 51 mm apart.
Over 0.25	0

### 3.4.1.3 Ultrasonic Inspection

When specified, product shall be subjected to ultrasonic inspection in accordance with AMS-STD-2154, except that a beryllium reference block may be used, and shall meet Class AA requirements of AMS-STD-2154.

3.4.1.3.1 If a material other than beryllium is used as the reference block, the difference in attenuation, noise level, and velocity shall be taken into account.

### 3.4.1.4 Radiographic Inspection

When specified, product shall be subjected to radiographic inspection in accordance with ASTM E 1742, to a penetrometer sensitivity of 2% except as specified by 3.4.1.4.1, and shall meet the acceptance criteria of 3.4.1.4.2, 3.4.1.4.3, and 3.4.1.4.4. The decision to accept or reject may be made directly beneath the IQI/Shim combination.

3.4.1.4.1 Exceptions are taken to the penetrometer contrast requirement and applicable area of penetrometer density ranges of +30% or -15% from the density at penetrometer location(s).

3.4.1.4.2 The total combined volume per cubic inch (16.4 cm<sup>3</sup>) of all detectable radiographic indications shall not exceed the volume of a 0.050 inch (1.27 mm) diameter sphere (e.g., total spherical volume shall not exceed 0.000065 in<sup>3</sup> [1.07 mm<sup>3</sup>]). For calculation purposes, assume all indications are spherical.

### 3.4.1.4.3 Part Density Uniformity

The terms variable density areas, banding, or striations denote relatively large areas of a radiograph, which vary in density as compared to the surrounding area. These areas shall not vary in radiographic density by more than 5% as compared to the surrounding area of comparable section thickness. Suspect areas shall be re-radiographed and interpreted with the appropriate penetrometer, or with beryllium of 5% in thickness, placed as follows:

3.4.1.4.3.1 Less dense (darker radiograph) areas shall be covered by the penetrometer. The radiograph of the covered area shall appear lighter than that of the adjacent area.

3.4.1.4.3.2 More dense (lighter radiograph) areas shall have the penetrometer placed immediately adjacent to them. The radiograph of the covered area shall appear lighter than that of the suspect more-dense area.

3.4.1.4.4 Discrete high density (light radiograph) indications, or areas in product 1.000 inch (25.40 mm) and under in nominal thickness, shall not exceed 5% in radiographic density variation compared to the surrounding material. (Note: The minimum detectable size of voids and inclusions will increase as the section thickness increases.)

### 3.5 Tolerances

Shall conform to the dimensions and dimensional tolerances established by the purchase order and applicable drawings. If tolerances are not so specified, standard tolerances in accordance with ASME Y14.5M, as shown in Table 4, shall apply.

#### 3.5.1 Thickness

TABLE 4A - THICKNESS TOLERANCES, INCH/POUND UNITS

Thickness Inch	Tolerance	Tolerance
	Inch plus	Inch minus
0.020 to 0.025, incl	0.003	0.003
Over 0.025 to 0.034, incl	0.004	0.004
Over 0.034 to 0.056, incl	0.005	0.005
Over 0.056 to 0.070, incl	0.006	0.006
Over 0.070 to 0.078, incl	0.007	0.007
Over 0.078 to 0.093, incl	0.008	0.008
Over 0.093 to 0.109, incl	0.009	0.009
Over 0.109 to 0.125, incl	0.010	0.010
Over 0.125 to 0.140, incl	0.012	0.010
Over 0.140 to 0.171, incl	0.014	0.010
Over 0.171 to 0.250, incl	0.015	0.010
Over 0.250 to 0.351, incl	0.015	0.010
Over 0.351 to 0.451, incl	0.020	0.010
Over 0.451 to 0.600, incl	0.025	0.015

TABLE 4B - THICKNESS TOLERANCES, SI UNITS

Thickness Millimeters	Tolerance	Tolerance
	Millimeter plus	Millimeter minus
0.51 to 0.64, incl	0.08	0.08
Over 0.64 to 0.86, incl	0.10	0.10
Over 0.86 to 1.42, incl	0.13	0.13
Over 1.42 to 1.78, incl	0.15	0.15
Over 1.78 to 1.98, incl	0.18	0.18
Over 1.98 to 2.36, incl	0.20	0.20
Over 2.36 to 2.77, incl	0.23	0.23
Over 2.77 to 3.18, incl	0.25	0.25
Over 3.18 to 3.56, incl	0.30	0.25
Over 3.56 to 4.34, incl	0.36	0.25
Over 4.34 to 6.35, incl	0.38	0.25
Over 6.35 to 8.92, incl	0.38	0.25
Over 8.92 to 11.46, incl	0.51	0.25
Over 11.46 to 15.24, incl	0.64	0.38

3.5.1.1 Thickness measurements on sheet and plate, 1.0 inch (25 mm) or more in width, shall not be conducted closer to any edge than 0.375 inch (9.52 mm). There shall be no restriction of thickness measurement location for sheet or plate under 1.0 inch (25 mm) wide. Thickness measurements shall be taken at a maximum of 6 inches (152 mm) apart over the entire surface of the sheet or plate.

### 3.5.2 Width

#### 3.5.2.1 Sheet

Shall not vary more than plus 0.125 inch (3.18 mm), minus 0 inch (0 mm).

#### 3.5.2.2 Plate

Shall not vary more than plus 0.125 inch (3.18 mm), minus 0.125 inch (3.18 mm).

### 3.5.3 Length

#### 3.5.3.1 Sheet

Shall not vary more than plus 0.250 inch (6.35 mm), minus 0 inch (0 mm).

#### 3.5.3.2 Plate

Shall not vary more than plus 0.125 inch (6.35 mm), minus 0.125 inch (6.35 mm).

### 3.5.4 Straightness

Maximum edgewise curvature (depth of arc) shall not exceed 1/16 inch/foot (5.2 mm/m) of length, measured in the plane of the sheet or plate.

### 3.5.5 Flatness

Shall not vary more than shown in Table 5, determined by methods agreed upon by purchaser and vendor.

TABLE 5A - FLATNESS TOLERANCES, INCH/POUND UNITS

Thickness, Inches	Class 1	Class 2	Class 3
Up to 0.040, incl	2%	1%	0.030 inch per foot
Over 0.040 to 0.250, incl	1%	1/2%	0.030 inch per foot
Over 0.250	1/2%	1/2%	N/A

TABLE 5B - FLATNESS TOLERANCES, SI UNITS

Thickness, Millimeters	Class 1	Class 2	Class 3
Up to 1.02, incl	2%	1%	2.5 mm/m
Over 1.02 to 6.35, incl	1%	1/2%	2.5 mm/m
Over 6.35	1/2%	1/2%	N/A

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 Responsibility for Inspection

The vendor of the product shall supply 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 product conforms to specified requirements.

### 4.2 Classification of Tests

All technical requirements are acceptance tests and shall be performed on each lot as applicable.