

AEROSPACE MATERIAL SPECIFICATION



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Beryllium Sheet and Plate
General Requirements for

FSC 9535

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1. SCOPE:**1.1 Scope:**

This specification covers general requirements for beryllium sheet and plate.

2. APPLICABLE DOCUMENTS:

The following publications, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-I-6866 Inspection, Penetrant
MIL-I-8950 Inspection, Ultrasonic, Wrought Metals Process for

MIL-STD-129 Marking for Shipment and Storage
MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage
MIL-STD-453 Inspection, Radiographic

2.2 National Academy of Sciences - National Research Council Publications:

Available from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314, or the Clearing House, U.S. Department of Commerce, Springfield, Virginia 22151. Request Document No. AD 631183. May also be available from the Materials Advisory Board, National Academy of Sciences, 2101 Constitution Ave., N.W. Washington, DC 20418.

MAB-205-M Evaluation Test Methods for Beryllium

2.3 American Industrial Hygiene Association (AIHA):

Available from the American Industrial Hygiene Association (AIHA), 14125 Prevoist Street, Detroit, MI 48227.

Hygienic Guide Series - Beryllium and Compounds

2.4 United States of America Standards Institute:

Available from United States of America Standards Institute, 10 East 40th Street, New York, NY 10016.

B46.1 - 1962 Surface Texture (Surface Roughness, Waviness and Lay)

3. REQUIREMENTS:

3.1 Material:

3.1.1 Condition: The material shall be produced by cross rolling from a block of consolidated beryllium powder. Unless otherwise specified, the material shall be furnished stress relieved and pickled, and the surface finish shall have a maximum roughness of 63 microinches (RHR) for sheet from 0.020 inch to under 0.250 inch in thickness, inclusive, and 125 RHR for plate 0.250 inch to 0.600 inch in thickness, inclusive.

3.2 Chemical composition:

The chemical composition of beryllium sheet and plate, as determined by blend analysis, shall be as follows:

<u>Element</u>	<u>Percent (max.)</u>
Beryllium oxide	2.0
Aluminum	0.16
Carbon	.15
Iron	.18
Magnesium	.08
Silicon	.08
Other metallic impurities (each)	.04
Beryllium	Remainder

3.3 Mechanical properties:

The mechanical properties (longitudinal and transverse direction) of beryllium sheet and plate shall be as follows:

<u>Thickness (inch)</u>	<u>Tensile strength (psi, min.)</u>	<u>Yield strength at 0.2 percent offset (psi, min.)</u>	<u>Elongation in 1 inch (percent, min.)</u>
0.020 to 0.249 (incl.)	70,000	50,000	5
0.250 to 0.450 (incl.)	65,000	45,000	4
0.451 to 0.600 (incl.)	60,000	40,000	3

3.4 Dimensional tolerance:

3.4.1 Thickness: Thickness tolerance for beryllium sheet and plate shall be as follows:

<u>Nominal thickness (inch)</u>	<u>Tolerance (inch)</u>	
	<u>Over</u>	<u>Under</u>
Including 0.020 - 0.025 (incl.)	0.003	0.003
Over 0.025 - 0.034 (incl.)	.004	.004
Over .034 - .056 (incl.)	.005	.005
Over .056 - .070 (incl.)	.006	.006
Over .070 - .078 (incl.)	.007	.007
Over .078 - .093 (incl.)	.008	.008
Over .093 - .109 (incl.)	.009	.009
Over .109 - .125 (incl.)	.010	.010
Over .125 - .140 (incl.)	.012	.010
Over .140 - .171 (incl.)	.014	.010
Over .171 - Under .351	.015	.010
.351 - Under .451	.020	.010
.451 - .600 (incl.)	.025	.015

3.4.1.1 Thickness measurements on sheet or plate 1 inch or more in width shall not be performed closer than 0.375 inch to any edge. There shall be no restriction of thickness measurement location for sheet or plate under 1 inch wide.

3.4.2 Width: The deviation in width from that specified shall be as follows:

<u>Specified thickness (inch)</u>	<u>Tolerance (inch)</u>	
	<u>Over</u>	<u>Under</u>
Less than 0.250	0.125	0.000
Over 0.250	0.125	0.125

3.4.3 Length: The deviation in length from that specified shall be as follows:

<u>Specified thickness (inch)</u>	<u>Tolerance (inch, maximum)</u>	
	<u>Over</u>	<u>Under</u>
less than 0.250	0.250	0
Over 0.250	0.125	0.125

3.4.4 Camber: The deviation the sheet edge exhibits shall not exceed 0.062 inch of convexity in any foot of length.

3.4.5 Flatness: Flatness is determined while the sheet is resting on a flat surface with its concave side upward. A straight edge is laid on the material in any direction. The point of greatest deviation from the straight edge to the material is then measured along with the distance between contact points of the straight edge. The deviation from flatness is then expressed as a percentage of the distance between the contact points of the straight edge. Deviation from flatness shall be as follows:

<u>Material nominal thickness (inch)</u>	<u>Deviation from flatness (percent)</u>
Under 0.035	3
0.035 - 0.250	2
0.250 and over	1/2

3.5 Identification of product:

Unless otherwise specified each sheet and plate shall be marked with this specification number, the manufacturer's name, sheet or plate number, lot number, and nominal dimensions. A waterproof black ink, readily removable by commercial nonreactive solvent and not harmful to the material, shall be used for this purpose.

3.6 Workmanship:

The material shall be uniform in quality and condition, free from surface contaminants and foreign material. It shall be clean, sound, smooth, and free of cracks and seams.

3.7 Penetrant inspection:

Material shall be free from cracks as determined by MIL-I-6866 penetrant inspection.

3.8 Ultrasonic inspection of plate:

When specified, ultrasonic test indications shall meet class AA requirements of MIL-I-8950.

3.9 Radiographic inspection:

When specified, the radiograph shall reveal the combined volumes of inclusion per cubic inch of material to be no greater than the equivalent volume of a 0.050-inch diameter sphere, and shall be in accordance with MIL-STD-453.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspection:

All the examinations and tests required for the inspection of beryllium sheet and plate shall be classified as quality conformance inspection.

4.3 Lot:

Unless otherwise specified in the contract or order, a lot shall consist of all sheet and plate produced from the same block of material.

4.4 Sampling:

4.4.1 Quality conformance samples:

4.4.1.1 Visual examination: All edges and surfaces of each sheet or plate of material shall be closely examined for conformance to 3.6.

4.4.1.2 Dimensional tolerances: Thickness measurements for each sheet or plate will be taken a maximum of 6 inches apart over the entire sheet or plate.

4.4.1.3 Chemical analysis: At least one sample shall be taken from each blend of powder used to produce sheet and plate. Complete powder blend analysis records shall be available to the procuring activity.

4.4.1.4 Mechanical test: At least two samples for specimens, one longitudinal and one transverse, shall be taken, in accordance with 4.4.2, to represent each sheet or plate.

4.4.2 Specimen preparation:

4.4.2.1 Specimens for mechanical test: Longitudinal test specimens shall be prepared in such a manner that the longitudinal axis of the specimen is parallel to the last rolling direction of the sheet or plate. Transverse specimens shall be prepared in such a manner that their longitudinal axis is at an angle of 90 degrees to the longitudinal axis of the longitudinal specimens.

- 4.4.2.2 Unless otherwise specified, edge and end trimmings may be used for mechanical test specimen preparation.
- 4.4.2.3 Specimens for mechanical test shall be prepared to the form and dimensions specified in MAB-205-M, and shall be machined and etched using the techniques therein.
- 4.5 Quality conformance inspection:
- 4.5.1 Examinations:
- 4.5.1.1 Examination of product: Each sheet or plate shall be visually examined for conformance to 3.1.1, marking for identification (see 3.5), workmanship (see 3.6), and measured for compliance with 3.4.
- 4.5.1.2 Examination of preparation for delivery: Preparation for delivery shall be examined for conformance to section 5.
- 4.6 Inspection methods:
- 4.6.1 Chemical analysis: A chemical analysis shall be performed on a sample chosen in accordance with 4.4.1.3. Any ASTM chemical or spectrochemical method may be used, provided the composition of the sample can be determined to the nearest hundredth of one percent. The chemical composition shall be as specified in 3.2.
- 4.6.2 Mechanical properties:
- 4.6.2.1 Tensile strength: Specimens for tensile test, prepared in accordance with 4.4.2.1, 4.4.2.2, 4.4.2.3, and 4.4.2.4, shall be tested for tensile strength in accordance with MAB-205-M to determine conformance to 3.3, as applicable.
- 4.6.2.2 Yield strength: The yield strength of the tensile test specimens shall be determined by the offset method, as detailed in MAB-205-M to determine conformance to 3.3, as applicable.
- 4.6.2.3 Elongation: The elongation of the tensile test specimens shall be determined as specified in MAB-205-M to determine conformance to 3.3, as applicable.
- 4.6.3 Penetrant inspection: When specified, each sheet or plate shall be fluorescent penetrant inspected in accordance with MIL-I-6866 to determine conformance with 3.7.
- 4.6.4 Surface roughness: Each sheet or plate shall be measured for surface roughness in conformance with USA B46.1-1962.
- 4.6.5 Ultrasonic inspection: When specified, plate material shall be inspected in accordance with MIL-I-8950 except that a beryllium reference block may be used; if another material is used as the reference block, the difference in attenuation, noise level and velocity shall be taken into account.