Inert Gas Fusion I-220-H beryllium is an instrument grade beryllium metal used in applications requiring high resistance to plastic deformation at low stress levels. The high resistance to plastic deformation at low stress levels is crucial for applications that require high micro-yield strength. Typical uses include telescope supports on space exploration satellites and optical satellites.

I-70-H grade beryllium consists of 99% beryllium with a maximum of 0.7% beryllium oxide. Low oxide grades allow for bare beryllium mirrors to yield a lower level scatter and to polish easier than higher oxide grades. I-70-H grade beryllium metal is stable over a wide range of temperatures from -196°C to 226°C (-321°F to 440°F) and offers superior reflectivity in the far infrared region (98.5% at 8-12 micron wavelengths) without optical coatings. This IR reflectivity enables designers to create defense applications that are more difficult to detect.

https://materion.com/-/media/files/beryllium/specsheets/i-220-h.pdf

MATERION

SPEC SHEET

I-220-H
GRADE BERYLLIUM

Effective: November 11, 2011 Revision C

1.SCOPE

This specification defines the requirements for an instrument grade of Beryllium designated as I-220-H.

2.CHEMICAL COMPOSITION

2.1. The chemical composition shall conform to the following:

Beryllium Assay, % minimum (1)	98.0
Beryllium Oxide, % maximum (2)	2.2
Aluminum, % maximum (3)	0.10
Carbon, % maximum (4)	0.15
Iron, % maximum (3)	0.15
Magnesium, % maximum (3)	0.08
Silicon, % maximum (3)	0.08
Other Metallic Impurities, % maximum (3)	0.04

Note: (1) Difference (i.e. 100% - other elements)
(2) Leco Inert Gas Fusion
(3) Spectrochemical Methods
(4) Leco Combustion

3. DENSITY

3.1. The minimum bulk density shall be 99.7% Theoretical Density.

3.2. The theoretical density is to be calculated using the following formula:

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MATERION BRUSH INC.
www.materion.com/beryllium

$$\text{Theoretical Density} = \frac{100}{\frac{100-\%BeO}{1.8477\,gm/cc} + \frac{\%BeO}{3.009\,gm/cc}}$$

3.3. Density shall be determined using the water displacement method.

4. THERMALLY INDUCED POROSITY (TIP) REISTANCE

4.1. Sample material from material produced as an integral part (prolongation) of each HIP'd shape shall be subject to a TIP test consisting of a heat treatment in a predominantly inert atmosphere at a temperature of 1450°F (788°C).

4.2. The minimum material density allowed following the TIP heat treatment shall be 99.7% of the Theoretical Density, calculated as shown in section 3.2. The maximum drop in density due to the TIP Resistance Test is to be 0.20%.

5. TENSILE PROPERTIES

5.1. Minimum tensile properties for the material at room temperature, as determined by testing complaint to ASTM E 8, with controlled specimen preparation and speed of testing.

Ultimate Tensile Strength, ksi, minimum	65.0
Yield Strength (0.2% offset), ksi, minimum	50.0
Elongation (% in 4 diameters), minimum	2.0
Elongation (% in 4 diameters), minimum*	1.0
Micro-Yield Strength, ksi, minimum Grade 1	6.0
Micro-Yield Strength, ksi, minimum Grade 2	8.0

*Use when material consists of blanks with either

(1) A calculated volume greater than 1500 cubic inches (0.0246 m^3)

(2) A major dimension greater than 20 inches (0.787m).

5.2. Mechanical properties shall be determined for each lot of shapes, defined by each combination of powder lot (blend) and HIP run. The properties may be determined from a sample shape of from material produced as an integral part (prolongation) of a HIP'd shape from the lot.

6.PENETRANT INSPECTION

6.1. Penetrant and Visual Acceptance Criteria:

A. Cracks are not permissible.

B. Indications (as determined by penetrant):

1. The size of an individual indication on the surface may not exceed 0.050” (1.27mm).

2. A maximum of 3 indications of the size of 0.0003” (0.08mm) to 0.050” (1.27mm) per square inch (650 mm^2) of the surface is acceptable.

3. No restrictions to size or number if they do not hold to penetrant.

6.2. Penetrant inspection shall be performed per ASTM E1417.

7.RADIOGRAPHIC INSPECTION

7.1. Radiography shall be accomplished in accordance with ASTM E-1742, quality level 1 (2-1T) sensitivity.

7.1.2. Where there is good visual definition of the penetrameter, exceptions are taken to the penetrameter contrast requirements and applicable area of penetrameter density ranges of +30% to -15% from the density measured through the body of the penetrameter location(s).

Accept/reject decisions may be made beneath the penetrameter(s).

Note: Due to the nature of radiographic inspection, it is pointed out that the sensitivity of the inspection method decreases with increasing material thickness.

7.2. Radiographic indications (voids and/or inclusions) shall conform to the requirements as established and defined below.

7.2.1. Requirements

Material shall conform to the following requirements, as defined in 7.2.2.

	Maximum Dimension	Maximum Average Dimension	Total Combined Volume per Cubic Inch
Type I	0.050 inch	0.030 inch	Sphere 0.050 inch diameter
Type II	0.030 inch	0.020 inch	Sphere 0.032 inch diameter

7.2.2. Dimensions:

7.2.2.1. Maximum Dimension of any Indication

Any dimension of an indication measured in the plane of the radiograph shall not exceed the indicated size.

7.2.2.2. Maximum Average Dimension of any Indication

The average dimension of an indication shall be the arithmetic average of the maximum and minimum dimensions measures in the plane of the radiograph. The average dimension of an indication shall not exceed the indicated average.

7.2.2.3. Total Combined Volume Per Cubic Inch of all Indications

The total combined volume per cubic inch (16.4 cm^3) of all indications with an average dimension larger than 0.001 inch (0.025mm) shall not exceed the volume of a sphere of the indicated volume.

7.2.2.4. The minimum detectable size of voids and inclusions will increase as the section thickness increases, due to the decrease in sensitivity referred to in paragraph 7.1.

7.2.2.5. Part Density Uniformity

The terms variable density areas, banding or striations shall 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 compare to the surrounding area of comparable section thickness.

7.2.2.6. Light high density indications or areas in material 1.000” (25.4mm) thick or less, which are 5% or less in radiographic density compared to the surrounding material are acceptable.

8. GRAIN SIZE

8.1. The average grain size shall be determined in accordance with ASTM E-112, using the intercept method at 500X magnification.

8.2. The average grain size shall not exceed 15 microns.

9. TOLERANCES

9.1. Materials furnished under this specification shall conform to the dimensions and dimensional tolerances as established by the purchase order and applicable drawings. If tolerances are not established by the purchase order, the following standard tolerances shall apply employing ANSI 14.5M:

Diameter, Width or Thickness (Inches)	Tolerance
Up to 3, inclusive	-0/ + 1/64
Over 3 to 20, inclusive	-0/ + 1/16
Over 20	-0/ +1/4

Length (Inches)	Tolerance
Up to 20, inclusive	-0/ +1/8
Over 20	-0/ +1/4

Diameter, Width or Thickness (Millimeters)	Tolerance
Up to 76, inclusive	-0/ +0.40
Over 76 to 508, inclusive	-0/ +1.59
Over 508	-0/ +6.35

Length (Millimeters)	Tolerance
Up to 508, inclusive	-0/ +3.18
Over 580	-0/ +6.35

10. SURFACE FINISH

10.1. The material shall be furnished with a machined surface. The standard surface finish shall be 125 micro-inches rms. (Approximately 110 Ra) maximum, employing ANSI/ASME B46.1.

11. REPORTS

11.1. Certification of Compliance with the specification will be furnished on request and, when specified, actual test results will be certified. Testing in accordance with individual customer instructions will performed if mutually acceptable and actual test results will be certified.

12. MARKING

12.1. Surface permitting, each part will be legibly marked employing an electro etching technique or tagging if insufficient area is available.

12.2. Marking is to include the following:

Materion Brush Inc.

Lot and/or Part Number

Serial Number

Specification Number

X-Ray Number

Purchase Order Number

Warning Beryllium

13. SAFETY / ENVIRONMENTAL

13.1. Handling Beryllium Containing Material in solid form poses no special health risk. Like many industrial materials, beryllium-containing materials may pose a health risk if recommended safe handling practices are not followed. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) has set mandatory limits on occupational respiratory exposures. Read and follow the guidance in the Material Safety Data Sheet (MSDS) before working with this material. For additional information on safe handling practices or technical data on Beryllium Containing Material, contact Materion Brush Beryllium & Composites, EH&S Product Steward @ 216-383-4040