AEROSPACE MATERIAL SPECIFICATION

AMS2431™/7	REV. C

Issued 1988-04
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Revised 2021-12

Superseding AMS2431/7B

Peening Media
Ceramic Shot

RATIONALE

AMS2431/7C is the result of a Five-Year review and update of this specification with changes to Shape (3.4.6) that allows image analysis and its resolution, allows dispersion of shot prior imaging, adds a preferred number of shot to be analyzed, changes Table 2 and Table 3 from shot per area to percentage which is more explicit, and changes to the definitions of Sphericity (8.2.2), Angularity (8.2.3), and Satellites (8.2.4) with new figures for each.

1. SCOPE

1.1 Purpose

The complete requirements for procuring the product shall consist of this document and the latest issue of the basic specification, AMS2431.

1.2 Application

Ceramic shot conforming to this specification is typically intended for use in peening of metal surfaces to impart compressive stresses to these surfaces thereby increasing resistance to fatigue and stress-corrosion cracking. Generally, ceramic shot may be used where ferrous contamination of the part is undesirable or very hard parts (over 60 HRC) are to be peened for maximum residual compressive stress.

2. APPLICABLE DOCUMENTS

Shall be in accordance with AMS2431.

3. TECHNICAL REQUIREMENTS

3.1 Ceramic shot shall conform to AMS2431, and the requirements specified herein.

3.2 Composition

Composition shall be high quality zirconium oxide and silica. The percentage variation by weight ranges of the main constituents of ceramic shot shall be as stated in Table 1:

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For more information on this standard, visit
https://www.sae.org/standards/content/AMS2431/7C/

Table 1 - Composition

Constituent	Min	Max
Zirconium Oxide	60	70
Silica	28	33
Alumina	--	10
Other Constituents, total	--	3

3.3 Properties

3.3.1 Hardness

3.3.1.1 Hardness shall be measured by the manufacturer at least on mother production batches. User should measure hardness at their discretion or when a counter analysis is required.

3.3.1.2 For AZB850 to AZB150, at least 90% of the readings shall fall within the range of 643 to 785 HV (58 to 63 HRC, for reference only).

3.3.1.3 For AZB100, the mean value of the readings shall fall within the same range of 643 to 785 HV.

3.3.2 Density

Density shall be between 3.60 and 3.95 g/cc, measured at 70 °F (21 °C) by a pycnometric method.

3.3.3 Contamination

3.3.3.1 Magnetic particles shall not exceed 0.1% by weight of the original sample.

3.3.4 Surface Discolorations

Not more than 15% of the shot shall show foreign discolorations. A particle shall be considered objectionable for foreign discoloration when more than 25% of its surface area is discolored.

3.3.5 Coatings

Coating of any kind are not permitted.

3.3.6 Shape

3.3.6.1 Ceramic shot shall be spherical to ellipsoid in shape. Table 2 shows the maximum percentage of ceramic shot having a sphericity lower than 0.5 and the minimum percentage of ceramic shot having a sphericity of 0.8 and above (true spheres). See Section 8 for definition of sphericity.

3.3.6.2 Maximum number of permissible broken or angular shots is shown on column 11 of Table 2. This number shall never exceed 3% of the actual count. See Section 8 for definition of roundness.

Table 2 - Ceramic shot for peening – sizes and sphericity

Designation	Nominal Sizes, Millimeters	Nominal Sizes, Inches	Nominal Sizes, Mesh	Sieve Size, Millimeters Maximum 0.5% Retained	Sieve Size, Millimeters Maximum 5% Retained	Sieve Size, Millimeters Maximum 10% Passing	Sieve Size, Millimeters Maximum 3% Passing	Minimum % of Shot W/Sphericity 0.8 and Above (True Spheres)	Maximum %of Shot with Sphericity Below 0.5	Maximum % Broken or Angular Shots Acceptable
AZB850	0.85/1.18	0.033/0.047	16/20	1.400	1.180	0.850	0.710	65	4.6%	2.3%
AZB600	0.6/0.85	0.024/0.033	20/30	1.000	0.850	0.600	0.425	65	5.3%	2.7%
AZB425	0.425/0.6	0.017/0.024	30/40	0.710	0.600	0.425	0.300	70	4.8%	2.7%
AZB300	0.300/0.425	0.012/0.017	40/50	0.500	0.425	0.300	0.250	70	3.9%	2.2%
AZB210	0.212/0.300	0.008/0.012	50/70	0.355	0.300	0.212	0.180	80	4.0%	1.5%
AZB150	0.150/0.212	0.006/0.008	70/100	0.250	0.212	0.150	0.125	80	11.0%	2.4%
AZB100	0.100/0.150	0.004/0.006	100/140	0.180	0.150	0.106	0.063	80	10.0%	1.5%

3.3.7 Satellites

Maximum allowable number of shot with satellites shall be Table 3. See Section 8 for definition of satellites.

Table 3 - Ceramic shot with satellites

Designation	Maximum % of Shot with Satellites	Maximum % of Shot with 3 or More Satellites
AZB850	9.3%	3.5%
AZB600	8.7%	4.0%
AZB425	12.9%	4.1%
AZB300	9.5%	3.0%
AZB210	9.2%	2.9%
AZB150	6.4%	1.8%
AZB100	5.8%	1.7%

3.3.8 Size

Size shall conform to the requirements of Table 2.

3.4 Test Methods and Procedures

3.4.1 Size Classification

Sieve analysis shall be determined in accordance with ASTM D1214. Screens shall be in accordance with U.S. Standard Series described in ASTM E11.

3.4.2 Composition

Composition shall be measured by the manufacturer at least on mother production batches by x-ray fluorescence or by other method acceptable to purchaser. User should measure composition at his discretion or when a counter analysis is required.

3.4.3 Hardness

Hardness shall be determined by a Vickers diamond pyramid penetrator using 1000-gram load in accordance with ASTM E384 or ASTM C1327. To avoid fracture of shots, the loads shall be as follows: 200-gram load for AZB100, 500-gram load for AZB150, AZB210, and AZB300 and 1000-gram load for AZB425, AZB600, and AZB850.

3.4.4 Contamination

Magnetic particle content shall be determined by slowly sprinkling approximately 1500 grams of the sample ceramic shot on an inclined aluminum tray that is 0.062 inch (1.57 mm) deep by 6 inches (152 mm) wide by 12 inches (305 mm) long. The tray shall be supported by a nonmagnetic frame so that it is inclined with a 6 inch (152 mm) rise from end to end (30 degrees from horizontal). Four 1 x 1 x 6 inches (25 x 25 x 152 mm) bar magnets are positioned against the under surface and crosswise to the inclined tray about the middle of its length. Thickness of tray at magnet location shall not exceed 0.062 inch (1.57 mm). Magnets shall be not less than 10000 Gauss each and arranged so that the magnetic north and south poles alternate. The magnetic particles (iron) that accumulate on the tray as the shots roll down shall be brushed into a pre-weighed dish. The procedure shall be repeated with the same 1500-gram sample until all visible magnetic particles are collected. The dish shall be reweighed, and the magnetic particle content calculated as a percentage of the total original sample.

3.4.5 Surface Discoloration

Surface discolorations shall be determined microscopically using magnification as stated in Table 4.

Table 4 - Minimum magnification and area values for shape control of approximately 300 shots

Shot Size	Minimum Magnification(1)	Minimum Resolution(2) (µm/pxl)
AZB850	20x	7
AZB600	20x	5
AZB425	20x	3.5
AZB300	32x	2.5
AZB210	32x	1.75
AZB150	64x	1.25
AZB100	64x	0.8

NOTES:
(1) Magnification = Optical lens × digital (camera for instance) × software (if applicable)
(2) Resolution = final resolution of the detector of the camera, taking into account the optical magnification.

3.4.6 Shape

3.4.6.1 An optical count shall be made of at least three fields or images such that at least 300 total shot are counted. The fields or images shall be randomly chosen from each strip as described below. Fields or images can be viewed manually or with image analysis tools such as software or image processing.

3.4.6.2 Sphericity, angularity, and satellites are measured by an actual counting of a one layer field of ceramic shots, using minimum area to be counted as follows:

3.4.6.2.1 A 30 × 30 mm sample strip is made of a double sided piece of adhesive tape mounted on a substrate: plastic or glass for example. The sample shall be then transferred onto a sample strip by pouring the sample onto the strip, or dipping the strip into the sample container, or dispersing the media on the strip (e.g., with pressurized air).

3.4.6.2.2 The measurements shall be made using a binocular magnifying glass or microscope at the minimum magnification stated in Table 4 or the measurements shall be made from a photograph/image taken at the minimum resolution stated in Table 4.

3.4.6.2.3 The measurement method can be done by visual inspection of the images or by automated image analysis. A mechanical method of inspection for shape is permitted provided that it can be correlated to the optical method and is acceptable to purchaser.

3.4.6.2.4 The results of the measurements of all the shots analyzed shall be added and compared to Tables 2 and 3.

3.4.6.3 The measurement method can be done by visual inspection of the images or by automated image analysis. A mechanical method of inspection for shape is permitted provided that it can be correlated to the optical method and is acceptable to purchaser.

3.4.7 Density

Each 60 gram sample of dry shot, shall be carefully weighed to the nearest 0.1 gram, and placed in a 100 mL graduated cylinder containing approximately 50 mL of reagent water. The resultant volume minus initial volume represents the shot volume. Density shall be determined using the following equation.

$$\text{Density} = \frac{60\,\text{g}}{\text{Shot Volume}}$$

4. QUALITY ASSURANCE PROVISIONS

Shall be in accordance with AMS2431 and the following:

4.1 Sampling

Samples for testing shall be representative of each production batch. Any 25 kg container from each production batch is representative of the production batch. The sampling method is to select randomly a 25 kg container from each production batch and blend the contents. Test samples can then be obtained by successive passes through a sample splitter until the test samples quantity 150 < Q < 300 grams is obtained. Two samples of approximately 200 grams each shall be split to the following test quantities.

4.1.1 Composition

Not less than two samples from each shipment.

4.1.2 Hardness

At least 10 micro-hardness readings shall be made with no more than one impression from any one shot.

4.1.3 Density

Two 60-gram samples for density determination.

4.1.4 Size

Two representative samples of 60 grams minimum weight each.

4.1.5 Shape

One representative sample of 50 grams minimum.

5. PREPARATION FOR DELIVERY

Shall be in accordance with AMS2431 and the following:

5.1 Packaging and Identification

Standard packaging shall be 25 kg units. Other packaging may be done at the request of the purchaser.

6. ACKNOWLEDGMENT

Shall be in accordance with AMS2431.