

SIZE CLASSIFICATION AND CHARACTERISTICS OF CERAMIC SHOT FOR PEENING

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. **Scope**—This specification covers characteristics for chemistry, microstructure, density, hardness, size, shape and appearance of zirconium oxide based ceramic shot, suitable for peening surfaces of parts by impingement.

2. **References**

2.1 **Applicable Publications**—The following publication forms a part of the specification to the extent specified herein.

2.1.1 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 11-70—Specification for Wire-Cloth Sieves for Testing Purposes

3. **Chemistry**—This specification includes the nominal chemistry of zirconium oxide based ceramic shot and the amount of free iron particles.

3.1 **Oxide Analysis**—Ceramic shot shall be manufactured from zirconium oxide and silica. The main constituents shall be:

- | | |
|-------------------|------------------------------|
| - Zirconium Oxide | 60 to 70 weight per cent |
| - Silica | 28 to 33 weight per cent |
| - Alumina | less than 10 weight per cent |

The total of other constituent contents shall not exceed 3 weight per cent. Analysis method is X-Ray Fluorescence or any other method acceptable to purchaser.

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3.2 Free Iron Content—The free iron content of the ceramic shot sample shall not exceed 0.10 weight per cent. It is determined by slowly sprinkling 500 g of the sample ceramic bead shot on an inclined aluminum tray that is 1.6 mm (0.062 in) deep by 152 mm (6 in) wide by 305 mm (12 in) long. The tray is supported by a nonmagnetic frame so that it is inclined with a 152 mm (6 in) rise from end to end, (30 degrees from horizontal). Four 25 x 25 x 152 mm (1 x 1 x 6 in) bar magnets are positioned against the under surface and crosswise to the inclined tray about the middle of its length. Magnets shall be not less than 10 000 Gauss magnetic field each and arranged so that the magnetic north and south poles alternate. The magnetic particles (iron) that accumulate on the tray as the beads roll down are carefully brushed into a preweighed dish. The procedure is repeated with the same 500 g sample until all visible magnetic particles are collected. The dish is then reweighed and the magnetic particle content is calculated as a percentage of the total original sample.

4. Microstructure—Ceramic shot are manufactured by electric fusion of oxides to form a closely bonded internal structure of a crystalline zirconia phase within an amorphous silica phase.

5. Specific Gravity—This characteristic is closely related to chemical analysis. It ranges between 3.60 and 3.95 g/cm³.

Specific gravity is measured at 31 °C by a pycnometric method.

6. Hardness—Unless otherwise specified, the ceramic shot shall have the following hardness:

623-785 DPH (1Kgf)
or 660-812 KHN (500 gf)
(for reference only approximately 57–63 HRC)

7. Size—Unless otherwise specified, the ceramic shot shall conform to Table I.

7.1 Testing—This is conducted by screening a 250 g sample with sieves conforming to ASTM E 11–70.

8. Shape—Sphericity and roundness are measured by an actual counting of a one layer field of a minimum of 200 ceramic beads, at a magnification of 20X.

8.1 Sphericity—It refers to the ratio of short to long axes of the hypothetical ellipse that would contain the actual image of the ceramic bead as seen through a microscope. Unless otherwise specified, Table I gives the maximal number of ceramic shot having a sphericity less than 0.5 and the minimum percentage of ceramic shot having a sphericity of 0.8 and greater.

8.2 Roundness—It refers to the relative angularity of grain corners, the ceramic shot having round and smooth surfaces. Scored, broken or angular particles are those that would present sharp or angular surfaces when impacted, causing metal removal or unsatisfactory or irregular finishes. An actual count shall be made of a field of 1 cm² at a 20X magnification. Maximum number of permissible broken or angular beads is shown on column 11 of Table I. This number shall never exceed 3%.

9. Appearance—Ceramic shot is constant in color, free flowing, free of defects and free of foreign matter.

10. Quality Assurance—Ceramic shot quality is checked by lots of 1,000 kg maximum. A representative sample of the shipped lot shall be tested for conformance to all requirements of this specification. Lot number and this specification number shall be marked on each container unit. All control data will be available from manufacturer on request for two (2) years after shipment.

TABLE 1—CERAMIC SHOT FOR PEENING - SIZES

DESIGNATION	NOMINAL SIZES			SIEVE SIZE (mm)				MIN % OF SHOT W/ SPHERICITY 0.8 & ABOVE	(7) MAX NO. OF BEADS PER SQUARE CM. WITH SPHERICITY BELOW 0.5	(8) MAX NO. BROKEN OR ANGULAR BEADS PER SQUARE CM.
	MM	IN	MESH	MAX 0.5% RETAINS	MAX 5% RETAINS	MAX 10% PASS	MAX 3% PASS			
	Z 850	0.850/1.180	0.033/0.046	16/20	1.400	1.180	0.850			
Z 600	0.600/0.850	0.024/0.033	20/30	1.000	0.850	0.600	0.425	65	8	4
Z 425	0.425/0.600	0.017/0.024	30/40	0.710	0.600	0.425	0.300	70	14	8
Z 300	0.300/0.425	0.011/0.017	40/50	0.500	0.425	0.300	0.250	70	27	15
Z 210	0.210/0.300	0.008/0.011	50/70	0.355	0.300	0.212	0.180	80	45	20
Z 150	0.150/0.210	0.006/0.008	70/100	0.250	0.212	0.150	0.125	80	300	65

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Rationale—Not applicable.

Relationship of SAE Standard to ISO Standard—Not applicable.

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Reference Section

ASTM E 11-70—Specification for Wire-Cloth Sieves for Testing Purposes

Developed by the SAE Mechanical Prestressing Task Force