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INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

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(R) HIGH CARBON CAST STEEL SHOT

1. ***Scope***—This SAE Recommended Practice describes chemical composition, hardness, microstructure, and physical characteristic requirements for high carbon cast steel shot to be used for shot peening or blast cleaning operations.

2. ***References***

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J444—Cast Shot and Grit Size Specifications for Peening and Cleaning
SAE J445—Metallic Shot and Grit Mechanical Testing

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 215, Method B—Methods of Sampling Finished Lots of Metal Powders
ASTM E 140—Hardness Conversion Tables for Metals (Relationship Between Brinell Hardness, Vickers Hardness Rockwell Hardness, Rockwell Superficial Hardness, and Knoop Hardness)
ASTM E 384—Test Method for Microhardness of Materials

3. ***Description***—High carbon cast steel shot is obtained by atomizing molten steel. The shot is heat treated and screened to produce a range of sizes from HCS70 to HCS1320 or larger as described in SAE J444.

4. ***Classification***—Cast steel shot shall be identified by HCS for shot, followed by three numbers representing the size in ten thousandths of inches, in accordance with SAE J444.

EXAMPLE—HCS330 indicates a cast steel shot identified by a nominal sieve opening of 0.0331 in.

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5. ***Chemical Composition***—The finished shot shall have the chemical composition shown in Table 1:

TABLE 1—CHEMICAL COMPOSITION

Element	Weight Percent
Carbon	0.85 - 1.2%
Manganese	
HCS70 - HCS110	0.35 - 1.2%
HCS170	0.5 - 1.2%
HCS230 and up	0.6 - 1.2%
Silicon	0.4 - 1.50%
Sulfur	0.050% maximum
Phosphorous	0.050% maximum

6. Hardness

6.1 Standard Hardness—The hardness of 90% of all shot particles shall be within the range of 400 to 540 KHN (40 to 50 Rockwell C).

6.2 Special Hardnesses—Other hardnesses may be specified by the purchaser.

7. Microstructure—The microstructure of high carbon cast steel shot shall be uniform martensite, tempered to a degree consistent with the hardness range, with fine, well distributed carbides, if any.

8. General Appearance—High carbon cast steel shot is generally spherical and shall have no more than 20% of the particles with objectionable characteristics. Any one particle tested that has several different defects, shall only be counted once in the total.

8.1 Objectionable Characteristics

8.1.1 PARTICLE SHAPE—No more than 5% of the particles in a shot sample shall be elongated. An elongated particle is one whose length is in excess of twice the maximum particle width.

8.1.2 VOIDS—No more than 10% of the particles in a sample shall contain objectionable voids. Such a void is a smooth-surfaced, internal hole whose cross section is larger than 10% of the particle area.

8.1.3 SHRINKAGE—No more than 10% of the particles in a sample shall contain objectionable shrinkage. Such a shrinkage is an internal cavity with an irregular dendritic surface whose cross-sectional area is large than 40% of the particle area.

8.1.4 CRACKS—No more than 15% of the particles in a shot sample shall contain objectionable cracks. Such a crack is a linear discontinuity longer than three times its width, longer than 20% of the shortest cross section of the particle, and radial in orientation.

8.1.5 MICROSTRUCTURE—Carbide networks, partial decarburization, grain boundary segregation, and pearlite are undesirable. No more than 15% of the particles tested shall have these defects.

8.1.6 NONMAGNETIC MATERIAL—No more than 1% of the shot sample, by weight, shall be of nonmagnetic material.

9. Density—The density of high carbon cast steel shot shall be not less than 7 g/cc.

10. Mechanical Tests—To conform with pending revision of SAE J445 that supersedes REV AUG84.

11. Inspection Procedures

11.1 Sampling—Samples for testing shall be representative of each shipment or production lot. The method of sampling shall be ASTM B 215, Method B.

11.2 Sample Mounting for Testing—Shot samples used for testing for hardness, microstructure, and objectionable defects shall be mounted one layer deep in bakelite or other suitable strong metallurgical sample mounting media.

The mounted sample shall be ground to the center of the particles and polished by methods acceptable for microscopic examination. When grinding and polishing the sample, care must be taken not to overheat the sample and affect microstructure and/or hardness.

11.3 Hardness Testing—Hardness measurements shall be taken at the half radius of 10 particles in the mounted samples.

The hardness shall be determined by using ASTM E 384 and using a 4.9 N (500 gf) load for sizes HCS280 and finer, and 4.9 N or 9.8 N (500 or 1000 gf) load for sizes HCS330 and larger. Other microhardness test methods may be used as long as a reliable hardness conversion can be obtained by calibrating the test machine against known standards. Approximate conversion to Rockwell C Hardness Numbers can be obtained form ASTM 140.

11.4 Microstructure—The mounted and polished sample shall be etched with 2% Nital or other suitable etchant and examined at approximately 500X magnification.

11.5 Objectionable Characteristics—Objectionable characteristics shall be measured using a metallurgical microscope with 10X magnification. A minimum of 50 particles contained in the mount shall be evaluated.

11.6 Density—Density shall be determined by placing 50 mL of water or alcohol in a 100 mL graduate, adding 100 g of shot and recording the increase in volume. Dividing 100 g by the volume increase will give the density in g/cc. A pycnometer method may be used for more critical density measurements.

11.7 Nonmagnetic Material—A hand magnet will be used to separate the magnetic shot from the nonmagnetic contaminants. The nonmagnetic contaminants shall be weighed and their percentage of the original sample weight calculated.

11.8 Chemical Analysis—Any suitable ASTM Analytical procedure for steel may be used to test chemical composition.

12. Notes

12.1 Marginal Indicia—The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

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