

# SURFACE VEHICLE RECOMMENDED PRACTICE

**SAE J2175**

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Submitted for recognition as an American National Standard

## SPECIFICATIONS FOR LOW CARBON CAST STEEL SHOT

1. **Scope**—This SAE Recommended Practice describes chemical analysis, hardness, microstructure, and physical characteristic requirements for low 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.  
ASTM A 370—Test Methods and Definitions for Mechanical Testing of Steel Products  
ASTM E 384—Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
  3. **Description**—Low carbon cast steel shot is the product obtained by atomizing and rapidly solidifying particles of molten steel in a controlled range of sizes. These shot particles are then screened to produce a range of sizes from LCS-70 to LCS-1320 or larger as described in SAE J444.
  4. **Classification**—Low carbon cast steel shot shall be identified by LCS followed by the numbers representing the nominal size in ten thousandths of inches, in accordance with SAE J444, i.e., LCS-460.
  5. **Chemical Composition**—The finished low carbon steel shot shall have the following chemical composition as listed in Table 1:

TABLE 1—CHEMICAL COMPOSITION

Low Carbon Steel Shot	Chemical Composition
Carbon	0.10 to 0.15%
Silicon	0.10 to 0.25%
Manganese	1.20 to 1.50%
Aluminum	0.05 to 0.15%
Phosphorus	0.035% maximum
Sulfur	0.035% maximum

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

**7. Microstructure**—The microstructure of low carbon cast steel shot shall be an intermediate structure (bainite), a mechanical mixture of ferrite and cementite particles with random feather-like appearance (upper bainite) and acicular (lower bainite) with few or no free carbides, (see 8.1.5).

**8. General Appearance**—The low carbon steel shot shall be as spherical as commercially possible and no more than 20% of the shot particles shall have objectionable defects. Any one particle tested that has several different defects will only be counted once in the total. Notwithstanding the allowable percentages listed as follows, no more than a total of 20% objectionable particles are allowed.

#### **8.1 Objectionable Defects**

**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 voids. A void is a smooth surfaced internal hole and must be greater than 10% of the particle to be considered harmful and counted as a void.

**8.1.3 SHRINKAGE**—No more than 10% of the particles in a sample shall contain shrinkage. A shrinkage area is an internal cavity with an irregular dendritic surface, and must be greater than 40% of the particle area to be considered harmful.

**8.1.4 CRACKS**—No more than 5% of the particles in a shot sample shall contain cracks. A crack is a linear discontinuity whose length is greater than three (3) times its width and its length is greater than 20% of the diameter or shortest dimension of the particle and radial in orientation.

**8.1.5 MICROSTRUCTURE**—Carbide networks, partial decarburization, and grain boundary segregation 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 nonmagnetic material.

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

**10. Mechanical Tests**—To conform with revised SAE J445.

#### **11. Inspection Procedures**

**11.1 Sampling**—Samples for chemical analysis, hardness, microstructure, density, objectionable defects, and mechanical testing shall be carefully obtained to be representative of each shipment of production lot.

**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 particle and polished by acceptable methods for examination using a microscope. 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 on a minimum of ten (10) randomly selected particles in the mounted sample.

The hardness shall be determined by using ASTM E 384 and using a 500 gf load for sizes LCS-280 and finer and 500 or 1000 gf load for sizes LCS-330 and larger. Other microhardness test methods may be used as long as a reliable hardness conversion can be obtained by calibrating various ma-

chines against known standards. Approximate conversions to Rockwell C hardness numbers are obtained from ASTM A 370.

- 11.4 **Microstructures**—The mounted and polished sample shall be etched with 2% Nital and examined at approximately 500X magnification.
- 11.5 **Objectionable Defects**—Objectionable defects shall be measured using a microscope with a 10X magnification. All of the particles contained in the mount shall be evaluated.
- 11.6 **Density**—Density shall be determined by placing 50 ml of ethanol or methanol 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 grams per cubic centimeter (cc). A pycnometer method may be used for more critical density measurements.
- 11.7 **Nonmagnetic Material**—A hand magnet shall be used to separate the magnetic shot from the nonmagnetic contaminants. The nonmagnetic contaminants shall be weighed and the percentage of the original sample weight calculated.
- 11.8 **Chemical Analysis**—Any suitable ASTM analytical procedure for steel may be used to test chemical analysis.

**Rationale**—Not applicable.

**Relationship of SAE Standard to ISO Standard**—Not applicable.

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

**Reference Section**

SAE J444—Cast Shot and Grit Size Specifications for Peening and Cleaning

SAE J445—Metallic Shot and Grit Mechanical Testing

ASTM A 370—Test Methods and Definitions for Mechanical Testing of Steel Products

ASTM E 384—Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies

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