

# SURFACE VEHICLE RECOMMENDED PRACTICE

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**SAE**

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(R) CAST STEEL SHOT

## 1. SCOPE:

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

## 2. REFERENCES:

### 2.1 Applicable Documents:

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

SAE J445, Metallic Shot and Grit Mechanical Testing

ASTM E 384

ASTM A 370

## 3. DESCRIPTION:

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 heat treated and screened to produce a range of sizes from S70 to S1320 or larger as described in SAE J444.

## 4. CLASSIFICATION:

Cast steel shot shall be identified by S for shot, followed by three numbers representing the nominal size in ten thousandths of inches, in accordance with SAE J444. Example: S-330 indicates a cast steel shot identified by a nominal screen aperture of 0.0331 in.

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## 5. CHEMICAL COMPOSITION:

The finished shot shall have the chemical compositions as shown in Table 1:

TABLE 1 - Chemical Composition

Carbon	0.85 - 1.2%
Manganese	
S70 - S110	0.35 - 1.2%
S170	0.5 - 1.2%
S230 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 hardness ranges can be specified by the purchaser with a minimum range of 68 KHN near 421 KHN (45 RC) and 120 KHN near 670 KHN (57 RC) (range of 6 RC range in both cases). The range stated is for a minimum of 90% of the particles tested. An example would be 90% minimum 630 to 754 KHN (55 to 61 RC).

Note: The relationship between Rockwell C and Knoop hardness number is not linear, one Rockwell C number is 12 KHN at 40 Rockwell C and 25 KHN at 66 Rockwell C.

## 7. MICROSTRUCTURE:

The microstructure of 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:

The cast steel shot shall be as nearly spherical as commercially possible and no more than 20% of the shot particles shall have objectionable defects.

## 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 area 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 15% of the particles in a shot sample shall contain cracks. A crack is a linear discontinuity whose length is greater than three times its width and its length is greater than 20% of the diameter or shortest dimension of the particle.
- 8.1.5 Microstructure: Carbide networks, partial decarburization, grain boundary segregation, and high temperature transformation products (e.g., pearlite) are undesirable. No more than 15% of the particles tested will have these defects.
- 8.1.6 Nonmagnetic Material: No more than 1% of the shot sample, by weight, will be nonmagnetic material.

9. DENSITY:

The density of cast steel shot shall be not less than 7 gm/cc.

10. MECHANICAL TESTS:

Several designs of shot testing machines are available commercially for application to routine acceptance procedures. See SAE J445 for methods of checking uniformity of shipments of shot or to determine the relative fatigue life of different types of shot.

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 or 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 metallurgical microscope.

11.3 HARDNESS TESTING:

Hardness measurements shall be taken at the half radius on a minimum of 10 particles in the mounted sample.

The hardness shall be determined by using ASTM E 384 and using a 500 gf load for sizes S280 and finer and 500 or 1000 gf load for sizes S330 and larger. Other microhardness test methods may be used as long as a reliable hardness conversion can be obtained by calibrating various machines against known standards. Approximate conversions to Rockwell C Hardness Numbers are obtained from ASTM A 370.

11.4 Microstructure:

The mounted and polished sample shall be etched with Nital and examined at approximately 500X magnification.

11.5 - Objectionable Defects:

Objectionable defects shall be measured using a metallurgical microscope with 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 water in a 100 ml graduate, adding 100 gms of shot and recording the increase in volume. Dividing 100 gms by the volume increase will give the density in gm/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 will be weighed and the percentage of the original sample weight calculated.

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.

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

APPLICATION:

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ASTM E 384

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