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FEDERAL SPECIFICATION

BEADS (GLASS SPHERES) RETRO-REFLECTIVE

This specification is approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION. This specification covers two types of retro-reflective beads used to reflectorize traffic and airfield marking paints.

Type I - Low Index of Refractions:
Gradation A (Course, Drop-on)
Gradation B (Fine, Premix)

Type II - Delete
Type III - High Index of Refraction

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

FEDERAL SPECIFICATIONS

UU-S-48 Sacks, Shipping Paper

FEDERAL STANDARDS

FED-STD-141 Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing

FED-STD-313 Preparation and Submission of Material Safety Data Sheets (MSDS)

DISTRIBUTION STATEMENT A: Approved for public release.
Distribution is unlimited.

FSC 8010

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MILITARY STANDARDS

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes.

(Copies of specifications and standards required by suppliers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Standards:

D 1155 - Standard Test Method for Roundness of Glass Spheres

D 1214 - Standard Test Method for Sieve Analysis of Glass Spheres

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

National Motor Freight Traffic Association, Inc. Agent:

National Motor Freight Classification

(Application for copies should be addressed to the ATA, Inc. Traffic Department, 2200 Mill Rd., Alexandria, VA 22314.)

National Railroad Freight Committee, Agent:

Uniform Freight Classification

(Application for copies should be addressed to G.F. Earl, Tariff Publishing Officer, Suite 1120, 222 South Riverside Plaza, Chicago, IL 60606-5945.)

3. REQUIREMENTS

3.1 Composition. The type I beads shall be manufactured entirely of reclaimed scrap glass (commercial cullet). No specific ingredients are required for the type III beads.

3.2 Physical properties

3.2.1 Appearance. When tested as specified in 4.3.1, the beads shall be transparent, clean, dry, free-flowing, and free from bubbles and foreign matter.

3.2.2 Roundness. When tested as specified in 4.3.2, the type I beads shall contain not less than 70 percent by weight of true spheres. The type III beads shall contain not less than 80 percent by weight of true spheres.

3.2.3 Index of refraction. When tested as specified in 4.3.3, the index of refraction shall be as follows: For the type I beads 1.50 to 1.55; for the type III beads 1.90 to 1.93.

3.2.4 Specific Gravity. When tested as specified in 4.3.4, the specific gravity shall be as follows: For the type I beads 2.30 to 2.50; for the type III beads 4.00 to 4.50[1].

3.2.5 Gradation. When tested as specified in 4.3.5, the beads shall pass each sieve series, in percent by weight, as specified in table I.

TABLE I. Gradation, percent by weight, passing

U.S. Sieve No.	Microns	Type I				Type III	
		A		B		Min.	Max.
		Min.	Max.	Min.	Max.	Min.	Max.
16	1180	---	---	---	---	100	---
20	850	100	---	---	---	95	100
30	600	80	100	---	---	55	75
40	425	---	---	---	---	15	35
50	300	18	35	---	---	0	5
70	212	---	---	100	---	---	---
80	180	---	---	85	100	---	---
100	150	0	10	---	---	---	---
140	106	---	---	15	55	---	---
200	75	0	2	---	---	---	---
230	63	---	---	0	10	---	---

3.2.6 Resistance to acid. When tested as specified in 4.3.6, the beads shall not develop any surface haze or dulling.

3.2.7 Resistance to calcium chloride. When tested as specified in 4.3.7, the beads shall not develop any surface haze or dulling.

[1] For field verification, the mass of Type I beads should be 1570 grams per liter and Type III should be 2670 grams per liter.

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3.2.8 Resistance to sodium sulfide. When tested as specified in 4.3.8, the sodium sulfide solution shall not darken the beads.

3.2.9 Water resistance. When tested as specified in 4.3.9, the water shall not produce dulling or hazing of the beads, and not more than 4.5 ml of 0.1N hydrochloric acid shall be used for the titration.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein using facilities approved by the Government. The Government reserves the right to perform any of the inspections set forth herein when deemed necessary to assure that the beads confirm to the prescribed requirements.

4.2 Testing of the end item.

4.2.1 Lot. A lot shall consist of all beads of one type offered for inspection at one time.

4.2.2 Inspection of preparation for delivery. An inspection shall be made to determine that the packing and marking comply with Section 5 of this specification. The sample unit shall be one filled shipping container. Sampling shall be in accordance with MIL-STD-105. The inspection level shall be S-2 with an AQL of 0 percent defective.

4.2.3 Sampling of the end item. A 500 to 600 g composited sample shall be obtained as follows:

- (a) Containers shall be selected in accordance with MIL-STD-105, inspection level S-2.
- (b) Using a 1:1 splitter, split the contents of each container until a 500 to 600 g sample is obtained.
- (c) Combine all of the samples from (b), and using a 1:1 splitter, split the composited sample into two equal portions.
- (d) Discard half of the sample, and split the remaining beads into two equal portions. Continue to discard half of the beads and split the remaining sample until a 500 to 600 g composited sample is obtained.

The composited sample shall be submitted to the laboratory for testing.

4.2.4 Certificate of compliance. When Type I beads are offered for inspection, the manufacturer shall certify that the beads conform to the requirement of 3.1.

4.3 Test procedures. The beads shall be tested in accordance with the methods specified in table II and as otherwise specified herein to determine compliance with the requirements of section 3. Unless otherwise specified, all tests shall be conducted at conditions specified in Section 9 of FED-STD-141. All test reports shall contain the individual values utilized in expressing the final results. Failure to pass any tests, or noncompliance with any requirement, shall be cause for rejection of the sample.

TABLE II. Tests and methods

Characteristics	Requirement paragraph	ASTM method	Test method paragraph
Appearance	3.2.1	—	4.3.1
Roundness	3.2.2	D 1155	4.3.2
Index of refraction	3.2.3	—	4.3.3
Specific gravity	3.2.4	—	4.3.4
Gradation	3.2.5	D 1214	4.3.5
Resistance to acid	3.2.6	—	4.3.6
Resistance to calcium chloride	3.2.7	—	4.3.7
Resistance to sodium sulfide	3.2.8	—	4.3.8
Water resistance	3.2.9	—	4.3.9

4.3.1 Appearance. Spread thinly 10 g of sample on white bond paper and examine visually for compliance with 3.2.1.

4.3.2 Roundness. The roundness of the beads shall be determined in accordance with ASTM method D 1155. Use Procedure A for Type III beads and Procedure B for Type I beads. Evaluate for compliance with the requirements of 3.2.2.

4.3.3 Index of refraction. The index of refraction shall be determined by the immersion method. A microscope capable of a minimum of 100 times magnification, equipped with a light source and certified immersion oils shall be used. Place crushed beads on a microscope slide and immerse in a refractive index immersion oil at standard conditions. (The immersion oil shall have a refractive index within 0.02 units of that of the beads to be tested.) Cover with a microscope slide and determine the refractive index of the beads to the nearest one-hundredth of a unit. Evaluate for compliance with the requirements of 3.2.3.

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4.3.4 Specific gravity. Place 100 g of the beads in an oven at 110 degrees C +/- 2 degrees C and dry to constant weight. Remove the beads and place in a desiccator until the sample is cool. Remove 60 g of beads from the desiccator and weigh the sample accurately. Pour the beads slowly into a 100 ml graduated cylinder containing 50 ml of reagent grade xylene. Make certain that air is not entrapped among the beads. Calculate the specific gravity as follows:

$$\text{Specific gravity} = \frac{M}{V - 50}$$

M = Mass of sample

V = Total volume (xylene level after addition)

Evaluate for compliance with 3.2.4.

4.3.5 Gradation. Determine the gradation of the beads in accordance with ASTM method D 1214 for compliance with 3.2.5.

4.3.6 Resistance to acid. Place 10 g of the beads in a 100 ml beaker and cover with 1N sulfuric acid. Let soak for 5 minutes. Rinse the beads 3 times with distilled water. Dry, then examine the beads under a microscope and compare with an untreated sample. Evaluate for compliance with 3.2.6.

4.3.7 Resistance to calcium chloride. Place 10 g of the beads in a 100 ml beaker and cover with a 1N calcium chloride solution. Let soak for 3 hours. Rinse 3 times with distilled water. Dry, then examine the beads under a microscope and compare with an untreated sample. Evaluate for compliance with 3.2.7.

4.3.8 Resistance to sodium sulfide. Place 10 g of the beads in a glass stoppered bottle and cover with a solution containing by weight 50 percent sodium sulfide, 48 percent distilled water, and 2 percent of an anionic wetting agent. Soak the beads for one hour and then rinse three times with distilled water. Dry, then examine the beads under a microscope and compare with an untreated sample. Evaluate for compliance with 3.2.8.

4.3.9 Water resistance. Place 10 g of the beads in a 25 x 80mm extraction thimble. Place the thimble in a large (No. 3) Soxhlet extractor with a 125 ml boiling flask. Add 100 ml of distilled water, and reflux for two hours. Remove the beads, dry, examine under a microscope for comparison to untreated beads. Add five drops of one percent phenolphthalein indicator to the content of the boiling flask and titrate with 0.1N hydrochloric acid to the phenolphthalein indicator end point. Evaluate for compliance with 3.2.9.

5. PREPARATION FOR DELIVERY

5.1 Packing, palletization, and marking. Beads shall be furnished in quantities specified. The packing, palletization and marking shall be as specified (see 6.2).

5.1.1 Packing. The glass beads shall be furnished in 23 kilogram (fifty pound) or 25 kilogram (fifty five pound) quantities in a shipping sack meeting the requirements of Federal Specification UU-S-48F, Type VI, Style B, MB grade 4, Sack No. 13X. The sack shall be securely closed to prevent accidental opening or loss of the glass beads during multiple shipments, handling and storage. The shipping containers shall be in compliance with the National Motor Freight Classification or Uniform Freight Classification.

5.1.2 Marking. Marking shall be as specified in the contract or order.

6. NOTES

6.1 Uses for each type.

Type I, Gradation A, coarse - low-index glass beads for drop-on application are intended for marking highways and traffic lanes.

Type I, Gradation B, fine - low-index glass beads used for premixed paint are intended for marking highways and traffic lanes.

Type III - high-index glass beads for drop-on application more uniform, rounder and provide better reflectance for marking airfield runways.

See appropriate pavement marking guide for recommended application rates.

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6.2 Ordering data. Purchasers should select the preferred options permitted herein, and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Type and gradation required (see 1.2).
- (c) Size and type of container required (see 5.1).
- (d) Palletization requirements.
- (e) Marking requirements.
- (f) Instructions and address for submission of MSDS (see 3.3).

Military custodian:

Air Force - 99

Air Force - 84

Navy - YD

Preparing Activity

GSA-FSS