STATE OF NORTH CAROLINA
DEPARTMENT OF ADMINISTRATION
PURCHASE AND CONTRACT DIVISION

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Supersedes
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SPECIFICATION FOR GLASS SPHERES, RETRO-REFLECTIVE

(This specification is released for procurement purposes until revised, or rescinded.)

SCOPE

This specification covers retro-reflective glass spheres for use in reflectorizing traffic paint.

I. CLASSIFICATION

This specification covers three types of retro-reflective glass spheres, as follows:

Type I - Premix type for use in traffic paint
Type II - Drop-on type, for application on traffic paint
Type III - Drop-on type, flotation treated, for application on traffic paint

II. APPLICABLE STANDARDS

The following documents of issue in effect on the date of the Invitation for Bids shall form a part of this specification to the extent described in REQUIREMENTS:

ASTM-D169 - Method of Chemical Analysis of Soda-Lime Glass
ASTM-D1155- Method of Test for Roundness of Glass Spheres
ASTM-D1214 Method of Test for Sieve Analysis of Glass Spheres
American Society for Testing and Materials (ASTM)
1916 Race Street
Philadelphia, PA 19103

III. REQUIREMENTS

A. GENERAL

Type III spheres shall be of such character so that when applied to a traffic paint line they shall hemispherically embed to approximately their equator in the paint film for optimum durability and brightness.

B. APPEARANCE

The glass spheres shall be essentially colorless, clean, transparent, free from surface scratches, milkiness or excessive
air bubbles.

C. SHAPE (ROUNDNESS)

Type I - Not more than 20% of the premix type glass spheres shall be irregular or fused spheroids, and at least 80% of the spheres shall be true spheres. Those spheres retained on the 60 and 100 mesh sieves shall be tested in accordance with Procedure B of ASTM-D1155, Method of Test for Roundness of Glass Spheres, using the sieve sizes listed in Section III.F. The roundness of those spheres retained on the 200 mesh sieve shall be determined by visual count at a minimum of 100 x magnification. Not less than 5 separate samples shall be checked, and the average result of all the samples checked will determine the percentage of rounds. A 70% roundness requirement is to be enforced on each
separate sieve size.

Types II and III - Not more than 20% of the glass spheres shall be irregular or fused spheroids, and at least 80% of the spheres shall be true spheres. The spheres retained on the 30, 50, and 80 mesh sieves and pan shall have the following minimum respective percentage of rounds - 60, 75, 85 and 85 when tested in accordance with procedure B of ASTM-1155, Method of Test for Roundness of Glass Spheres, as modified for the proceeding mesh sieves.

D. SPECIFIC GRAVITY

The specific gravity of the beads shall be in the range 2.40-2.56 when tested according to the procedure in Section VI.

E. REFRACTIVE INDEX

The spheres shall show a minimum refractive index of 1.50 when tested by the liquid-immersion method at 25°C.

F. GRADATION REQUIREMENT

The glass spheres shall be in accordance with the gradation listed below, when tested in accordance with ASTM-D1214, Method of Test for Sieve Analysis of Glass Spheres.

TYPE I

U. S. Standard Sieve	% Passing
40	100
60	80-100
100	30-50
200	0-5

TYPES II AND III

U.S. Standard Sieve	% Retained	
	Minimum	Maximum
#20		0
Passing #20, Retained on #30	5	10
Passing #30, Retained on #50	40	80
Passing #50, Retained on #80	15	40
Pan	0	5

G. MOISTURE RESISTANCE - TYPE II GLASS SPHERES

The Type II - Drop-on type glass spheres shall be tested for moisture resistance according to the procedure in Section VI. The entire sample shall flow freely through the funnel withoutstoppage.

H. FLOTATION - TYPE III GLASS SPHERES

A minimum of 90% of the glass spheres shall float on Xylene (Aromatic solvent) and a minimum of 75% of the glass spheres shall float on heptane (aliphatic solvent) when tested according to the procedure in Section VI.

I. CHEMICAL PROPERTIES

1. Silica

   The glass shall contain not less than 65% by weight of silica, when tested in accordance with ASTM-D169.

2. Resistance

   The beads shall not develop surface haze and not be otherwise detrimentally affected when tested according to the procedure in Section VI for the following:

   - Water Resistance
   - Resistance to Calciumn Chloride
   - Resistance to Sodium Sulfide
   - Resistance to Acid

IV. WARRANTY

The contractor warrants to the purchaser that all glass spheres furnished under this specification will be new, of good material and workmanship and agrees to replace promptly any shipment which by reason of defective material or workmanship shall fail to pass any of the required tests herein.

V. SERVICE, PARTS, AND MANUALS

This section is not applicable.

VI. ACCEPTANCE EVALUATION AND QUALITY ASSURANCE

The Invitation for Bids (IFB) will explain the specific requirements relating to acceptance, evaluation and quality assurance.

A. TEST PROCEDURES

The following test procedures apply to the REQUIREMENTS section.

1. Specific Gravity

The specific gravity of the beads shall be tested according to the following procedure:

a) Place 100 grams in an oven at 110°C for one (1) hour.
b) Remove beads and place in a desiccator until the sample is cool.
c) Remove approximately 60 grams of beads from the desiccator and weigh the sample accurately.
d) Pour the beads slowly in a clean 100 ml graduated cylinder containing 50 ml of isopropyl alcohol. Make certain that air is not entrapped among the beads.
e) The total volume, minus 50, will give the volume of the beads.
f) Calculate the specific gravity as follows:

$$\frac{\text{Weight of sample}}{\text{Volume of the sample}}$$

2. Moisture Resistance

The Type II - drop-on type glass spheres shall be tested for moisture resistance as follows: A minimum of 2 lbs. (907 grams) of glass spheres are placed in a clean, washed, cotton bag with a thread count of 50 warp, 50 woof and shall be subjected to the following moisture resistance test:

Immerse the bag containing the sample in a container of water for 30 seconds or until water covers the spheres, whichever is longer. Remove the bag and force excess water from the sample by squeezing the bag. Suspend the bag and allow to drain for two hours at room temperature 70-72°F. (21°-22°C). At the end of this time, mix the sample in the bag by shaking the bag thoroughly. Transfer sample slowly to a clean, dry glass funnel having a stem 4" (101.6 mm) in length, with a 3/8" (9.53 mm) inside diameter stem entrance opening and minimum exit opening of l/4" (6.35mm). The entire sample shall flow freely through the funnel without stoppage. When first introduced into the funnel, if the spheres clog, it is permissible to lightly tap the funnel to initiate the flow.

3. Flotation

The type III glass spheres shall be tested for flotation as follows:

Approximately 100 spheres shall be spread in a single layer on a suitable thin, flat receptacle such as a pint can lid. The solvent shall be slowly introduced with a syringe or dropper at the edge of the lid until it overflows. The percentage of spheres floating on the solvent surface shall be estimated visually.

4. Water Resistance

The glass spheres shall be tested for water resistance as follows:

a) Place 15 grams of glass beads in a 22x65 mm extraction thimble.
b) Place the thimble in a #3 (large) Soxhlet extractor. Utilize a 250 ml boiling flask.
c) Add 100 ml distilled water.

d) Reflux for 8 hours.
e) Remove the beads, dry, and examine under a microscope.
f) Compare the beads with an untreated sample.

5. Resistance to Calcium Chloride

The beads shall be tested for resistance to calcium chloride according to the following procedure:

a) Place 10 grams of beads in a 100 ml beaker.
b) Cover the sample with 0.5 M (IN) calcium chloride.
c) Let the beads soak for three (3) hours.
d) Rinse the beads three (3) times with distilled water.
e) Dry and examine the beads under a microscope.
f) Compare the beads with an untreated sample.

6. Resistance to Sodium Sulfide

The beads shall be tested for resistance to sodium sulfide according to the following procedure:

a) Place 5 grams of beads in a 100 ml glass stopperedbottle.
b) Cover with a solution containing 50% sodium sulfide, 48% distilled water, and 2% wetting agent (e.g., aerosol OT).
c) Soak the beads for one (1) hour.
d) Rinse the beads three (3) times with distilled water.
e) Dry and examine the beads under a microscope.
f) Compare the beads with an untreated sample.

7. Resistance to Acid

The beads shall be tested for resistance to acid according to the following procedure:

a) Place 10 grams of beads in a 100 ml beaker.
b) Cover the beads with a 1 M (IN) solution of hydrochloric acid.
c) Soak for five (5) minutes.
d) Rinse the beads three (3) times with distilled water.
e) Dry and examine the beads under a microscope.
f) Compare the beads with an untreated sample.

VII. DELIVERY AND PAYMENT

Delivery of and payment for glass spheres under this specification shall be in accordance with the terms and conditions of the Invitation for Bids. The contractor shall be responsible for any packing, packaging, or protection required to insure delivery in an undamaged condition. Final acceptance of any delivery will be determined by an analysis check.

A. SAMPLING

The cube root of the number of containers shall be selected at random for sampling. Each of these containers shall be split on a Tyler 16-1 Sample Reducer. After all the containers are split, the representative material may be again passed over the Sample Reducer to

obtain a sample of three to five pounds which is representative of the entire shipment or lot.

Further reduction of the representative sample can be accomplished by putting it through the Tyler Sample Reducer, which is a 1:1 split.

B. PACKING AND MARKING

All glass spheres shall be packaged in 50 lb. suitable 5 plymulti wall natural kraft color bag consisting of 1 ply .5 mil high density polyvinyl liner; 2 plys - 40# natural kraft and 2 plys - 50# natural kraft with outside ply to be coated with a non-slip coating or an acceptable equivalent constructed bag. Bags to be properly marked (identified) printed in ink as follows:

Type I Premix	-	Bags marked "N.C. Premix Type"
Type II Drop-On	-	Bags marked "N.C. Drop-On Type"
Type III Flotation	-	Bags marked "N.C. Drop-On Flotation Type"with color of outside bag to be any color except natural kraft.

The successful supplier shall furnish to the user a description of the bag material and a sample bag of those to be furnished for user's approval prior to making any deliveries.

VIII. ORDERING DATA

Purchasers should exercise any desired option offered herein and should specify the following in the Requisition and the Invitation For Bids:

1. Title, number, and date of this specification.
2. The type(s) of glass spheres desired.
3. Place(s) of delivery.
4. Acceptance, evaluation and quality assurance requirements.