

STEEL FOUNDERS' SOCIETY OF AMERICA

Standard Specification for

ZIRCON SAND AND FLOUR

SFSA Designation: 11-72

ISSUED: 196 1

1. Scope

1.1 Zircon Sand

1.1.1 Primarily for use as either a molding sand or as a core sand in the production of steel castings.

1.2 Zircon Flour

1.2.1 As an additive to zircon sand when used as indicated in 1.1.1 above.

1.2.2 For use in the preparation of zircon core and mold washes.

2. Location of Deposit

2.1 The vendor must indicate on the acknowledgment of the purchase order and on the invoice the source of the zircon sand, i.e., imported (Australian) or domestic (Florida or elsewhere).

3. Acknowledgment

3.1 When specified, a vendor shall indicate this specification number in all quotations when acknowledging purchase orders.

4. Quality

4.1 The material shall be of uniform color, clean, and free from foreign materials.

4.2 The material shall not be contaminated with oils or acids. (See Notes 1 and 2)

NOTE 1.—Eucalyptus oil or any other type of oil adheres to the surface of the grains and waterproofs them in such a manner that the green strengths of zircon sand mixes are reduced and dry strengths are nil. Heating zircon sand to 1200 degrees F will remove the oil.

NOTE 2.—Oleic acid has an extremely harmful influence on the strength of shell molds made with zircon sand.

5. Composition

5.1 The chemical composition shall conform in general to the following limitations:

Zircon _____	97.00 percent minimum
TiO ₂ _____	0.35 percent maximum
Fe ₂ O ₃ _____	0.40 percent maximum
Free SiO ₂ _____	1.00 percent maximum

5.2 The vendor, upon request, shall furnish to the purchaser a certified representative analysis within **30 days** of shipment.

6. Identification

6.1 All bagged material shall be plainly marked in a contrasting color to the container "Zircon Sand" or "Zircon Flour".

6.2 The name of the vendor or supplier shall be legibly stamped on each container.

7. Sample Preparation

7.1 The number of bags to be sampled by the consumer for routine testing shall be a minimum of 5 bags selected at random.

7.2 The number of bags sampled for umpire checks shall be according to ASTM C322-5 3T, procedure C.

7.2.1 The number of samples shall depend on the number of units in a shipment. A grain sampler (see Note 3) or similar sampling instrument shall be used to take samples which shall then be combined, mixed and quartered or riffled to obtain a 10-pound laboratory sample.

7.2.2 When a shipment consists of 100 bags or less, the number of bags sampled at random shall be not less than 5 and preferably 10. When the

number is greater than **100** but less than 500, the number of bags sampled shall be not less than 15.

NOTE 3.—A satisfactory sampler is the ASTM approved sampler for bulk cement (ASTM-C183-55T; Part III, page 181). The Central Scientific Company, Chicago 13, Illinois, also has a sampling tube (CAT. No. 2814A).

7.3 Reduction of Composite Sample

7.3.1 Reducing the sample shall be done by quartering until a 10-pound sample is obtained.

7.3.2 An alternate method for reducing the gross sample is done by using a sample splitter which is described in the AFS "Foundry Sand Handbook," Sixth Edition, Section III, paragraph 26.

7.4 Identification of sample shall indicate material, supplier, source of shipment and date received.

8. Technical Requirements

8.1 Screen Analyses

8.1.1 Screen analyses shall be made on 100-gram samples of the zircon sand.

8.1.2 The sizes of the screens shall be in accordance with the National Bureau of Standards series as given in ASTM E 11:

8.1.3 The U.S. Standard sieve numbers to be used in the screen analysis shall be as follows:

8.1.3.1 For sand analysis.

<u>Screen</u>	<u>DIAMETER IN INCHES</u>
40	0.0165
50	0.0117
70	0.0083
100	0.0059
140	0.0041
200	0.0029
270	0.0021
Pan	

8.1.3.2 For zircon flour.

<u>SCREEN No.</u>	<u>DIAMETER IN INCHES</u>
140	0.0041
200	0.0029
325	0.0017

8.1.4 Classification of zircon sand.

8.1.4.1 Three grades of zircon sand are recommended—S-8 0, S-10 5 and S-13 0. The recommended classification for each grade is given in Table 1.

TABLE I—SCREEN CLASSIFICATION RANGES FOR VARIOUS SFSA GRADES OF ZIRCON SAND

<u>Screen No.</u>	SFSA (S-80)	SFSA (S-105)	SFSA (S-130)
	% RETAINED ON SIEVE	% RETAINED ON SIEVE	% RETAINED ON SIEVE
50	0 - 5	0 - 1	-----
70	15 - 35	1 - 5	-----
100	40 - 70	5 - 20	0 - 3
140	10 - 25	50 - 70	15 - 35
200	1 - 10	15 - 40	50 - 70
270	-----	-----	5 - 20
Pan	2-Max	2 -Max	2-Max

8.1.5.1 Three grades of zircon flour are recommended, F-140, F-200 and F-325. The recommended classification for each grade is given in Table 2.

TABLE 2--SCREEN CLASSIFICATION RANGES FOR VARIOUS SFSA GRADES OF ZIRCON FLOUR

<u>SCREEN No.</u>	SFSA (F-140)	SFSA (F-200)	SFSA (F-325)
	% RETAINED ON SIEVE	% RETAINED ON SIEVE	% RETAINED ON SIEVE
140	15 - 30	-----	-----
200	30 - 45	1 - 10	-----
325	8 - 20	8 - 30	1 - 5
Thru			
325	20 - 35	60 - 90	95 - 99

8.2 Physical properties listed are average properties and it shall not be required that these properties be determined by the vendor or the foundry.

8.2.1 **Melting point**4500°F

8.2.2 **Sintering point**4200°F

8.2.3 **Specific gravity**4.6

9. Acceptance Tests

9.1 Free silica in zircon sand shall not exceed the amount specified in 5.1 and may be determined as follows:

9.1.1 Test procedure is based on a heavy liquid procedure which employs S-tetrabromoethane (density 2.950 at 20 degrees C).

9.1.1.1 Carefully reduce the laboratory sample of granular zircon by quartering to about 50 grams and carefully weigh.

9.1.1.2 Details of Procedure

9.1.1.2.1 Transfer to a clean and dry **250 ml** pearshaped separatory funnel about **50 ml** S-tetrabromoethane, then slowly add the quartered sample in small increments of about **5 grams**, and stir gently with a stirring rod after each addition. After the final addition, wash the sides of the separatory funnel with an additional **20 to 25 ml** of S-tetrabromoethane and allow the mixture to stand for about ten minutes.

9.1.1.2.2 Slowly drain the zircon fraction with some of the S-tetrabromoethane through the stopcock onto a coarse-texture filter paper in a funnel. Discard the zircon and reserve the S-tetrabromoethane. Place a new filter paper in the funnel and filter the free SiO_2 fraction from the remaining S-tetrabromoethane. The above two fractions of S-tetrabromoethane are suitable for further use, provided no diluent is added to change the specific gravity.

9.1.1.2.3 Place another container under the funnel, with the stopcock open, wash the sides of the funnel free from SiO_2 with **15 to 20 ml** of methyl alcohol. Finally wash the paper and free SiO_2 a few times with methyl alcohol. Discard the washings.

9.1.1.2.4 Transfer the paper and free SiO_2 to a crucible and burn off the paper. The weight of the residue is free SiO_2 .

9.1.1.2.5 Percent of free SiO_2 =

$$\frac{\text{Weight of residue} \times 100}{\text{Weight of Sample}}$$

9.2 Test for oil

9.2.1 Samples shall be obtained from laboratory samples by quartering to about **100 grams**.

9.2.2 Add zircon sample carefully to **500 ml** of distilled water.

9.2.3 Observations

9.2.3.1 Zircon not containing eucalyptus oil will sink rapidly and will not show any air bubbles collecting next to the bottom of the beaker.

9.2.3.2 Zircon grains coated with eucalyptus oil will collect air bubbles on individual grains.

9.3 Screen analysis

9.3.1 The screen analysis of zircon sand shall be performed by either of two methods:

9.3.1.1 By means of agitating an assembled series of screens and noting the weights retained on each sieve.

9.3.1.2 By the hydrometer methods or pipette method. (See Note 4.)

9.3.2 The screen analysis for zircon flour shall be performed by wet screening.

9.3.2.1 Apparatus

9.3.2.1.1 200-mesh Tyler sieve, 6-inch diameter

9.3.2.1.2 325-mesh Tyler sieve, 6-inch diameter

9.3.2.1.3 4-liter beaker

9.3.2.1.4 4-inch shallow drying pans

9.3.2.2 Procedure

9.3.2.2.1 Transfer **100 g** of the laboratory sample to the **600 ml** beaker containing about **400 ml** of water and thoroughly mix with a stirring rod. Place the **200-mesh sieve** in the flared top of the **4-liter beaker** and then pour the slurried sample through the sieve. Flush any residue in the beaker onto the sieve and wash the residue on the sieve with a stream of water from a **1/4-inch-diameter** hose connected to the cold water tap until the beaker is full. Reserve the screened slurry. The water pressure for washing the residue is adjusted by the faucet to just fill the hose and directed on the sieve in a rotary motion.

9.3.2.2.2 Carefully flush the residue on the sieve into a shallow pan, decant the excess water, dry, and weigh the residue. The weight of residue is reported as percent + **200 mesh**.

9.3.2.2.3 The reserved slurry in the **4-liter beaker** is slowly poured onto the **6-inch 32 T-mesh sieve**. If the superfine material tends to clog the sieve, slightly tap the side of the sieve. After all the material has been transferred to the screen, wash as described above until most of the superfines are washed through. Place the sieve on the **4-liter beaker** and continue to wash with a rotary motion until the beaker is full. Remove the sieve, discard the washings, then continue washing the residue until the beaker is filled three times.

9.3.2.2.4 Flush the residue on the sieve into a shallow pan, decant the excess water, dry and weigh. The weight of residue is reported as percent -**200 + 325 mesh**.

NOTE 4.-For details of these procedures see AFS "Foundry Sand Handbook", Section 5, paragraphs 56 - 83.

10. Packaging or Bagging

10.1 The zircon sand shall be bagged in such a manner as to insure that the zircon sand is not exposed to moisture and is protected against shipping loss.

10.2 The zircon sand shall be bagged in sacks that hold a maximum of 115 pounds or in metal or wooden barrels of 500 pounds/net weight.

10.3 Each container or bag shall be legibly marked or tagged with the following information:

10.3.1 "Zircon Sand" or "Zircon Flour."

10.3.2 Quantity or weight.

1 0.3.3 Vendor's name or supplier's name.

11. Rejection

11.1 Material not conforming to the specification will be subject to rejection by the foundry.

NOTE: This **specification may** not cover contaminants that interfere with proper **bonding when** using certain types of binders, such as phenolics and the no-bakes.