



# Standard Specification for Sulfur Polymer Cement and Sulfur Modifier for Use in Chemical-Resistant, Rigid Sulfur Concrete<sup>1</sup>

This standard is issued under the fixed designation C 1159; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers the requirements for sulfur polymer cement and sulfur modifier for use in rapid setting and high strength applications of chemical-resistant sulfur concrete.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

C 267 Test Method for Chemical Resistance of Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes<sup>2</sup>

C 904 Terminology Relating to Chemical-Resistant Non-metallic Materials<sup>2</sup>

D 70 Test Method for Specific Gravity and Density of Semi-Solid Bituminous Materials<sup>3</sup>

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, see Terminology C 904.

## 4. Types and Composition of Sulfur Concretes

4.1 There are currently two types of commercial sulfur concrete technology in use. Both utilize cyclopentadiene-type hydrocarbons reacted polymerically with sulfur, but the sulfur concrete production processes differ. Each technology is described further in 4.1.1 and 4.1.2.

4.1.1 *Type 1*—Type 1 sulfur concrete uses sulfur polymer cement made by reacting a blend of dicyclopentadiene and oligomers of cyclopentadiene with sulfur. The sulfur polymer

cement shall conform to the chemical and physical requirements prescribed in Table 1.

4.1.2 *Type 2*—Type 2 sulfur concrete uses a sulfur modifier made by reacting sulfur with an oligomeric polymer of cyclopentadiene. The sulfur modifier shall conform to the chemical and physical requirements prescribed in Table 2. The sulfur modifier is mixed with elemental sulfur on site during the sulfur concrete production process.

## 5. Physical Properties

5.1 Particles of sulfur polymer cement and sulfur modifier shall be small enough (generally less than ¼ in. nominal size) to melt efficiently when exposed to heated aggregate while minimizing the amount of dust particles (generally less than 74  $\mu\text{m}$ ) to reduce potential dust hazards.

## 6. Methods of Sampling and Testing

6.1 Sulfur polymer cement and sulfur modifier shall be sampled and tested to determine the properties enumerated in this specification in accordance with the following methods:

6.1.1 *Sampling*—When the purchaser desires that the sulfur polymer cement or sulfur modifier be sampled and tested to verify compliance with this specification, every precaution shall be taken to obtain representative random samples that will show the true nature and condition of the material. Samples shall be taken to represent as nearly as possible an average of the bulk material sampled or to ascertain the maximum variation in characteristics which the material possesses.

6.1.2 Sulfur and carbon contents shall be determined by combustion of a small sample of sulfur polymer cement or sulfur modifier using carbon/sulfur analyzing equipment. Typical equipment is that used for analyzing coal samples.

6.1.3 Hydrogen content shall be determined by combustion of a small sample of sulfur polymer cement or sulfur modifier in an oxygen environment converting the hydrogen to water vapor measured using gravimetric procedures by absorption into calcium chloride.

6.1.4 Specific gravity shall be determined in accordance with Test Method D 70. Measurements are made at 77°F (25°C).

6.1.5 Viscosity shall be determined at 275°F (135°C) using a rotating spindle-type viscometer equipped with an electrically heated cell and temperature controller.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.05.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.03.

**TABLE 1 Sulfur Polymer Cement for Use in Type 1 Sulfur Concrete**

Property	Value
Sulfur, % by weight	95.0 ± 1.0
Carbon, % by weight	5.0 ± 0.5
Hydrogen, % by weight	0.5 ± 0.05
Specific gravity at 77°F (25°C)	1.90 ± 0.02
Viscosity, cP at 275°F (135°C)	25 to 100

**TABLE 2 Sulfur Modifier for Use in Type 2 Sulfur Concrete**

Property	Value
Sulfur, % by weight	80 ± 2.0
Carbon, % by weight	18 ± 1.0
Hydrogen, % by weight	2.0 ± 0.1
Specific gravity at 77°F (25°C)	1.71 ± 0.02
Viscosity, cP at 275°F (135°C)	35 to 100

## 7. Inspection

7.1 Inspection of the material shall be made as agreed upon by the purchaser and the seller as part of the purchase contract.

## 8. Rejection

8.1 At the discretion of the purchaser, sulfur polymer cement or sulfur modifier may be rejected if it fails to meet any of the requirements of this specification.

## 9. Packaging and Package Marking

9.1 The sulfur polymer cement or sulfur modifier shall be

packaged in suitable containers, plainly marked to denote the contents, the name and brand of the manufacturer, batch number, and the weight of cement contained therein. Similar information shall be provided with bulk shipments of these materials. All packages shall be in good condition at the time of inspection.

9.2 Packages may be marked at the discretion of the supplier and on his responsibility, indicating that the product satisfies this specification.

## 10. Storage

10.1 Materials should be stored in a clean, dry, area in such a manner as to permit easy access for proper inspection of each shipment. Sulphur modifier should be stored at ambient temperatures, generally less than 105°F (40°C).

## 11. Manufacturer's Certification

11.1 Upon request of the purchaser in the contract or order, a manufacturer's report shall be furnished at the time of shipment stating the results of tests made on samples of the material taken during production or transfer and certifying that the applicable requirements of this specification have been met.

## 12. Keywords

12.1 chemical-resistant; sulfur concrete; sulfur modifier; sulfur polymer cement (SPC); sulfur polymer cement concrete

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