Designation: D4295 – 89 (Reapproved 2017)

Standard Classification for Rubber Compounding Materials—Zinc Oxide[1]

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1. Scope

1.1 This classification system covers the compounding material commercially known as zinc oxide. The types of zinc oxide used in the rubber industry are related to the production process used. Typical chemical and physical properties are included.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D280 Test Methods for Hygroscopic Moisture (and Other Matter Volatile Under the Test Conditions) in Pigments

D3037 Test Method for Carbon Black—Surface Area by Nitrogen Adsorption (Withdrawn 1999)[3]

D3280 Test Methods for Analysis of White Zinc Pigments

D4075 Test Methods for Rubber Compounding Materials—Flame Atomic Absorption Analysis—Determination of Metals

D4315 Test Methods for Rubber Compounding Material—Zinc Oxide

3. Significance and Use

3.1 Zinc oxide is an important rubber compounding material. It is used to activate the organic accelerators to increase the rate of vulcanization and to enhance physical properties. It is also a vulcanizing agent for halogen-containing elastomers.

4. Classification of Zinc Oxides by Types

4.1 *American Process or Direct Type*—When zinc oxide is manufactured by the reduction and reoxidation of a zinc-bearing material, such as a zinc ore by a carbonaceous fuel, it is called American process or direct type. American process zinc oxide is produced with widely varying chemical properties and physical characteristics. Nodular-type particle shape, as observed by the light microscope, is generally preferred for rubber compounding. Due to wide variations in the material processed and in the process itself, the properties of American process zinc oxide can only be characterized in a general way.

4.2 *French Process or Indirect Type*—When zinc oxide is manufactured by the burning of zinc vapor (produced by boiling zinc metal in a retort or zinc boiler), it is called French process or indirect type. It is characterized by a high degree of chemical purity resulting from the use of high purity (>99.9% zinc). As generally produced, the particles are nodular in shape as observed by the light microscope.

4.3 *Secondary Zinc Oxide Type:*

4.3.1 *Chemical*—When zinc oxide is manufactured as a by-product of a chemical reaction, it is considered a secondary type. The chemical and physical properties can vary widely depending on the raw material source and the type of reaction.

4.3.2 *Metallurgical*—When zinc oxide is manufactured from burning zinc vapor produced by boiling die cast scrap zinc, galvanized zinc dross, or other scrap zinc units without purification, it is considered a secondary type. The chemical purity can vary widely and is dependent on the purity of the feed metal.

5. Composition and Properties

5.1 Typical properties for untreated zinc oxide by types are described in Table 1.

5.2 *Treated Zinc Oxide*—Zinc oxide for use in rubber is often surface treated, most frequently with a fatty acid such as propionic acid.

5.2.1 A fatty acid treated zinc oxide will typically contain about 0.5 % less zinc oxide than the corresponding untreated grade.

5.2.2 The typical fatty acid treated zinc oxide shows a greater heat loss, about 0.2 %, than the corresponding untreated grade due to partial vaporization of the fatty acid.

[1] This classification is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.20 on Compounding Materials and Procedures.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

TABLE 1 Typical Properties of Zinc Oxide

Property	ASTM Method	American Type (Direct)	French Type (Indirect)			Secondary Types		
			Class 1	Class 2	Class 3	Chemical	Metallurgical	
							Class 1	Class 2
% Zinc oxide	D3280	99.0	99.5	99.5	99.5	95.0	99.0	99.0
% Lead	D4075	0.10	0.002	0.002	0.002	0.10	0.10	0.10
% Cadmium	D4075	0.05	0.005	0.005	0.005	0.05	0.05	0.05
% Sulfur	D3280	0.15	0.02	0.02	0.02	0.15	0.02	0.02
% Heat loss at 105°C	D280	0.25	0.30	0.25	0.25	0.50	0.25	0.25
% Sieve residue, 45 µm	D4315	0.10	0.05	0.05	0.05	0.10	0.10	0.10
Surface area, m^2/g	D3037	3.5	9.0	5.0	3.5	40.0	5.0	3.5