Standard Method of Test for

Protective Sealers for Portland Cement Concrete

AASHTO Designation: T 384-19[1]

Technical Subcommittee: 4c, Markings and Coatings

Release: Group 2 (June)

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1. SCOPE

1.1. This method covers test methods and selection criteria for prequalification of sealers for protecting new concrete or prolonging the life of sound in-service concrete used in highway structures. Sealer testing and evaluation for routine and job site product quality assurance, field performance, and re-application are provided in R 94.

1.2. Sealers are divided into two basic types: coatings, which remain on the surface; and penetrants, which penetrate into the concrete to some measurable depth and do not substantially change the appearance of the concrete.

1.3. The values stated in SI units are to be regarded as the standard.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 6, Fine Aggregate for Hydraulic Cement Concrete
- M 80, Coarse Aggregate for Hydraulic Cement Concrete
- M 233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete
- R 94, Quality Assurance, Job Site Quality Control, and Reapplication of Protective Sealers for Portland Cement Concrete
- T 22, Compressive Strength of Cylindrical Concrete Specimens
- T 160, Length Change of Hardened Hydraulic Cement Mortar and Concrete
- T 260, Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials
- T 278, Surface Frictional Properties Using the British Pendulum Tester

2.2. *ASTM Standards*:

- C33/C33M, Standard Specification for Concrete Aggregates
- C138/C138M, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete
- C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
- C192/C192M, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

- C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C494/C494M, Standard Specification for Chemical Admixtures for Concrete
- C496/C496M, Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
- C511, Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
- C642, Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
- C666/C666M, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
- C672/C672M, Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
- C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
- C1152/C1152M, Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete
- C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
- C1583/C1583M, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
- D891, Standard Test Methods for Specific Gravity, Apparent, of Liquid Industrial Chemicals
- D2369, Standard Test Method for Volatile Content of Coatings
- D4138, Standard Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means
- D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- D5095, Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments
- D6132, Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Coating Thickness Gage
- D6762, Standard Test Method for Determining the Hiding Power of Paint by Visual Evaluation of Spray Applied Coatings
- D7089, Standard Practice for Determination of the Effectiveness of Anti-Graffiti Coating for Use on Concrete, Masonry and Natural Stone Surfaces by Pressure Washing
- E274/E274M, Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire
- E355, Standard Practice for Gas Chromatography Terms and Relationships
- E573, Standard Practices for Internal Reflection Spectroscopy
- E1252, Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis

2.3. *Other Reference*:

- Pfeifer, D. W., and M. J. Scali. *National Cooperative Highway Research Program Report 244: Concrete Sealers for Protection of Bridge Structures*. National Academy Press, Washington, DC, 1981, 138 pp.

3. SEALER PROPERTIES

3.1. A number of performance categories must be considered when choosing a sealer. There are basic properties that are universally significant for all sealers and other special properties that depend on the intended application. The performance categories include the following:

3.2. *Universal Properties*—All sealers, by definition, are intended to reduce water penetration into concrete and to extend the service life of the concrete. Most sealers for highway structures are used to reduce the ingress of chlorides from deicers or seawater to protect the embedded reinforcing steel from corrosion. Therefore, improving the resistances, in concrete, to both water and chloride penetration is a basic property of all sealers.

Highway structures are exposed to their environments, so all sealers must work under a variety of environmental conditions (temperature and moisture) and be durable to weathering and alkalis present in the concrete. Reasonable curing or drying time is also needed, so that the sealers are not damaged by rain shortly after treatment and to avoid lengthy lane closures of decks when sealers are installed.

Good vapor transmission of sealed surfaces is a preferred property of most sealers, since this property allows moisture that is present or able to penetrate into the treated structure to dry as environmental conditions permit. Nonbreathable sealers have limited applications in highway structures, since preventing concrete from drying between rain events limits the sealer effectiveness at slowing moisture-driven deterioration mechanisms. Improperly applied, non-breathable sealers can trap water in concrete and increase moisture-drive deterioration.

Sealers should be effective on both new and older concrete, but specific materials can be tested and specified for each condition.

3.3. *Traffic Exposure Resistance*—Sealers on traveled surfaces must not reduce the frictional properties of the concrete and must be effective after traffic wear. Penetrants require good penetration to remain effective after surface wear, and coatings must be wear resistant. Rapid curing may also be needed if applied during short lane closure periods.

3.4. *Freeze–Thaw, Scaling, and Concrete Durability*—Sealers can be used to improve the concrete's resistance to cyclic freezing damage or surface scaling. Special tests recreating cyclic freezing conditions are presented to evaluate these properties. Sealers have also been used to extend the service life of structures with other concrete distress. Such deleterious reactions are highly dependent on site conditions and materials, and no widely useful test can be proposed to characterize the ability of sealer to slow or stop all types of concrete deterioration. However, in a general sense, the ability of sealer to retard moisture ingress will be a determining factor in the likelihood that such reactions will be affected.

3.5. *Adverse Conditions*—It may be necessary to apply the sealer under adverse conditions, such as very low ambient temperatures or very high moisture conditions. In these cases, a sealer must be chosen that can be installed and offer protection under these adverse conditions.

3.6. *Other Considerations*:

3.6.1. *Color*—Color and final appearance may be important for some structures. If the color of the treated concrete is important, test blocks or mock-ups should be treated with candidate materials for evaluation prior to use.

3.6.2. *Safety*—Sealers must be safe to store, handle, and apply. Several sealer types involve toxic or hazardous components and may not meet local air quality regulations.