



Designation: D476 – 15 (Reapproved 2021)

Standard Classification for Dry Pigmentary Titanium Dioxide Products¹

This standard is issued under the fixed designation D476; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This classification describes eight types of dry pigmentary titanium dioxide products, grouped by composition, typical end use application, and some performance properties.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[D34 Guide for Chemical Analysis of White Pigments](#)

[D153 Test Methods for Specific Gravity of Pigments](#)

[D185 Test Methods for Coarse Particles in Pigments](#)

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

[D1394 Test Methods for Chemical Analysis of White Titanium Pigments](#)

[D2448 Test Method for Water-Soluble Salts in Pigments by Measuring the Specific Resistance of the Leachate of the Pigment](#)

[D3720 Test Method for Ratio of Anatase to Rutile in Titanium Dioxide Pigments by X-Ray Diffraction](#)

3. Significance and Use

3.1 This classification is given as an aid in determining the fitness for use of a titanium dioxide pigment for a coating

application. It is limited to dry, hiding pigments. It excludes pigment dispersions, and non-hiding specialty titanium dioxide products.

4. Basis for Classification

4.1 Titanium dioxide pigments can differ in many ways, including composition and performance. This classification outlines differences between pigment types that should be considered when selecting a product for a coating application. A minimum number of properties are given to highlight major differences, while allowing maximum flexibility.

5. Composition and Properties

5.1 *Titanium Dioxide Pigments*, should conform to the requirements for composition prescribed in [Table 1](#). They are chemically prepared pigments consisting of anatase or rutile titanium dioxide with or without modifications with water-insoluble oxides of aluminum, silicon, zinc, etc., or other agents; these reagent materials are introduced specifically to improve those properties for which the pigment is used. The titanium dioxide pigments shall be free of extenders such as barium sulfate, clay, magnesium silicate, whiting, etc.

5.2 The desired properties of the pigment, other than as herein indicated, shall be subject to agreement between the purchaser and the seller and shall be based on a satisfactory match between the submitted pigment sample and a previously agreed upon reference sample (see [6.1.6](#)).

6. Test Methods

6.1 Tests shall be conducted in accordance with the following test methods. Test procedures not covered by ASTM test methods shall be mutually agreed upon between the purchaser and the seller.

6.1.1 *Chemical Analysis*—Guide [D34](#) or Test Methods [D1394](#).

6.1.2 *Specific Gravity*—Test Methods [D153](#).

6.1.3 *Coarse Particles*—Test Methods [D185](#).

6.1.4 *Moisture*—Test Methods [D280](#).

6.1.5 *Matter Soluble in Water, Specific Resistance*—Test Method [D2448](#). The measured specific resistance of the aqueous leachate from the pigment is an index of the level of water-soluble salts.

¹ This classification is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.31 on Pigment Specifications.

Current edition approved June 1, 2021. Published June 2021. Originally approved in 1938. Last previous edition approved in 2015 as D476 – 15. DOI: 10.1520/D0476-15R21.

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.



TABLE 1 Classification of Dry, Pigmentary Titanium Dioxide Pigments

| Classification Type | Typical Properties | | | | | | | | ASTM Standards |
|---|--|------------------|------------|--|--|------------------------------------|---------------------------------|--|----------------|
| | I | II | III | IV | V | VI | VII | VIII | |
| Crystal type | anatase ^A | rutile | rutile | rutile | rutile | rutile | rutile | rutile | |
| Chalking resistance, relative | free chalking | low-medium | medium | high | high | medium-high | medium-high | very high | |
| Typical end use application(s) | white exterior house paint and interior uses | low-medium % PVC | high % PVC | exterior coatings requiring excellent durability | exterior coatings requiring excellent durability with high gloss | int-ext coatings medium-high % PVC | int-ext coatings low-high % PVC | exterior colored coatings and polymers requiring infra-red reflectance with excellent durability | D3720 |
| Titanium dioxide (TiO ₂) content, min., % | 94 | 92 | 80 | 80 | 90 | 90 | 92 | 92 | D1394 |
| Specific resistance, min, Ω | 5000 | 5000 | 3000 | 3000 | 3000 | 5000 | 5000 | 3000 | D2448 |
| Moisture content as packed, max, % | 0.7 | 0.7 | 1.5 | 1.5 | 1 | 0.7 | 0.7 | 1 | D280 |
| Specific gravity | 3.8–4.0 | 4.0–4.3 | 3.6–4.3 | 3.6–4.3 | 3.6–4.3 | 3.6–4.3 | 4.0–4.3 | 3.6–4.3 | D153 |
| 45-µm screen residue, max, % | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | D185 |

^A Identification of anatase or rutile or mixtures thereof is made by X-ray analysis (Test Method D3720).

6.1.6 *Chalking Resistance*—It is recommended that purchaser and seller agree upon standards and methods of test suitable for their requirements (see 5.2). Comparison in a good quality exterior air-dry alkyd enamel (trade sales or industrial) and exposure in Florida at 45° facing south are recommended. Chalking differences are minimized by less durable vehicles, while required exposure times are prolonged by more durable vehicles. Once the reference sample agreed upon between the

purchaser and seller has qualified, subsequent shipments of that product may be compared with the reference sample by an agreed upon accelerated weathering test.

7. Keywords

7.1 anatase; dioxide pigments; rutile; titanium; white pigments

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