



Standard Test Method for Wet-to-Dry Hiding Change¹

This standard is issued under the fixed designation D 5007; 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.

1. Scope

1.1 This test method covers the determination of the change in hiding power of an architectural coating during drying, by visual evaluation of the wet and dry film.

1.2 This test method is not recommended for colors other than white and tints.

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:

D 2805 Test Method for Hiding Power of Paints by Reflectometry²

D 3924 Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *hiding index, h_s* —the Spreading Index at a standard film opacity. In this test method the latter is a visual contrast standard prepared by applying a semi-opaque white coating on a black and white hiding-power chart to give a contrast ratio of 0.98 (98 %) which is just short of complete hiding, and is the conventional so-called *full hiding* end point in photometric hiding-power methods such as Test Method D 2805. Refer to the hiding indices of the wet and dry films as h_{SW} and h_{SD} respectively.

3.1.1.1 *Discussion*—Since this test method is intended to measure hiding-power difference rather than hiding power itself, a 0.98 (98 %) contrast ratio standard is not required. It is necessary only that the same standard be used for measuring both wet and dry films. See 3.1.8. For this purpose the standard needs to lie within the contrast range of both the wet and dry stripes, which is true of the 0.98 (98 %) contrast-ratio standard for most commercial paints. With paints of unusually low

hiding, a lower contrast standard may be required, which can be simply one of the stripes taken from a drawdown of the test paint.

3.1.2 *hiding power*—the spreading rate of a paint applied uniformly on a standard black and white hiding power chart to give a standard degree of contrast just short of complete hiding.

3.1.2.1 *Discussion*—In reflectometry the standard contrast for hiding power measurements is generally accepted as the contrast ratio $C = 0.98$ (98 %), which with white and light tinted coatings is equivalent to a visual color difference of about 0.75 CIELAB units. That amount of color difference can reasonably be described as “just-short-of complete-hiding.” Since this is a visual method it employs a visual comparator as a standard, which is a hiding power chart with a white coating applied at a contrast ratio of 0.98 (98 %).

3.1.3 *logicator*—a multi-notch applicator with clearances, and corresponding wet film thicknesses and spreading rates, in equal percentage steps.

3.1.4 *logicator scale*—a scale with values directly related to the logarithms of corresponding spreading rates. A specified change in scale value represents the same percentage change in spreading rate over any part of such a scale.

3.1.5 *spreading index, h* —the spreading rate expressed in logicator scale units (LU) as described in 3.1.4 and 3.1.7.

3.1.6 *spreading rate, H* —the area covered per unit quantity of coating. (In this test method the quantity is volumetric).

3.1.7 *TG19 logicator*—a logicator designed for this test method with eight notches numbered at four-unit intervals on a scale from 20 to 48, the notch clearances ranging from 2.65 to 10.4 mils (67 to 264 μm) corresponding to wet film thicknesses from 1.46 to 5.7 mils (37 to 145 μm) and spreading rates from 280 to 1100 ft^2/gal (6.9 to 27 m^2/L), with one scale unit representing a change of 5% and the four-unit interval between notches a cumulative change of 21.55% in the clearance and corresponding film thicknesses and spreading rates. Refer to this scale unit as a logicator unit (LU). (See Fig. 1.)

3.1.7.1 *Discussion*—The percentage difference between notches is calculated as $(1.05^4 - 1) \times 100 = 21.55$. This percentage is applicable precisely to the notch clearances and approximately to their related wet-film thicknesses and spreading rates. The detailed relationships between scalar value and the notch clearance, wet film thickness, and spreading rate are given in Table 1 and Table 2.

3.1.8 *wet-to-dry hiding change (WDHC)*—the difference in the Hiding Index of a paint between the wet and the dry state,

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² *Annual Book of ASTM Standards*, Vol 06.01.

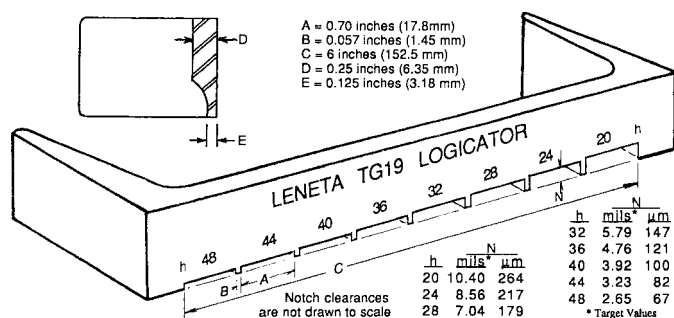


FIG. 1 Diagram of the Leneta TG19 Logicator

TABLE 1 Equations Relating the Logicator Scale Value or Spreading Index, *h*, to the Notch Clearance, *N*, Wet Film Thickness, *T*, and Spreading Rate, *H*

NOTE 1—The relationships involving *T* and *H* are based on a presumed *T/N* ratio of 0.55, which ratio is approximate and somewhat variable, depending on coating rheology, drawdown technique, and clearance.

Inch-Pound Units (mils, ft ² /gal):	Metric Units (μm, m ² /L):
$N = 1.05^{68-h} = 27.6 \div 1.05^h$	$N = 25.4 \times 1.05^{68-h} = 701 \div 1.05^h$
$h = 68 - 47.2 \log N$	$h = 134.3 - 47.2 \log N$
$T = 0.55 N = 15.18 \div 1.05^h$	$T = 0.55 N = 385.5 \div 1.05^h$
$h = 55.75 - 47.2 \log T$	$h = 122.05 - 47.2 \log T$
$H = 105.7 \times 1.05^h$	$H = 2.594 \times 1.05^h$
$h = 47.2 \log H - 95.52$	$h = 47.2 \log H - 19.54$

expressed in logicator units (LU) as follows:

$$WDHC = \Delta h_s = h_{SD} - h_{SW} \quad (1)$$

3.1.8.1 Discussion—The WDHC is unchanged if the contrast level of the hiding standard is varied, because the resultant changes in the two hiding power values are proportional and their ratio therefore constant.

3.1.8.2 Discussion—The WDHC is unaffected by deviations from the estimated film thickness/clearance ratio *T/N* (see Note 1, Table 1), because the ratio of the two recalculated hiding-power values is unchanged.

4. Summary of Test Method

4.1 The test paint is applied with a TG19 Logicator on a logicator test chart (see 6.2 and Fig. 2) and the drawdown examined in comparison with an agreed hiding standard immediately after application and again after drying.

4.2 The scale numbers of the wet and dry stripes that match the standard in contrast are recorded as the Wet Hiding Index, *h_{SW}*, and the Dry Hiding Index *h_{SD}*.

4.3 The difference between the wet and dry hiding indices is recorded as the wet-to-dry hiding change WDHC.

4.4 If desired, the percent change in hiding power corresponding to the WDHC value is calculated and reported.

5. Significance and Use

5.1 Many architectural paints, particularly white and light tints, change significantly in film opacity as they dry. An increase in hiding is sometimes associated with porosity and poor film integrity with conventionally formulated coatings. A decrease can result in a disappointing paint job. The wet-to-dry hiding change is therefore a property of great practical importance.

5.2 This test method can be used in paint specifications and as a short, simple procedure for evaluation and quality control.

6. Apparatus

6.1 TG19 Logicator³—A multi-notch, varied-clearance applicator designed specifically for this test method (see 3.1.7 and Fig. 1).

6.2 Logicator Test Charts³—Black and white hiding charts with a chevron-stripe pattern and scale numbers printed at the top corresponding to the paint stripes applied by the Logicator (see Fig. 2).

6.3 Vacuum Plate, for holding the chart flat while the drawdown is made.

6.4 Visual Hiding Standard⁴—A narrow stripe cut from a logicator test chart on which a durable glossy white coating had been applied to obtain a contrast ratio of 0.98. The stripe is mounted on a blank card for convenient handling, as illustrated in Fig. 3.

7. Procedure

7.1 Prepare a hiding standard as described in 6.4, or use the standard supplied with the logicator test charts.

NOTE 1—Strong colors were measured according to this test method using standards prepared with the self-same coatings. Some measurements were also made using the regular white standard. Due to poor correlation in these tests it was decided to exclude strong colors from the scope of the test method. However, should measurements with such colors be attempted anyway, it is of interest to note that the white standard apparently served as well for that purpose as a standard made with the identical color.

7.2 Place a test chart on the vacuum plate. Then place the logicator at the top of the chart with its arms extending toward the operator.

7.3 Spread about 6 mL of the test paint evenly in front of the logicator, then draw down the full length of the chart (about 10 in. (254 mm)) at a uniform speed such that the total drawdown time is about 2.5 to 3 s.

7.4 Promptly after film application, determine the Wet Hiding Index (*h_{SW}*) in accordance with 7.5.

7.5 Observation of the Hiding Index (*h_s*):

7.5.1 Place the chart vertically in a well-illuminated glare-free location.

7.5.2 Hold the hiding standard next to the chart and identify by number the stripe that the standard matches in contrast. This number is the Hiding Index.

7.5.3 If there is no exact match and it is difficult to decide which of two adjacent stripes is matched more closely, record their mean as the Hiding Index. However, if the standard is perceived as closer to one or the other of the two stripes, then report the Hiding Index as one more than the lower or one less than the higher, as the case may be.

7.6 Immediately after determining the Wet Hiding Index (*h_{SW}*), place the drawdown horizontally in a well-ventilated,

³ The sole source of supply of logicator test charts known to the committee at this time is the Leneta Company, 15 Whitney Rd., Mahwah, NJ 07430. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

⁴ A white standard of this description is supplied with the TG19 Logicator Test Charts.

TABLE 2 Logicator Scale Relationships Calculated from Equations in Table 1

Index ^A		Clearance		Film Thickness ^B		Spreading Rate ^B		Index ^A		Clearance		Film Thickness ^B		Spreading Rate ^B						
<i>h</i>	mils ^C	μm	mils	μm	ft ² /gal	m ² /L	<i>h</i>	mils ^C	μm	mils	μm	ft ² /gal	m ² /L	<i>h</i>	mils ^C	μm	mils	μm	ft ² /gal	m ² /L
20	10.40	264	5.72	145	280	6.88	36	4.76	121	2.62	67	612	15.0	37	4.54	115	2.50	63	643	15.8
21	9.90	252	5.44	138	294	7.23	38	4.32	110	2.38	60	675	16.6	39	4.12	105	2.26	58	709	17.4
22	9.43	240	5.19	132	309	7.59	40	3.92	100	2.16	55	744	18.3	41	3.73	95	2.05	52	781	19.2
23	8.98	228	4.94	126	325	7.97	42	3.56	90	1.96	50	820	20.1	43	3.38	86	1.86	47	861	21.1
24	8.56	217	4.71	120	341	8.37	44	3.23	82	1.77	45	904	22.2	45	3.07	78	1.69	43	950	23.3
25	8.15	207	4.48	114	358	8.78	46	2.93	74	1.61	41	997	24.5	47	2.79	71	1.53	39	1047	25.7
26	7.76	197	4.27	108	376	9.22	48	2.65	67	1.46	37	1100	27.0	48	2.65	67	1.46	37	1100	27.0
27	7.39	188	4.07	103	395	9.68														
28	7.04	179	3.87	98	414	10.2														
29	6.70	170	3.69	94	435	10.7														
30	6.38	162	3.51	89	457	11.2														
31	6.08	154	3.34	85	480	11.8														
32	5.79	147	3.19	81	504	12.4														
33	5.52	140	3.03	77	529	13.0														
34	5.25	133	2.89	73	555	13.6														
35	5.00	127	2.75	70	583	14.3														

^A Boldface values refer to notches in TG19 Logicator.

^B Based on wet film thickness estimated at 55% of clearance.

^C Target values are significant to one decimal place.

dust-free location, as specified in Specification D 3924, and allow to dry for 40 to 48 h. Then repeat 7.5 to determine the Dry Hiding Index (h_{SD}).

7.7 Make drawdowns in triplicate and calculate the mean index value to 0.1 units. Individual values that deviate from the mean by more than 1.5 units should be discarded and the test repeated.

8. Calculation

8.1 Subtract the Wet Hiding Index, h_{SW} from the Dry Hiding Index, h_{SD} to obtain the wet-to-dry hiding change (WDHC), Δh_s , as follows:

$$WDHC = \Delta h_s = h_{SD} - h_{SW} \quad (2)$$

The value for WDHC is positive for an increase and negative for a decrease in hiding. To avoid possible misunderstanding write the sign of the change (+ or -) in every case.

8.2 If desired, calculate the corresponding percent change in wet-to-dry hiding power as follows:

$$WDHC\% = (1.05^{WDHC} - 1) \times 100 \quad (3)$$

9. Report

9.1 Report the following information:

9.1.1 The Wet-to-Dry Hiding Change (WDHC) in logicator units (LU) to one decimal place, as described in 8.1, and

9.2 If desired, the percent change in conventional hiding power (WDHC%), calculated as shown in 8.2.

10. Precision and Bias ⁵

10.1 In an interlaboratory study of this test method, two operators in each of two laboratories and one operator in each of six laboratories, tested in triplicate five coatings with a wide range in wet-to-dry hiding change. Since the test was not repeated the repeatability is only for replicates. On this basis the intralaboratory standard deviation was 0.77 LU with 85 df and the interlaboratory standard deviation was 1.97 LU with 39 df. See Note 2. Based on these standard deviations the following criteria should be used for judging the acceptability of results at the 95% confidence level:

10.1.1 *Repeatability (Replicate)*—Three replicates by the same operator should be considered suspect if they differ by more than 2.6 LU.

10.1.2 *Reproducibility*—Two results, each the mean of triplicates, obtained by different operators should be considered suspect if they differ by more than 5.7 LU.

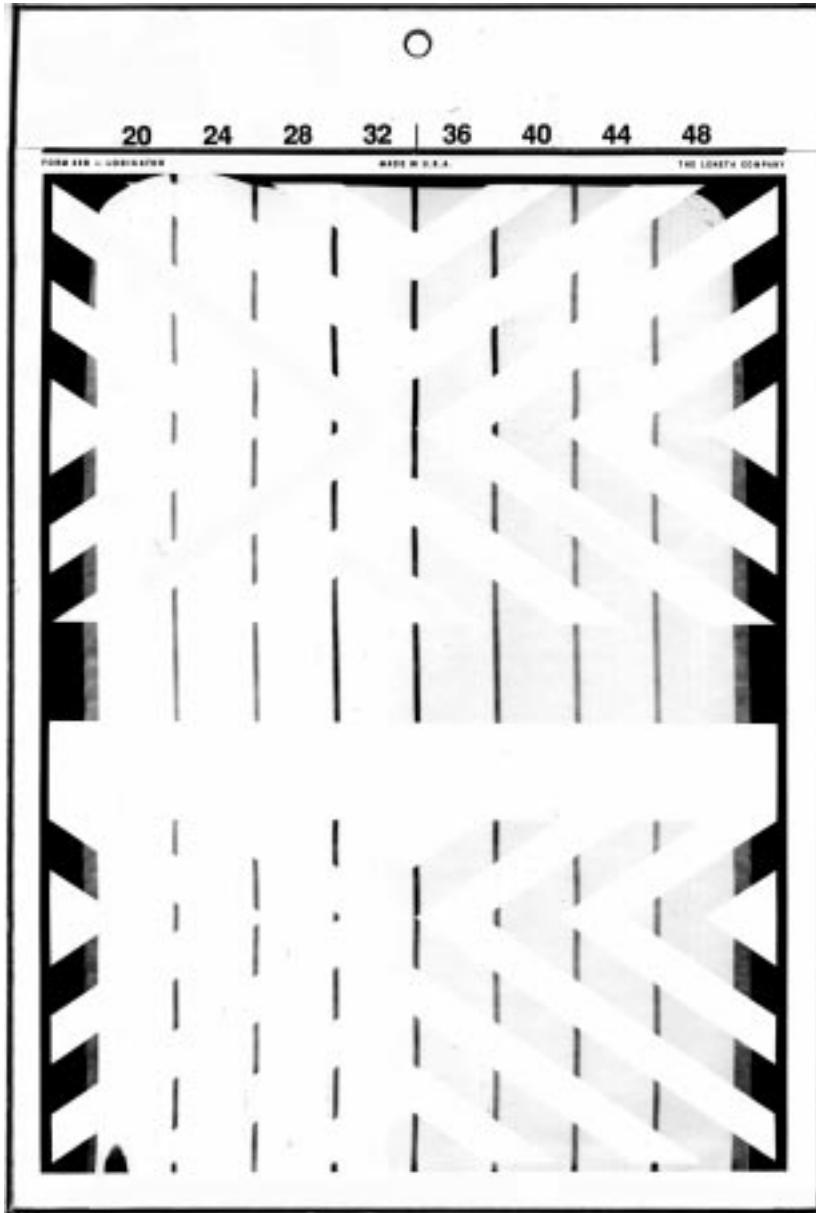
NOTE 2—In the statistical analysis results were discarded on the following basis: (1) all results from one operator who appeared to be less sensitive than the other operators in detecting differences among triplicates, (2) one replicate result from one laboratory because the triplicate range was significantly higher than for other laboratories, and (3) all three results from the same laboratory for another paint because the mean differed significantly from other means for that paint.

10.2 *Bias*—This test method has no bias because there is no criterion for the measured property more valid than the test method itself.

11. Keywords

11.1 hiding power; wet-to-dry hiding change

⁵ Supporting data are available from ASTM Headquarters. Request RR:D01-1063.



NOTE 1—For illustration only. Shading is not accurate.

FIG. 2 Logicator Test Application



NOTE 1—For illustration only. Shading is not accurate.

FIG. 3 Visual Hiding Standard

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