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Standard Test Method for Polyurethane Raw Materials: Instrumental Measurement of Tristimulus CIELAB Color and Yellowness Index of Liquids[1]

This standard is issued under the fixed designation D7133; 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 provides an instrumental method for measuring the CIELAB color and Yellowness Index (YI) of liquid polyurethane raw materials. The CIELAB and YI results are derived from mathematical manipulation of CIE tristimulus values in accordance with Practices E308 and E313, respectively.

~~1.2See Section 5 for cautions in using this test method.~~

~~1.3~~1.2 *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.*

NOTE~~1—There is no equivalent ISO standard.~~ 1—There is no known ISO equivalent to this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D883 Terminology Relating to Plastics
D1193 Specification for Reagent Water
E180 Practice for Determining the Precision of ASTM Methods for Analysis and Testing of Industrial and Specialty Chemicals
E284 Terminology of Appearance
E308 Practice for Computing the Colors of Objects by Using the CIE System
E313 Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions*—For definitions of terms that appear in this test method, refer to Terminologies E284, D883, and the terminology section of Practice E308.

4. Summary of Test Method

4.1 The color of the total transmitted light is measured by a spectrophotometer in CIE tristimulus values under CIE standard illuminant D65 and CIE 1964 supplementary standard observer commonly called the 10° standard observer. These values are then converted by the appropriate equations to the CIELAB color scale and the Yellowness Index. L*a*b* and YI values are reported.

5. Significance and Use

5.1 CIELAB is a visual-based scale that can be used to specify color and set color tolerances for the polyurethane industry.

5.2 Yellowness Index specifies the degree of departure of the sample from colorless towards yellow. This index is only suitable for clear liquids with degrees of saturation in yellow (dominant transmission wavelength in the 570 to 580 nm range). It can be used to set tolerances for appropriate polyurethane raw materials.

5.3 This test method does not include provisions for materials with fluorescence or visible haze (usually greater than 5 % haze).

5.4 Before proceeding with this test method, make reference to the specification of the material being tested. Any test specimen preparation, conditioning, dimensions, or testing parameters or combination thereof, covered in the materials specification shall

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[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.22 ~~on Cellular Materials—Plastics and Elastomers.~~

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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.

***A Summary of Changes section appears at the end of this standard.**

take precedence over those mentioned in this test method. If there are no material specifications, then the default conditions apply.

6. Interferences

6.1 This test method is to be used to compare samples only when they are measured under the same conditions.

6.1.1 The medium in the cuvette used during standardization of the instrument will have an effect on the measured results. Light mineral oil is recommended, however, distilled water can be used as a substitute but a note of the substitution must be included in any report of the results.

6.1.2 The temperature of the sample is also expected to affect the results obtained.

7. Apparatus

7.1 *Instrument*—A hemispherical geometry (integrating sphere) spectrophotometer capable of total transmission (TTRAN) CIE tristimulus measurement through a cuvette. TTRAN includes both the regularly transmitted portion and the diffused portion of the incident light. The instrument must be capable of converting CIE XYZ tristimulus values to the CIELAB color scale as defined in Practice E308 using CIE D65 standard illuminant and 10° standard observer. The instrument must also be capable of converting CIE XYZ tristimulus values to the Yellowness Index value defined in Practice E313 using CIE D65 standard illuminant and 10° standard observer. The instrument is to meet the manufacturer's requirements for calibration. For highly transparent samples, such as the polyols ~~below,~~in Tables 1 and 2, spectrophotometers or tristimulus colorimeters without a spherical geometry can be used with equivalent results.

7.2 *Sample Cuvettes*—The cuvette must have a 20 ± 0.06 mm pathlength. The entrance and exit windows shall be parallel, colorless, clear and unaffected by the material being analyzed. The optical properties of the cuvette used during standardization of the instrument and the cuvette used for measuring samples (if not the same cuvette) must be matched. This can be determined by proving that the variation, if any, in the different cuvettes used do not affect the measured value of a standard sample. Glass or plastic cuvettes can be used.

8. Reagents

8.1 *Mineral Oil*—Colorless NF or FCC grade light mineral oil.

TABLE 1 CIELAB Round Robin Data

			L* values				
Standard	Material	Viscosity	Average	S_r^A	S_R^B	r^C	R^D
Mineral Oil							
	PMDI A	200 mPa s (200 cP)	44.93	0.05	0.76	0.15	2.13
	PMDI B	750 mPa s (750 cP)	1.64	0.03	0.26	0.10	0.74
	Polyol A	475 mPa s (475 cP)	99.88	0.03	0.14	0.07	0.40
	Polyol B	6500 mPa s (6500 cP)	96.01	0.11	0.85	0.31	2.37
			a* values				
Standard	Material	Viscosity	Average	S_r^A	S_R^B	r^C	R^D
Mineral Oil							
	PMDI A	200 mPa s (200 cP)	45.80	0.03	0.26	0.07	0.72
	PMDI B	750 mPa s (750 cP)	9.17	0.12	1.01	0.33	2.82
	Polyol A	475 mPa s (475 cP)	–0.13	0.00	0.02	0.01	0.07
	Polyol B	6500 mPa s (6500 cP)	–1.82	0.03	0.26	0.07	0.72
			b* values				
Standard	Material	Viscosity	Average	S_r^A	S_R^B	r^C	R^D
Mineral Oil							
	PMDI A	200 mPa s (200 cP)	72.88	0.09	4.72	0.25	13.22
	PMDI B	750 mPa s (750 cP)	2.37	0.08	0.44	0.23	1.23
	Polyol A	475 mPa s (475 cP)	0.63	0.01	0.10	0.03	0.29
	Polyol B	6500 mPa s (6500 cP)	12.32	0.06	1.33	0.16	3.74

[A] S_r = within laboratory standard deviation of individual replicates.
[B] S_R = between laboratories standard deviation of means of replicates.
[C] r = within laboratory critical interval between individual replicates ($2.8 \times S_r$)—repeatability.
[D] R = between laboratory critical interval between means of replicates ($2.8 \times S_R$)—reproducibility.