Designation: D 4361 – 97 (Reapproved 2002)

Standard Test Method for Apparent Tack of Printing Inks and Vehicles by a Three-Roller Tackmeter[1]

This standard is issued under the fixed designation D 4361; 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 procedure for determining the apparent tack of printing inks using a mechanical or electronic model of a three-roller tackmeter.

1.2 This test method is applicable to paste-type printing inks and vehicles that are essentially nonvolatile under ordinary room conditions.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *tack*, *n*—a function of the force required to split a thin fluid film of a printing ink or vehicle between two rapidly separating surfaces; it is a rheological parameter indicative of internal cohesion of the fluid.

2.1.1.1 *Discussion*—Tack of a printing ink or vehicle is not a fixed number but varies with operating conditions, primarily separation velocity, splitting area, and film thickness. Tack also varies with changes in the rheological properties of the ink or vehicle due to time, temperature, and interactions with the separating surfaces. In practice, one or more of these surfaces usually consist of rubber-like rollers that differ in composition and geometry and whose properties tend to change with age, nature of previously run fluids, type of wash-up solvent, and mechanical flaws. On laboratory instruments, tack readings are also sensitive to the calibration and zero accuracy of the tackmeter employed.

2.1.2 *apparent tack*, *n*—a tack reading obtained at a specific set of conditions.

2.1.3 *flying*, *n*—the tendency of a printing ink or vehicle to be ejected as large globules from a roller distribution system.

2.1.3.1 *Discussion*—Flying is generally most severe during rapid roller acceleration such as occurs when switching immediately from zero or a slow speed to a high operating speed.

2.1.4 *misting*, *n*—the tendency of a printing ink or vehicle to be ejected as a fine aerosol from a roller distribution system.

2.1.4.1 *Discussion*—Misting is generally most severe at high operating speeds and with fluids that produce long filaments.

3. Summary of Test Method

3.1 A thin film of the test printing ink or vehicle is applied to the three-roller distribution system of the tackmeter, which operates at speeds comparable to those on production printing presses. Measurement of the frictional torque induced by drag forces in the splitting film provides an arbitrary value for apparent tack. On mechanical models, the torque is determined with a manually balanced lever arm, a direct-reading attachment, or a recorder; on electronic models, with a digital readout, recorder, or printer. Readings are in units of gram-meters (g-m).

3.2 The procedure in this test method is designed to give a single value for apparent tack at a specific set of instrument conditions. Typical conditions are as follows: a cooling water temperature of 90°F (32.2°C); a volume of 1.32 mL (film thickness 12.3 μm) of the test printing ink or vehicle applied to the rollers; an operating speed of 400 r/min for vehicles, 800 r/min for sheet-fed offset inks, and 1200 r/min for web-fed inks; and a reading after 1 min of operation. Alternative conditions may be used by agreement between the supplier and the customer.

3.3 Instructions are also given for calibration of the Inkometer and for minimizing effects of interactions among the rollers, test fluids, and wash-up solvents.

4. Significance and Use

4.1 Tack of printing inks controls their high-speed transfer properties, as manifested by throughput in roll milling, picking of paper during printing, and wet trapping in multicolor printing. Although an apparent tack measurement does not completely predict the transfer performance of an ink or a

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.56 on Printing Inks. Subcommittee D01.37 on Ink Vehicles assisted in the development of the vehicle portion of this test method.

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vehicle, it provides a meaningful parameter for quality control, development, and research.

4.2 A given tackmeter will produce repeatable results on a day-to-day basis only if proper attention is paid to calibration and maintenance procedures and to control of experimental variables referred to in 2.1.1.1.

4.3 Two or more instruments may not produce identical apparent tack readings, but if each gives repeatable results, they may be mathematically correlated.

NOTE 1—A number of three-roller tackmeters are available which differ in design features such as roller weight, geometry, and composition of the distribution system. It cannot be presumed that test results from these other types of tackmeters will either agree or correlate with those from the tackmeters specified in 6.1 and 6.2 of this test method.

5. Interferences

5.1 *Tackmeter Squeal*—A high pitched whine or squeal may be noted when running high tack fluids or at high rotating speeds, or both. Squeal may result in instability of the balance beam or direct reading attachment of mechanical models, or fluctuation of the digital readout of electronic models, making definite readings difficult.

6. Apparatus

6.1 *Three-Roller Tackmeter*—Models differ in available speeds and type of readout as follows:

6.1.1 *Mechanical Models*, operate three or four fixed speeds selected from among 400, 800, 1200, and 2000 r/min. A direct reading attachment or a recorder is recommended to supplement the manually operated balance beam.

6.1.2 *Electronic Models*, operate at variable speeds ranging from 100 to 2000 or 3000 r/min. A recorder or printer, or both, are recommended to supplement the digital readout.

NOTE 2—To convert to units of linear speed, multiply revolutions per minute by 0.785 to obtain feet per minute or by 0.004 to obtain metres per second.

6.2 *Tackmeter Rollers*, of suitable composition, preferably one set for each major system to be evaluated (see 10.3.1.) A set consists of a top (measuring) roller 3⅛ in. (79 mm) in diameter and 6⅛ in. (155 mm) in length, and a vibrator 2.0 in. (51 mm) in diameter and 7¼ in. (184 mm) in length. Together with the fixed brass roller, the total surface area of the distribution system is 166 in.^{2} (0.107 m^2). The measuring roller weighs 9.2 lb (4.2 kg) on mechanical models and 9.6 lb (4.4 kg) on electronic models.

6.3 *Ink Pipet*, consisting of a metal cylinder and a metal or TFE-fluorocarbon plunger. Suitable pipets include fixed-volume pipets, 1.32-mL capacity; and variable volume micropipets, 2-mL capacity, accurate to 0.01 mL.

6.4 *Stopwatch or Timer*, accurate to 1 s.

6.5 *Ink Knife*, small, free from nicks and rough edges.

6.6 *Manufacturer's Calibration Apparatus*, for the specific model tackmeter.

7. Reagents and Materials

7.1 *Wash-Up Solvent*, compatible with the test system, fast evaporating, and having minimal effect on the rollers; it should be acceptable environmentally. Hydrocarbon solvents with an initial boiling range of 250 to 350°F (120 to 177°C), a final boiling range of 300 to 400°F (150 to 205°C), a Kauri-Butanol value of 30 to 40 and less than 1 % benzene content are appropriate for many sheet-fed and heat-set systems. Specific solvents may be required for unique systems.

7.2 *Rags or Wipers*, clean, soft, absorbent, lint-free.

7.3 *Manufacturer's Current Manual*, for the specific model tackmeter.

8. Hazards

8.1 Never let an ink or a vehicle dry completely on the rollers of the tackmeter. (**Warning—**Never turn the ZERO button except during the calibration process (see 12.2.1)).

8.2 Take care not to damage the rollers during the cleaning process or by leaving them in contact when the instrument is not in use.

8.3 Do not disengage the balance beam of a mechanical model except when taking a reading.

9. Sampling and Test Specimen

9.1 Carefully select a sample that is free of skin and other contamination and representative of the lot being evaluated. A minimum of 3 to 4 mL is sufficient for two specimens. Transfer to a clean container, protect with skin paper, close, and seal.

9.2 When ready to make a run (see 12.3), fill the ink pipet as follows: Transfer 1.5 to 2 mL of sample to a clean glass plate; close and reseal the container. Gently work up with an ink knife but do not aerate. Fill the ink pipet with 1.32 mL of the worked sample (or with a smaller volume (0.5 to 1.0 mL) if a thinner film thickness is desired). Use the ink knife to force the specimen into the cylinder while slowly pulling back the ram. Wipe excess material off the top of the pipet.

NOTE 3—A specimen volume of 1.32 mL, divided by the roller surface area of 0.010 ft^2 (0.107 m^2), gives an initial film thickness of 12.3 μm when distributed uniformly on the roller system. However, the occurrence of appreciable flying or misting will result in loss of specimen from the rollers. Hence, operating film thickness is unknown.

10. Preparation and Conditioning of the Tackmeter

10.1 Locate the tackmeter on a sturdy bench in a draft-free temperature-controlled environment, preferably 73.5 ± 3.5°F (23 ± 2°C). Humidity control is necessary for test samples that are moisture-sensitive or prone to misting.

10.2 Set the water bath at 90.0 ± 0.2°F (32.2 ± 0.1°C). All tests are to be run at this temperature. (See also A1.3.)

10.3 Prior to use, ascertain the nature of the test sample for the following reasons:

10.3.1 *Roller conditioning*—Use only an instrument having rollers well broken in for the type of test system. The break-in procedure is given in A1.2. A separate set of broken-in rollers is mandatory for radiation curing systems. The necessity for separate sets of broken-in rollers, or for extensive reconditioning when switching among different types of conventional test systems shall be determined in each laboratory.

10.3.2 *Operating speed*—Vehicles are most commonly run at 400 r/min, alternatively at 800 r/min; sheet-fed inks at 800 r/min, alternatively at 400 or 1200 r/min; and web-fed inks at 1200 r/min, alternatively at 800 or 2000 r/min. (The conversion to linear speed is given in Note 2.)