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

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1. Scope*

1.1 This test method covers the procedure for determining the apparent tack of printing inks using a three-roller tackmeter.

1.2 This test method is applicable to all paste-type printing inks and vehicles that are essentially nonvolatile under ordinary room conditions, provided that any elastomer covered rollers in the tackmeter are resistant to attack by the particular ink or vehicle chemistry. Different elastomers may be required for different ink or vehicle chemistries.

1.3 This test method covers three-roller tackmeters of two different geometries, referred to as Geometry A and Geometry B.

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

1.5 *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*—function of the force required to split a thin fluid film of a printing ink or vehicle between two rapidly separating surfaces.

2.1.1.1 *Discussion*—Tack is a rheological parameter indicative of internal cohesion of the fluid. It is not a fixed number but varies with operating conditions, primarily separation velocity, splitting area, force applied by the measuring roller and film thickness. Tack also varies with changes in the rheological properties of the ink or vehicle as a result of time, temperature, and interactions with the separating surfaces. In practice, one or more of these surfaces usually consist of elastomer rollers that may 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. Tack readings are also sensitive to the calibration and zero accuracy of the tackmeter used. Different manufacturers' tackmeters may use different tack scales.

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

2.1.3 *flying*, *n*—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*—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 the roller trains of production printing presses. Measurement of the frictional torque induced by drag forces in the splitting film provides a value for apparent tack. Readings may vary from instrument supplier to instrument supplier and from geometry to geometry.

3.2 The procedures in this test method are 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 32°C; a film thickness of 12 μm of the test material applied to the rollers for Geometry A and 5 μm for Geometry B; and a reading after 1 min of operation. Different speeds are specified for different types of instruments. Alternative conditions may be used by agreement between the supplier and the customer.

3.3 Depending on the geometry and model, the torque is determined with a manually balanced lever arm, a direct-reading attachment, a digital readout, printer, computer or a recorder.

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

3.4 Instructions are also given for calibration of the tackmeter and 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 vehicle, it provides a meaningful parameter for quality control, development, and research.

4.2 A number of three-roller tackmeters are available that differ in design features such as roller weight, geometry, and composition of the distribution system. Instruments of different types do not give the same apparent tack readings.

4.3 Instruments of the same type will only give apparent tack readings within tolerance, provided that they are maintained and calibrated properly and in the same manner.

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 usually results in unstable readings or in unreliable/wrong values. If readings are taken where squeal occurs this has to be recorded in the report.

6. Apparatus

6.1 *Three Roller Tackmeters of Geometry A*:

6.1.1 Models differ in available speeds and type of readout as follows:

6.1.1.1 *Mechanical Models* operate with a number of fixed speeds of the central motor driven roller, selected from among 400, 800, 1200, and 2000 r/min or higher. A direct reading attachment or a recorder is recommended to supplement the manually operated balance beam.

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

6.1.2 *Tackmeter Rollers*, of suitable composition to be resistant to chemical attack by the particular ink or vehicle system being evaluated (see 10.3.1). A set consists of rollers having dimensions given in Table 1.

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

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

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

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

6.1.7 *Infrared Pyrometer or Internal Temperature Sensor*, to monitor tackmeter roller temperatures.

6.2 *Three Roller Tackmeters of Geometry B*:

6.2.1 Geometry B models differ in available speeds and types of readout as follows:

6.2.1.1 *Model 1* operates fixed speeds selected from among 50, 100, up to 450 m/min or more. A recorder, printer or PC is recommended to supplement the digital readout to plot the curve of the measurements.

6.2.1.2 *Model 2* operates at variable speeds ranging from 0 to 450 m/min or more. A computer with additional software, a printer or a recorder or all of these are recommended to supplement the digital readout.

6.2.2 *Tackmeter Rollers*, of suitable composition to be resistant to chemical attack by the particular ink or vehicle system being evaluated (see 10.3.1). A set consists of rollers having dimensions given in Table 1.

6.2.3 *Ink Pipet*, consisting of a metal cylinder and a plunger, 2-mL capacity, accurate to a minimum of 0.01 mL.

6.2.4 Same as 6.1.4-6.1.7.

TABLE 1 Key Features of Three-Roller Tackmeters

Feature	Geometry A[A]	Geometry B[A]
Dimensions of central motor driven roller		
diameter, mm	76	74.5
length, mm	154	142
Conversion factor		
m/min to rpm		4.3
rpm to m/min	0.24	
Dimensions of top (measuring) roller		
diameter, mm	79	50
length, mm	155	148
Dimensions of vibrator (oscillating) roller		
diameter, mm	51	40
length, mm	184	160
Surface area of distribution system,[B] m^2	0.107	0.073
Measuring roller mass,[C] kg		
mechanical models	4.2	
electronic models	4.4	1.6
Applied ink amount, mL	1.32	0.4
Film thickness,[C] µm	12.3	5

[A] Geometry A applies to Inkometers and Inkomats. Geometry B applies to Tackoscopes and Tack Testers

[B] Top roller and vibrator roller together with fixed central roller.

[C] Includes mounting system.

7. Reagents and Materials

7.1 *Wash-Up Solvent*, compatible with the test system, fast evaporating, and having minimal effect on the rollers. Hydrocarbon solvents with a boiling range of 100 to 140°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 **Warning—**Since solvents may be hazardous to the skin and eyes, wear rubber gloves and safety glasses during cleanup to avoid solvent contact with skin and eyes. In case of contact, wash skin with water; flush eyes for 15 min with water and call a physician. See supplier's Material Safety Data Sheet for further information on each solvent used.

8.2 Never turn the ZERO button except during the calibration process (see 12.1.2.1).

8.3 Never let an ink or a vehicle dry completely on the rollers of the tackmeter.

8.4 Take care not to damage the rollers during the cleaning process or by leaving them in contact when they are not rotating.

8.5 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 conduct the test (see 12.1.3), 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 shear the sample with an ink knife but do not aerate. For Geometry A, fill the ink pipet with 1.32 mL of the worked sample. For Geometry B, fill the pipette with 0.4 mL of the worked sample. Use the ink knife to force the specimen into the cylinder of the pipet while slowly pulling back the plunger. Wipe excess material off the top of the pipet.

NOTE 1—As seen in Table 1, the two volumes give initial ink film thicknesses of 12.3 µm and 5.0 µm respectively. However, the occurrence of appreciable flying or misting will result in loss of specimen from the rollers. Hence, operating film thickness may be 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 23 ± 2°C. Humidity control is necessary for test samples that are moisture-sensitive or prone to misting. In this case 50 ± 5 % RH is standard.

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

10.3 Before 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 energy 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*—See Table 2. Any different speed shall be recorded in the report.

TABLE 2 Typical Operating Speeds for Various Materials

	Geometry A		Geometry B	
	r/min	m/min	m/min	r/min
Vehicles	400	96	100	430
Sheet-fed inks	800	192	200	860
Web-fed inks	1200	288	300	1290

10.4 Before the first use of the day, equilibrate the tackmeter as follows:

10.4.1 Warm up the instrument by activating the water-cooling system. Place all the rollers in contact and run at the lowest available speed for about 30 min.

10.4.2 Make a conditioning run with a specimen representative of the system to be evaluated. For Geometry A, apply 1 to 1.5 mL of the test material. For Geometry B, apply 0.4 mL of the material. Run for 5 to 10 min at the specified test speed (see Table 2). Clean up as directed in Section 13.

11. Calibration of the Tackmeter

11.1 Calibrate the tackmeter before initial use, after change of rollers and periodically as needed. First, conduct the necessary steps in 10.3 and 10.4.

11.2 Using the manufacturer's calibration apparatus, follow the directions in the instrument manual.

11.2.1 *Mechanical Models of Geometry A*—Zero and calibrate the balance beam (and direct reading attachment or recorder, if they are to be used) at the test speed specified in Table 2.

11.2.2 *Electronic Models of Geometry A*—Zero and calibrate the digital readout (and recorder, if it is to be used) at 1000 r/min. When calibration is completed, check the dry reading at the specified test speed (see Table 2).

NOTE 2—Some three-roller tackmeters can be calibrated at only one speed, therefore recalibration is required if a different speed is to be used than the calibrated one.

11.2.3 After each calibration or at regular periods, conduct a test run with a standard ink or vehicle. (See A1.5.)

12. Procedure for Tack Evaluation

12.1 *Geometry A*:

12.1.1 If necessary, make preparations as in Section 10 and calibrate as in Section 11. If using an electronic model, make sure the motor is preset to the test speed specified in Table 2 and the drive is in the LOW mode.

12.1.2 Engage the rollers and run at the specified test speed. If the dry reading differs from zero by more than ±0.5 tack units, reclean the rollers in accordance with 13.1 or recalibrate in accordance with Section 11. Note that recalibration of a not perfectly clean roller system will result in bad readings.

12.1.2.1 The dry reading on a properly calibrated instrument is directly related to the condition of the top (measuring) roller; therefore, large deviations from zero are suspect. Usual causes are inadequate cleaning, residual sample or wash-up solvent, or mechanical damage. Do not turn the ZERO button, as doing so will shift the scale. Do not attempt to compensate by subtracting the dry reading from the test reading. Always reclean or recalibrate. Should large deviations from zero persist, contact the manufacturer about the possibility of serious mechanical damage.

12.1.3 Disengage the rollers and fill the pipet as in 9.2. Transfer its contents to the vibrator (oscillating) roller in a series of thin ribbons around the middle 125 mm of the roller. Wipe any specimen remaining in the pipet onto a clean place on the same roller. Reengage the rollers.

12.1.4 Distribute the specimen on the rollers and start the run as follows:

12.1.4.1 *Mechanical Models with Electronic Transmission*: