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# Standard Test Method for Non-Lint Content of Cotton[1]

This standard is issued under the fixed designation D 2812; 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 non-lint content of cotton using the Shirley Analyzer. The cotton may be in the form of (*1*) raw stock, that is, cotton fiber that has been separated from the seed by ginning; (*2*) partially processed cotton, such as picker lap or sliver; or (*3*) ginning or processing waste, such as obtained from ginning, opening and cleaning, picking, carding, or combing machines.

1.2 This test method is especially adapted for determining non-lint content of cotton by use of the Shirley Analyser.

1.3 The values stated in SI 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.* For specific hazard statements, see Section 7.

## 2. Referenced Documents

2.1 *ASTM Standards:*

D 123 Terminology Relating to Textiles Materials[2]

D 1441 Practice for Sampling Cotton Fibers for Testing[2]

## 3. Terminology

3.1 *Definitions*—For definitions of textile terms used in this test method, refer to Terminology D 123.

3.1.1 *foreign matter, n—in cotton,* non-lint material commonly referred to as waste or trash such as dust, sand, seed-coat fragments, leaves, and stems normally present in raw and partially processed cotton.

3.1.2 *invisible waste, n—in cotton testing,* weight loss due to dust, moisture, loose fibers, etc., carried away by the air stream during the test.

3.1.3 *lint, n—in loose cotton,* fibers mostly of spinnable length.

3.1.4 *lint content, n*—that portion of a mass of cotton fiber consisting of fiber, including normal moisture content, but excluding foreign matter.

3.1.5 *non-lint content, n*—that portion of a mass of cotton fiber which is essentially foreign matter.

3.1.6 *visible waste, n—in cotton testing,* foreign matter deposited in the waste boxes of the machine during the test.

**TABLE 1 Confidence Limits in Percentage Points at the 95 % Probability Level**

| Number of Specimens | Confidence Limits Shirley Analyzer |
|---|---|
| 2 | ± 0.7 |
| 3 | ± 0.5 |
| 9 | ± 0.3 |

## 4. Summary of Test Method

4.1 A known mass of raw cotton, partially processed cotton, or waste is fed into the machine. The machine, operating on mechanical-pneumatic principles, separates the foreign matter from the cotton and discharges the non-lint particles and lint into separate chambers.

4.2 The amounts of lint and non-lint recovered are calculated as a percentage of the original specimen mass.

## 5. Significance and Use

5.1 This test method for testing cotton for non-lint content is considered satisfactory for acceptance testing of commercial shipments since it is the best available procedure for obtaining objective data.

5.1.1 In case of a dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using Student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before the testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results with consideration to the known bias.

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.11 on Cotton and Fibers.

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[2] *Annual Book of ASTM Standards,* Vol 07.01.

5.2 This test method gives data on the non-lint content of raw cotton which can be used as a basis for: (*1*) estimating the net amount of manufactured textile product obtainable from raw cotton; (*2*) predicting the quality of cotton textile products, particularly their aesthetic properties; (*3*) assembling and blending bales in a mix on a non-lint content basis; (*4*) adjusting ginning and textile processing machines for maximum efficiency in cleaning lint; and (*5*) relating non-lint content of cotton to end-product quality and processing efficiency.

## 6. Apparatus

6.1 *Testing Instrument*—Shirley Analyzer,[3] commercially available non-lint testing machine operating on mechanical-pneumatic principles, described in Annex A1.

6.2 *Laboratory Balance*, with a capacity of 200 g, a sensitivity of 0.01 g, and a pan large enough to weigh a 100-g specimen of cotton.

## 7. Hazards

7.1 Use care in running the specimen through the machine. Spread the specimen uniformly on the feed plate so that fingers do not have to come into contact with the feed roll.

7.2 In conducting tests, the machine should be completely stopped before cleaning any clumps of fiber or trash which have adhered to the upper parts of the delivery box or trash tray.

## 8. Sampling, Selection, and Number of Specimens

8.1 *Lot Sample*—For acceptance testing, take as directed in Practice D 1441.

8.2 *Laboratory Sample*:

8.2.1 *Unprocessed or Processed Cotton*—Take the laboratory sample and the test specimen as directed in Practice D 1441. Do not blend the laboratory sample. Handle it in such a way as to prevent loss of foreign matter. Take a laboratory sample large enough to provide two 100 ± 5-g test specimens.

8.2.2 *Ginning or Processing Waste*—Take as a laboratory sample all the waste accumulated during the test run which should last long enough to provide one specimen weighing not less than 45 g (1 lb).[4]

8.3 *Test Specimens*—Test two 100 ± 5-g specimens from each laboratory sampling unit.

## 9. Preparation of Specimens

9.1 No special preparation is required, but handle the laboratory sample and the specimens carefully, particularly specimens accumulated from ginning and processing waste products to avoid any loss of leaf, dust, or other foreign matter.

## 10. Conditioning

10.1 Do not precondition the test specimens.

10.2 Bring the laboratory sample from the prevailing atmosphere to approximate moisture equilibrium with the air of the room in which the test will be performed by exposing the samples at least 24 h.

NOTE 1—Changes in relative humidity during the test will seriously affect test results. Although tests may be made in the standard atmosphere for testing textiles as defined in Terminology D 123, studies have shown that the most efficient separation of lint and foreign matter occurs at a relative humidity of 60 % or less.[4] Temperature variations up to ± 1.1°C (2°F) or variations up to ± 2 % relative humidity during the conditioning period do not introduce any significant errors, but atmospheric conditions should be constant between the times of weighing the specimen and weighing the clean lint or waste, or both.

## 11. Procedure

11.1 Clean the delivery box, trash tray, and settling chamber. If the machine has not been operated previously during the day, start the motor and run the machine for 2 to 3 min with the clutch disengaged and the feed roller inoperative.

11.2 Weigh the specimen (see 8.2.1 and 8.2.2) to the nearest 0.1 g. Record the mass, *W*.

11.3 *Placement of the Specimen on the Feed Table*:

11.3.1 For testing raw cotton or picker laps, arrange about one third of the specimen in a uniform layer of small tufts on the feed table, tearing apart hard lumps where necessary.

11.3.2 For testing slivers, spread short lengths on the feed table perpendicular to the feed roller.

11.3.3 For testing ginning and processing waste, arrange about one fourth of the specimen uniformly on the feed table.

11.4 Open the air control valve, engage the feed roller clutch and start feeding the specimen through the machine. Observe the character of the trash as it begins to fall into the tray. Only small amounts of unopened lint should be falling with the trash during the first passage. If there are hard tufts in the specimen, it may be necessary to tighten the loading springs on the feed rollers.

11.5 As the specimen is fed into the machine, continue placing portions of it on the feed table to maintain a uniform feed rate until the whole specimen has been processed as indicated by the absence of fibers under the streamer plate.

11.6 When all of the specimen has passed under the feed roller, collect all lint-bearing trash from the settling chamber and trash tray. Spread it over a small central area of the feed plate and pass it through the analyser.

11.7 Disengage the clutch and close the air control valve momentarily to allow the cleaned lint to be collected from the delivery box.

11.8 Pass the cleaned lint through the machine a second time.

11.9 Remove the lint-bearing trash from the settling chamber and trash tray and pass it through the machine again.

11.10 Disengage the feed roller clutch and close the valve momentarily and remove the cleaned lint from the delivery box. Weigh it to the nearest 0.1 g. This is the mass of the lint, *L*.

11.11 Collect the trash from the trash tray, taking care to recover all of the fine particles of trash from the walls of the settling chamber and the surface of the feed table. Weigh the

[3] The Shirley Analyser may be purchased from Platt, Saco, Lowell, Inc., P.O. Box 2327, Greenville, SC 29602.

[4] Cotton Branch, PMA, U.S. Dept. of Agriculture, "Effect of Atmospheric Conditions on Processing and Testing of Carded Cotton Yarn," Washington, DC, July, 1953.

trash to the nearest 0.1 g. This is the mass of the visible waste, *V*.

## 12. Calculation

12.1 Calculate to the nearest 0.10 % the lint content, visible waste, invisible waste, and total non-lint content using Eq 1-4.

$$\text{Lint content, \%} = (L/W) \times 100 \quad (1)$$

$$\text{Visible waste, \%} = (V/W) \times 100 \quad (2)$$

$$\text{Invisible waste, \%} = [(W - (V + L))/W] \times 100 \quad (3)$$

$$\text{Total non-lint content, \%} = 100 - \text{lint content, \%} \quad (4)$$

where:

$W$ = mass of specimen, 11.2 or 12.1,
$L$ = mass of lint recovered, 11.10, 12.2.3 or 12.3.4, and
$V$ = mass of visible waste, 11.11.

## 13. Report

13.1 State that the tests were made as directed in this test method. Describe the material or product sampled and the method of sampling.

13.2 Report the following information:

13.2.1 Lint content, and visible and invisible waste, each.

13.2.2 Temperature and relative humidity prevailing during the test.

## 14. Precision and Bias

14.1 *Interlaboratory Test Data*[5]—An interlaboratory test with the Shirley Analyser was run in 1974 in which nine laboratories each tested five specimens from a low and a high foreign matter bale of lint cotton. All 45 specimens for low and for high foreign matter content came from as nearly the same portion of each bale as possible. The components of variance for the foreign matter content results expressed as standard deviation were calculated to be as follows:

| | |
|---|---|
| *For Low Foreign Matter Cotton:* | |
| Within-laboratory component | 0.179 % |
| Between-laboratory component | 0.273 % |
| *For High Foreign Matter Cotton:* | |
| Within-laboratory component | 0.329 % |
| Between-laboratory component | 0.706 % |

14.2 *Precision*—For the components of variance reported in 14.1, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the critical differences listed in Table 2.

14.3 *Bias*—The procedure in this test method for measuring the non-lint content of cotton has no bias because the value of that property can be defined only in terms of this test method.

## 15. Keywords

15.1 content; cotton; non-lint

**TABLE 2 Critical Differences, Foreign Matter (Total Visible and Invisible Loss), %, for the Condition Noted[A]**

| Number of Observations in Each Average | Within Laboratories | Between Laboratories |
|---|---|---|
| *Low foreign matter:* | | |
| 1 | 0.50 | 0.91 |
| 2 | 0.35 | 0.84 |
| 3 | 0.29 | 0.81 |
| 4 | 0.25 | 0.80 |
| 5 | 0.22 | 0.79 |
| *High foreign matter:* | | |
| 1 | 0.91 | 2.16 |
| 2 | 0.64 | 2.06 |
| 3 | 0.53 | 2.03 |
| 4 | 0.46 | 2.01 |
| 5 | 0.41 | 2.00 |

[A] The critical differences were calculated using $t = 1.96$, which is based on infinite degrees of freedom.

[5] Supporting data have been filed at ASTM Headquarters and may be obtained by requesting RR: D13-1043.

# ANNEX

**(Mandatory Information)**

## A1. INSTRUCTIONS FOR ADJUSTMENT AND MAINTENANCE OF THE SHIRLEY ANALYSER

A1.1 A schematic diagram is shown in Fig. A1.1.

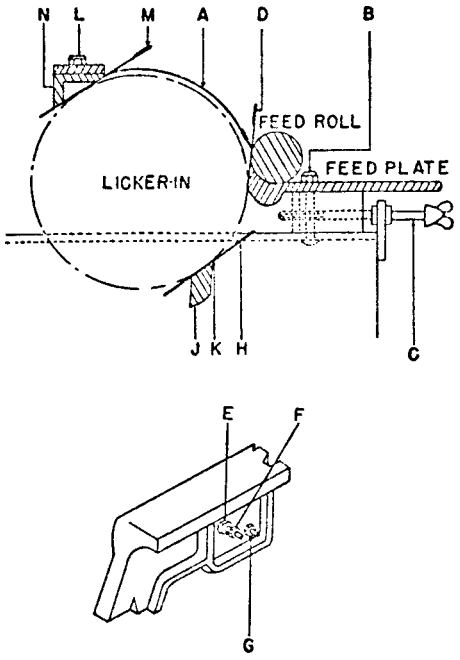
A1.2 *Speeds of Various Parts:*

| Part | r/min |
|---|---|
| Licker-in cylinder | 900 |
| Feed roll | 0.9 |
| Cage | 80 |
| Fan | 1500 |
| Motor | 1400 (approximate) |

A1.3 *Settings of Various Parts:*

| Part | mm | in. |
|---|---|---|
| Feed plate to licker-in | 0.1 | 0.004 |
| Streamer plate (lead-in edge) to licker-in | 0.1 | 0.004 |
| Streamer plate (lead-off edge) to licker-in | 0.2 | 0.007 |
| Stripping knife (bottom edge) to licker-in | 0.1 | 0.004 |
| Stripping knife (bottom edge) to cage | 7.9 | 5/16 |
| Licker-in to cage | 5.6 | 7/32 |
| Separation Sheet (top edge) to cage | 6.4 | 1/4 |
| Separation sheet (top edge) to licker-in | 14.3 | 9/16 |
| Delivery plate to cage | 1.6 | 1/16 |

A1.4 *Adjustments (Fig. A1.1):*




A—Cover
B—Nuts
C—Adjusting screw
D—Feeler gage, 0.1 mm (0.004 in.)
E—Bush nuts
F and G—Securing nuts
H—Feeler gage, 0.2 mm (0.006-in.)
J—Streamer plate
K—Lead-in edge
L—Nuts
M—Feeler gage, 0.1 mm (0.004-in.)
N—Knife

**FIG. A1.1 Schematic Diagram of Shirley Analyser**

A1.4.1 *Feed Plate*—Remove cover, *A*, and loosen nuts, *B*, at each end of the feed plate. Then, by means of adjusting screw, *C*, move the plate up to a 0.1-mm (0.004-in.) feeler gage, inserted as at *D*, across the full width of the machine, while revolving the licker-in slowly by hand. Tighten nuts, *B*. Two feed plates, differing in length of striking face, are normally supplied with each Shirley Analyser. The feed plate with the longer face is used with cotton 32 mm (1¼ in.) or longer in staple length; the other feed plate with the shorter face is used with cotton shorter than 32 mm (1¼ in.) in staple length. For cotton wastes use the same settings for both feed plates.

A1.4.2 *Streamer Plate*—Loosen brush nuts, *E*, and secure nuts, *F* and *G*, on each side of the machine. Insert a 0.2-mm (0.006-in.) feeler gage as at *H*, and bring streamer plate, *J*, up to the gage across the full width of the machine. Tighten *E* on both sides of the machine, remove the gage, and allow the streamer plate to swivel to a 0.1-mm (0.004-in.) gage placed between the licker-in and the lead-in edge, *K*. Tighten *F* and *G* on both sides of the machine.

A1.4.3 *Stripper Knife*—Remove cover, *A*, and loosen nuts, *L*, slightly. Insert at *M* a 0.1-mm (0.004-in.) gage along the full width. Press or tap screws, *L*, toward the licker-in until the knife, *N*, is just in contact with the gage. Tighten nuts, *L*, securely.

A1.4.4 *Fan Exhaust*—The fan is provided with an outlet, arranged to discharge the dust-laden air into a dust-filter bag. The machine will not function efficiently if the fan blows directly to the outside atmosphere or to a mill-dust chamber, whereby the pneumatic system in the machine would be subject to the effects of variable backdrafts.

A1.5 *General:*

A1.5.1 *Greasing and Oiling*—Avoid excessive greasing and oiling in regions where working surfaces might be contaminated. Keep the fluted surface of the roller which makes contact with the test specimen free from grease or oil. Also keep the cage surface free from grease or oil.

A1.5.2 *Motor*—Do not run the driving motor supplied with the machine continuously for longer than ½ h, which is the rating period.

A1.5.3 *Cleaning*—Keep all the working parts of the machine smooth and clean to give correct performance. Maintain the working face of the streamer plate brightly polished and free from burrs. Do not allow the outside surface of the cage to become dirty and lose its bright polish. Clean the inside of the cage occasionally and remove any accumulations of dust and waxy matter. Clean the choke valve on the fan occasionally. Remove the whole outlet unit from the fan housing to do this. It should always be sufficiently clean to allow the lever

operating the valve to be moved freely to either extreme of the scale.

A1.5.4 *Damage to Working Parts*—The machine will not function efficiently if certain working parts are damaged even to the slightest extent. The main components that must retain their smoothness and freedom from burrs are as follows:

A1.5.4.1 Striking face of the feed plate,

A1.5.4.2 Lead-in and lead-off edge and outer working face of the streamer plate,

A1.5.4.3 Lower edge and working face (facing the cage) of the stripping knife, and

A1.5.4.4 Outer surface of the cage.