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DRAFT NO. \_\_\_\_\_ 02 \_\_\_\_\_

DATE \_\_\_\_\_ May 16, 2024 \_\_\_\_\_

WORKING GROUP  
CHAIR \_\_\_\_\_ Dave Carlson \_\_\_\_\_

SUBJECT  
CATEGORY \_\_\_\_\_ Fiberboard Shipping \_\_\_\_\_

RELATED  
METHODS \_\_\_\_\_ See "Additional Information" \_\_\_\_\_

**CAUTION:**

This Test Method may include safety precautions which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

## **Determination of containerboard roll hardness**

*(Five-year review of Official Method T 834 om-18: Approval of T834 Draft 2)*

*(Underscores, strikethroughs, and notes indicate changes from Draft 1)*

### **1. Scope**

This test method describes a procedure to determine the uniformity in relative hardness of rolls of containerboard. Since several devices are currently available that use significantly differing technologies to determine hardness, this method only addresses the actual measurement process and not the test equipment specifically.

### **2. Significance**

2.1 This method provides a means to determine the uniformity of roll hardness.

2.2 Variation in roll hardness can be the result of excessive moisture, basis weight, or thickness variation as well as an indication of winder problems.

2.3 Non-uniform roll hardness can result in serious converting problems which, without the aid of hardness measurements, can be very difficult to troubleshoot.

2.4 Although low values can be a concern, it is typically the variation in hardness across a given roll that relates most directly to such converting issues with soft edges being perhaps the biggest contributor.

### 3. Safety

While hardness testers are relatively safe, it is recommended never to discharge the device directly against any part of the body.

### 4. Apparatus

4.1 Multiple devices are currently available that will provide comparable readings.

4.2 As the most widely used and most heavily referenced apparatus, the Type L Schmidt Hammer is the primary reference device. In order to avoid ambiguity and until such time as the use of the Schmidt Hammer **diminishes**, where possible, all such measurements should be referenced to and reported as Schmidt Hardness values.

### 5. Calibration and maintenance

5.1 Calibration and maintenance are unique to the specific test apparatus in use. Reference manufacturer documentation for further guidance.

5.2 Regardless of measurement apparatus, calibrate the hardness tester regularly through the use of a known calibration standard.

5.2.1 Prior to each use or once a week, whichever is less frequent, place the measurement device on the calibration standard.

5.2.2 Take ten readings in a row on the reference calibration standard.

5.2.3 Record the average of the ten readings.

5.2.4 If the average readings vary from the equipment manufacturer's specifications, **service and recalibrate the device** until **they** meet such requirements.

### 6. Sampling

6.1 Sample, test, and accept or reject individual reels or rolls according to one of the following methods:

6.1.1 Sample reels at the mill after the **winder reel is formed** to determine paper uniformity and to troubleshoot paper machine operations before **individual rolls are made on the winder rewinding**.

Note 1; To harmonize nomenclature between mills and converting plants, the following definitions are stated:

- The machinery that creates a reel (sometimes called a “Parent Roll”) after delivery of the web from the paper machine (generally from the calendar stack) does not have a formal name.
- The piece of machinery that cuts the reel into the rolls of containerboard that are used in our industry’s box plants is called a “Winder”.
- The third piece of machinery, a “Rewinder”, could be found in a paper mill to salvage quarantined rolls from the Winder by removing a defective section or to cut to rolls to a smaller width, or may be found in converting plants that convert rolls into usable sizes for making smaller items.

6.1.2 **Sample Inspect** ~~rewound~~ individual rolls at the mills to monitor ~~rewinder~~ **winder** performance and roll quality.

6.1.3 Sample rolls upon arrival at the converting operation to identify issues such as if excessive drying of the edges has occurred during transport.

6.1.4 The most widely used sampling and measurement method **at the converting operation** occurs after the bands and **any** outer or **damaged** wraps have been removed, and the rolls have been mounted in the converting operation.

6.2 Note also that hardness values can change as rolls age or are wound or unwound. When troubleshooting specific issues sample the rolls at various intervals as they are built or consumed based on the problem under investigation.

## 7. Conditioning

Perform this test in an operating environment on unconditioned samples.

## 8. Procedure

8.1 Place the measurement device solidly against the roll, perpendicular to the roll surface and parallel to the ground.

8.2 Begin the measurement process no less than 2.5 cm (about 1 in.) but no more than 7.5 cm (about 3 in.) in from the edge of the roll.

8.3 Repeat measurements approximately every 15 cm (6 in.) across the roll in the CD direction.

8.4 Record individual readings by position.

## 9. Calculation

9.1 Calculate the average or mean of all readings.

9.2 Determine the maximum variation (highest reading minus the lowest reading).

## 10. Report

Report the mean value and variation of each roll evaluated in Schmidt Hardness units.

## 11. Precision

11.1 The following estimates of repeatability and reproducibility are based on results from a study conducted in 2002. The precision estimates below are based on a single roll of linerboard that was transported to multiple locations and tested at each location with different instruments and by multiple operators.

Repeatability (within a lab) = 9 %

Reproducibility (between laboratories) = 26 %

11.2 The study used to estimate the precision involved a single roll of linerboard transported to 4 different locations and tested at each location with 2 different instruments. At each location three operators conducted independent measurements with both of the instruments. The instruments used at each location were the Schmidt Hammer and the Parotester. Due to the nature of the testing, the number of results gathered from each location was larger than the number of results meeting reproducibility conditions. The repeatability was calculated using this large number of results from each location while the reproducibility was calculated from the smaller number of results. The precision estimates are greatly dependent on the instrument used. Users should use caution when applying these estimates to each application. Each of the 24 results gathered involved 5 determinations on the sample roll.

### Precision Results 1

Sample Mean	Repeatability (r)	Repeatability % (%r)	Reproducibility (R)	Reproducibility % (%R)	Instrument
52.9	6.2	11.7%			Schmidt Hammer

738	41.9	5.7%			Parotester 2
48.5			22	46%	Schmidt Hammer
738			42	6%	Parotester 2

Repeatability and reproducibility are estimates of the maximum difference (at 95%) which should be expected when comparing test results for materials similar to those described above under similar test conditions. These estimates may not be valid for different materials or testing conditions.

## 12. Keywords

Wound rolls, Hardness, Hammers, Container boards

## 13. Additional Information

13.1 Effective date of issue: To Be Assigned

13.2 This method was formerly TAPPI UM 402 “Roll Hardness Using the Concrete Test Hammer.”

13.3 Changes in the 2007 edition included replacing “grammage” with “basis weight” as grammage is metric and basis weight is generic. Metric equivalents were also changed to general ranges more appropriate to their usage. The 2012 edition added a complete precision statement, a safety precaution statement, and minor editorial changes. The 2023 edition corrects a “comma” typo in 4.2, removes a superfluous “underline” in 5.4.2, corrects inaccurate nomenclature regarding creating individual rolls of containerboard in 6.1.1 and 6.1.2, housekeeping changes to 5.2.4, 6.1.2, and updates 13.3

*Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department.*

