InterNational Committee for Information Technology Standards (INCITS)
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Document Date:	02/06/2024
To:	INCITS Members
Reply To:	Kim Quigley
Subject:	Public Review and Comments Register for the Approval of:
	INCITS 322-202x: Information Technology - Card Durability Test Methods
Due Date:	**The public review is from February 23, 2024 to April 23, 2024.**

Action: The InterNational Committee for Information Technology Standards (INCITS) announces that the subject-referenced document(s) is being circulated for a 60-day public review and comment period. Comments received during this period will be considered and answered. Commenters who have objections/suggestions to this document should so indicate and include their reasons.

All comments should be forwarded not later than the date noted above to the following address:

INCITS Secretariat/ITI
700 K Street NW - Suite 600
Washington DC 20001
Email: comments@standards.incits.org (preferred)

This public review also serves as a call for patents and any other pertinent issues (copyrights, trademarks). Correspondence regarding intellectual property rights may be emailed to the INCITS Secretariat at patents@itic.org.

American National Standards
For Information Technology -

INCITS 322: 2023, Card Durability Test Methods (INCITS 322 Working Draft)

Version 7 SEP 2023 for letter ballot to go to public review

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Foreword

This standard provides an agreed upon set of set of test methods which contain specific procedures to be followed. The acceptance or rejection criteria of identification cards, based on test results from these durability test methods, are not within the scope of work of this standard.

The precision and bias of test results obtained from a given test method are influenced by a host of variables. The major sources of this variation are contributed by test method, test design, operator, measurement technique, equipment, calibration, environment and materials variation. Round robin test results from many of the test methods are available upon request.

The test method development has attempted to minimize the variation that the test methods might contribute. The test design should consider randomization of test materials, replication and the skillful grouping of test materials. Each operator must be diligent in the use of good testing practices in order to minimize the contributions of the operator to the test variability.

Durability of the card is not established in this standard. Recommended durability categories and requirements are established in the INCTS 440 companion document, final card durability requirements are based on a mutual agreement between the card issuer and the supplier.

INCITS ID Cards Test Methods Task Group on Card Durability Test Methods has established the following process steps for generating this standard:

Step 1: Identify existing ID card durability problems experienced in field performance.

Step 2: Identify potential test methods that relate to the durability concern.

Step 3: Select a team leader, with other experts, to coordinate proposed test methods in given categories (i.e. abrasion resistance, Peel Strength, and adhesion).

Step 4: Presentation of a new Test Method for consideration.

Step 5: Task Group discussion of the proposal. Determination of whether it 'fits' within the Scope of Work.

Step 6: Proposal is given 'Pending Status' for determination at the next meeting. At the next meeting the proposal is either 'Accepted in Principal' or rejected. If accepted, the proposal is incorporated into the working paper for further discussion and possible modification at succeeding meetings.

Step 7: Testing is conducted and results reported to 'validate' the test technique and/or to resolve technical issues.

Step 8: The Test Method status becomes 'Accepted for Publication' after all issues have been resolved.

These test methods may suggest use of materials or test equipment, which are trade-names of a product supplied by a specific manufacturer. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

American National Standard
for Information Technology -

Card Durability Test Methods

1 SCOPE

This American National Standard describes Test Methods for the evaluation of Identification (ID) card durability. An ID card is defined as a card identifying its holder and issuer which may carry data required as input for the intended use of the card.

These test methods are to be used by card issuers, card manufacturers and card component suppliers to make comparisons of ID card performance. These test methods do not imply a specific correlation to end use field performance or a given card service life. However, these test methods may be useful for ranking or comparing the relative durability of ID cards.

Results obtained by use of these test methods should not be represented as equivalent to field use performance or an absolute index of ultimate card service unless a degree of quantitative correlation has been established for the ID card material construction in question.

These test methods do not possess and do not constitute requirements for ID cards in general. The reader is referred to specific application standards for performance requirements and acceptance criteria (INCITS 440). It is the responsibility of card issuers and their suppliers to decide which attributes are required for card performance in a given card application and to mutually agree which test methods may be appropriate to assess card performance.

These test methods may involve the use of hazardous materials, operations and equipment. This standard does not purport to address all safety problems 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 local and federal regulatory limitations prior to use.

2 NORMATIVE REFERENCES

The following references constitute provisions of this American National Standard on Test Methods. At the time of publication, the editions indicated were valid. All references are subject to revision and interested parties are encouraged to access the impact of updated revisions.

Copies of the following documents can be obtained from ANSI: Approved ANSI standards, approved and draft international standards (ISO, IEC, CEN/CENELEC), and approved foreign standards (including BSI, JIS and DIN). For further information, contact ANSI Customer Service Department at 212-642-4900 (phone), 212-302-1286 (fax) or via the World Wide Web at http:/www.ansi.org.

Document	**Title**
ANSI/INCITS 182	*Guideline for Barcode Print Quality*[1]
ANSI/ISO/IEC 7810	*Identification cards - Physical characteristics*[1]
ANSI/ISO/IEC 7811-1	*Identification cards - Recording Technique - Part 1: Embossing*[1]
ANSI/ISO/IEC 7811-2	*Identification cards - Recording Technique - Part 2: Magnetic Stripe*[1]

[1] Available from American National Standard Institute

Document	Title
ANSI/ISO/IEC 7811-6	*Identification cards – Recording Technique – Part 6: High Coercivity*[1]
ANSI/ISO/IEC 10373-1	*Identification cards - Test Methods Part 1: General Characteristics*[1]
ANSI/ISO/IEC 10373-2	*Identification cards - Test Methods Part 2: Cards with magnetic stripes*[1]
ASTM G154	*Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials*[2]
ASTM D4329	*Standard Practice for Fluorescent UV Exposure of Plastics*[2]
ASTM C778	*Standard Specification for Standard Sand*[2]
ISO/CIE 11664-4	*Colorimetry -- Part 4: CIE 1976 L* a* b* Colour Space*
ISO/CIE 11664-6	*Colorimetry -- Part 6: CIE DE 2000 Colour-difference formula*
ISO 3274	*Geometrical Product Specifications (GPS) - Surface texture: Profile method - Nominal characteristics of contact (stylus) Instruments* [1]
ISO 4892-2	*Plastics - Method of exposure to laboratory light sources - Part 2 – Xenon-arc lamps*[1]
ISO/IEC 15416	*Information technology -- Automatic identification and data capture techniques -- Bar code print quality test specification -- Linear symbols*[1]

3 DEFAULT TEST CONDITIONS and TOLERANCES

Unless otherwise specified, the environment for the test specified within this Test Method Standard shall be 23°C ± 3°C (73°F ± 5°F) and 40% to 60% relative humidity. Condition test cards at the designated temperature and humidity for a period of 24 hours before testing.

Cards shall be free of any contamination that could affect test results. Examples include, but are not limited to finger oils, rubber band residue and particles from card processing.

Unless otherwise specified, a default tolerance of ± 5% shall be applied to the quantity values given to specify the characteristics of the test equipment (e.g. linear dimensions) and the test method procedures (e.g. test equipment adjustment).

[1] Available from American National Standard Institute
[2] Available from ASTM
[3] Available from CIE Central Bureau, Babenbergerstraße

4 DEFINITIONS

4.1 Overlay film (a.k.a. - laminating film): A film (typically clear) used to make the outer surfaces of cards.

4.2 Heat transfer film (a.k.a. - heat transfer foil): A thin resinous layer transferred from a carrier (typically polyester) by thermal means.

4.3 Flexure: The cyclical bending of the card.

4.4 Core film layers: Internal structural layers which constitute the core stock.

4.5 ID-1 Card: The size of a card specified in ANSI/ISO/IEC 7810.

4.6 Card structure: The composite of all the components of any identification card including but not limited to:

plastic polymers
adhesives
inks and coatings
dye diffusion thermal transfer media
recording media (magnetic, IC, optical etc.)
security feature components
protective foils
laminates

4.7 Degradation: Unfavorable loss of card properties including, but not limited to fading, discoloration and breakdown of physical properties.

4.8 Card printed information: Constitutes both fixed print graphics/text (typically by a printing ink process) and variable imaging graphics/text (typically by dye diffusion, resin thermal transfer technology, ink jet, etc.).

4.9 Card orientation: The two orientations of the card shall be referred to as Axis A and Axis B as shown in Figure 11.

4.10 Card fracture: A crack or break in the card where the depth appears to be at least 1/3 of the card thickness.

4.11 Tear: A split in something caused by it having been pulled apart forcefully.

4.12 Crack: A line on the card surface along which it has split without breaking into separate parts

4.13 Special Feature: An area on the card, typically a security feature, that may have a peel strength value that is lower than the adjacent areas.

5 TEST METHODS

5.1 Peel Strength - 90° peel angle

5.1.1 Significance and Use

This test method can be used to determine the bond strength between layers of a card. Bond strength between card layers is a function of fabrication process conditions and construction materials.

5.1.2 Apparatus

Sharp cutting instrument
Pressure sensitive adhesive filament (fiber reinforced) tape or suitable clamp
Tensile tester with suitable chart recorder or equivalent
Gripping device
Stabilizing plate (flat rigid plate): 51,0 mm x 86,0 mm x 3,2 mm thick - (2.0 in x 3.375 in x 0.125 in thick)
Double-sided pressure sensitive adhesive tape
Film thickness gauge 0,01 mm (0.0005 in) resolution

5.1.3 Procedure

Horizontally along the card, cut or score through the layer of the card into 10 mm (0.4 in) wide test strips. The number fo strips can be up to 4 as shown in Figure 1, or located anywhere on the card surface. Where possible, choose a section with ink coverage or other areas of potentially weak bond strength. Measure the test strip width to 0,1 mm (0.004 inch) accuracy.

If initial separation of layers is not possible, the peel test shall be attempted from the opposite direction. If separation is not possible from both directions, report the result as inability to separate layers.

Notes:
1. It is acceptable to construct the test card with the means to easily prepare the test card for the peel strength test. Caution should be taken to make sure the preparation does not affect the peel results.
2. The number of 10 mm (0.4 in) test strips can be up to four and located anywhere on the card surface.
3. The adhesive strength between the filament tape and the layer being peeled must be greater than the bond strength of the layers being separated.
4. It is acceptable to cut through the card in order to insure that the layer of interest has been separated from the card structure.

Affix the test sample to the stabilizing plate by means of double-sided pressure sensitive adhesive tape or other means. The adhesive strength between the test sample and the stabilizing plate shall be greater than bond strength between the card layers.

Apply the clamp or filament tape to the peeled back edge of one layer as shown in Figure 2.

Place the test strip in the tensile tester fixture as shown in Figure 5.

Operate the tensile tester according to the instructions of the manufacturer at 300 mm/min (11.8 in/min) to measure the peel strength in Newtons (lb_f).

Exclude the first 5 mm (0.2 in) and any features less than 1 mm (0.04 in) in length (spikes) from consideration as shown in Figure 3. Record the minimum peel strength(s) for the section tested

If there are special features in the card that cause the peel value to drop lower than the remaining test area, then the minimum value for peel strength of the feature shall be recorded, along with the minimum peel value for the remaining section of the test strip. Special feature properties shall also be reported. Properties to report include but are not limited to location, color, shape and size. Taking photographs of the special features is recommended. See Figure 4.

If the layer being peeled begins to tear, so that it is no longer 10 mm wide, within the 5 mm (0.02 in) exclusion area (see above), then the peel test shall be attempted from the opposite directions. If the layer tears from both directions, report the result as film tear.

If the layer being peeled tears, so that it is no longer 10 mm wide, after the 5 mm (0.2 in) exclusion area, record the minimum peel strength as per above in the areas before the tearing started, along with the location on the card where the tear started.

Record the thickness of the material peeled off the card.

Note: Divide the force measurement by the width of the sample peeled to calculate the peel strength in Newtons per millimeter (pounds force per inch).

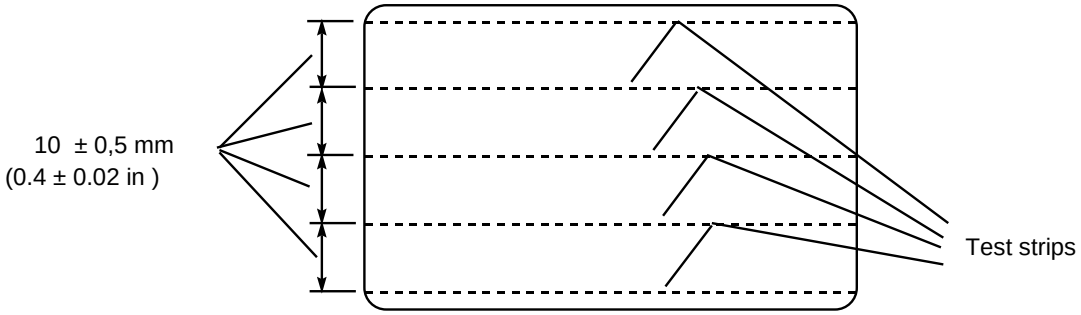


Figure 1 - Card preparation for 4 test strips

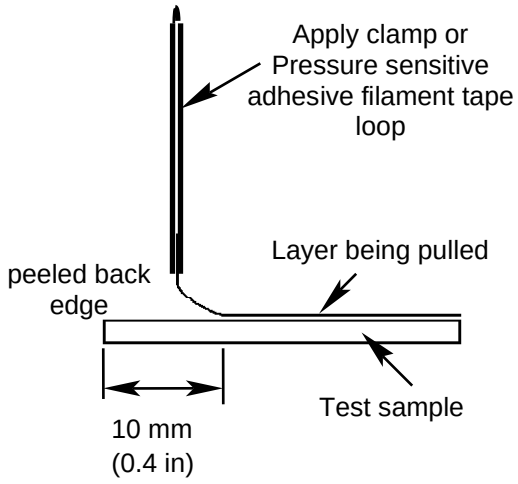


Figure 2 - Card preparation for peel test

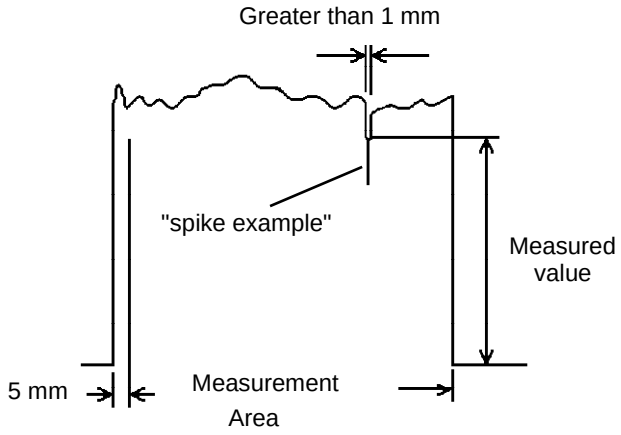


Figure 3 - Example of peel strength chart recording

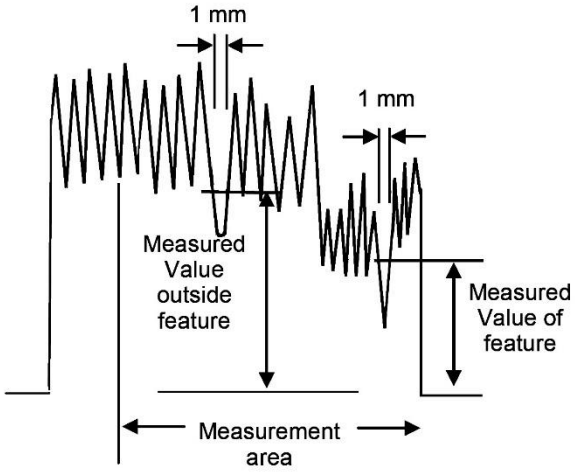


Figure 4 - Example of peel strength chart recording

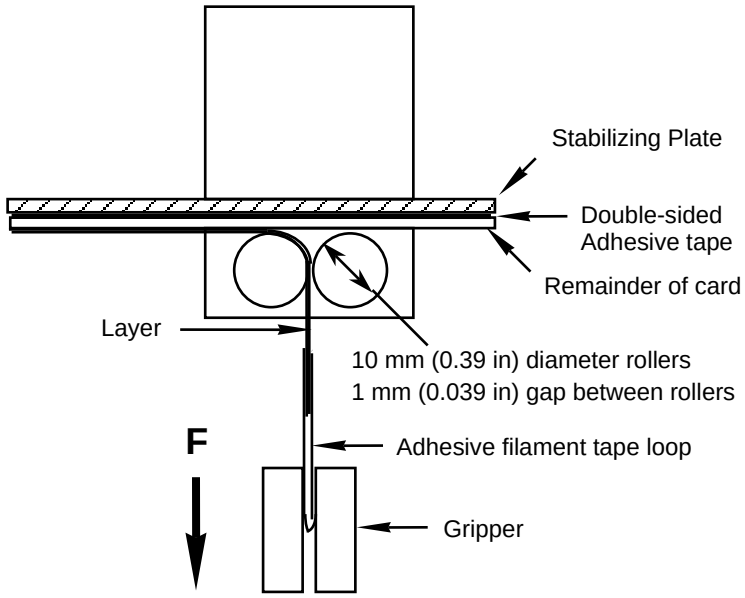


Figure 5 - Card mounted in tensile tester

5.1.4 Test Report

The test report shall give the location of test strip along with the measured values, sizes and positions of peel strengths for the test in N/mm (lb_f/in). Report the thickness of the film removed from the card. Report any inability to separate the layers or film tears.

Report the sample cutting technique and any other observations.

5.1.5 Precision and Bias

5.1.5.1 Interlaboratory Test Program

An interlaboratory study of Delamination – 90° was run in 2005. Twelve sets of samples were run by three different laboratories.

5.1.5.1.1 Test Results

The precision information given below in the units of measurement (lb_f/in or N/mm) is for the comparison of twelve test results, each of which is the average of three test determinations.

5.1.5.1.2 Precision

	95% confidence interval		99% confidence interval	
	lb_f/in	N/mm	lb_f/in	N/mm
Repeatability limit (within laboratory)	+/- 0.32	+/- 0,056	+/- 0.42	+/- 0,074
Reproducibility limit (among laboratories)	+/- 0.62	+/- 0,11	+/- 0.81	+/- 0,14
Test Measurement Tolerance (overall)	+/- 0.70	+/- 0,12	+/- 0.92	+/- 0,16

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.1.5.2 Intralaboratory Test Program

An intralaboratory study of Delamination – 90° was run in 2005. Twelve sets of samples were run by four different appraisers in the same laboratory.

5.1.5.2.1 Test Results

The precision information given below in the units of measurement (lb_f/in or N/mm) is for the comparison of twelve test results, each of which is the average of three test determinations.

5.1.5.2.2 Precision

	95% confidence interval		99% confidence interval	
	lb_f/in	N/mm	lb_f/in	N/mm
Repeatability limit (within appraisal)	+/- 0.24	+/- 0,042	+/- 0.32	+/- 0,056
Reproducibility limit (among appraisers)	+/- 0.07	+/- 0,012	+/- 0.09	+/- 0,016
Test Measurement Tolerance (overall laboratory)	+/- 0.25	+/- 0,044	+/- 0.33	+/- 0,058

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.1.5.3 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.2 Adhesion Crosshatch Tape Test

The primary purpose of this test is to evaluate adhesion of thin films, such as but not limited to, heat transfer films or ink jet coatings on ID cards. The thin film may be applied by thermal print head, heated roller, hot stamp die or ink jet. This test may be used to establish how much thin film is removed from the card substrate with the specified pressure sensitive tape.

5.2.1 Significance and Use

This test method may be used to determine the relative adhesion between the applied thin film layers and the base card. Relative adhesion of the thin film layer is a function of application process conditions, the film itself and/or the surface finish of the base card, surface contamination, etc.

5.2.2 Apparatus

Cutting Tool - Sharp razor blade or cutting device having a cutting edge angle between 15° and 30° that will either make a single cut or several parallel cuts at the same time, spaced 2 mm (0.079 in) apart. A cross cutting tool with six cutting edges 2 mm (0.079 in) apart is recommended. The cross cutting tool allows for six parallel cuts in one stroke, improving consistency of cuts.

Pressure Sensitive Adhesive (PSA) Tape - 3M Scotch Tape #600 or equivalent, 25 mm (1 inch) wide.
Cleaning Brush
Burnishing Tool - Chartpak #340 or equivalent

5.2.3 Procedure

Secure the card to be tested on a firm surface.

Make cuts through the thin film to the substrate in one steady motion. If cuts are to be made singularly, space six cuts 2 mm (0.079 in) apart about 20 mm (0.79 inches) long.

Make a second set of cuts intersecting the first set at 90°. Clean the cut surface (crosshatch) with the soft brush or tissue to remove flakes and other debris.

Inspect the crosshatch area for corner tearing or other material removal. Note any corner tearing.

Cut a piece of the pressure sensitive tape about 80 mm (3 in) long and place over the grid of cuts on the thin film. Ensure good and uniform contact between the tape and the thin film surface by evenly burnishing the area with the bone end (plastic spatula end) of the burnishing tool. The clarity of the tape is a useful indication of overall contact.

Wait 90 ± 30 seconds, then rapidly peel off the tape in one smooth, continuous motion at an angle of approximately 60°. Do not jerk the tape from the card. See Figure 6.

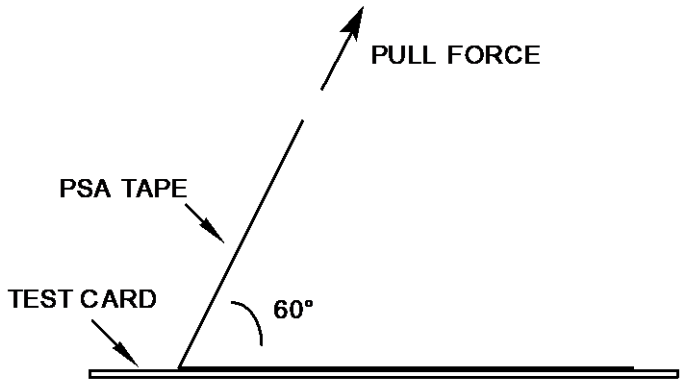


Figure 6 - Tape peel angle

Inspect the crosshatch area for removal of the thin film from the card.

5.2.4 Test Report

Refer to Table 1 below for rating the adhesion after the tape peel. A rating of "5" corresponds to no lift off of the thin film and a rating of "0" corresponds to greater than 65% material removal. Record the rating value, pressure sensitive tape product used and location of the tested area.

Report any corner tearing after the crosshatch cuts.

Note: This test has shown to be qualitative in nature and is subject to variations in results.

5.2.5 Precision and Bias

5.2.5.1 Interlaboratory Test Program

An interlaboratory study of Adhesion Crosshatch Tape Test was run in 1999. Three sets of samples were run by three different laboratories.

5.2.5.2 Test Results

The precision information given below in the units of measurement (material removal rating) is for the comparison of three test results for each laboratory, each of which is the average of six test determinations.

5.2.5.3 Precision

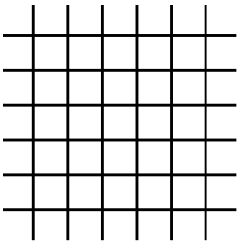
	95% confidence interval (rating)	99% confidence interval (rating)
Repeatability limit (within laboratory)	+/- 0.4	+/- 0.6
Reproducibility limit (among laboratories)	+/- 1.0	+/- 1.3
Test Measurement Tolerance (overall)	+/- 1.1	+/- 1.4

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

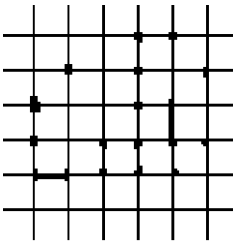
5.2.5.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

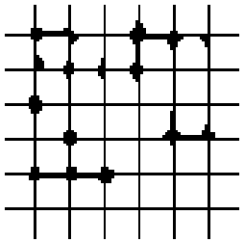
Table 1 - Rating diagrams (as per ASTM D3359-2002)



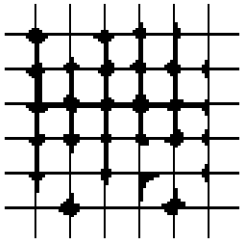
NONE
"5" Rating



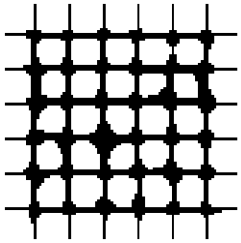
less than 5%
"4" Rating



5% to 15%
"3" Rating



15% to 35%
"2" Rating



35% to 65%
"1" Rating

GREATER THAN 65%

"0" Rating

The above cutting tool may be obtained from Paul N Gardner Company. The burnishing tool and adhesive tape may be obtained from art supply outlets. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.3 ID-1 Card Flexure

The horizontal displacement dimensions below are intended to replicate the vertical displacement dimensions specified in the Dynamic Bending Stress test method described in ISO/IEC 10373-1. This flexure method differs from ISO/IEC 10373-1 in rate of flex and is intended to assess the structural integrity of a card.

5.3.1 Significance and Use

This test method may be used for in-process card fabrication evaluations, material selections, when the flexure characteristics of a card is desired to be tested and when a card type is suspected of being "brittle" or have experienced early field fractures. Flexure characteristic of a card is a function of fabrication process conditions, card materials, card thickness, presence or absence of embossed characters, or presence or absence of surface applied decorations.

5.3.2 Apparatus

ID-1 Card flexure apparatus is constructed to meet the extent of flexure and jaw dimensions as described in ISO/IEC 10373-1.

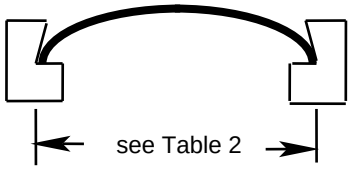


Figure 7 - Full flex condition

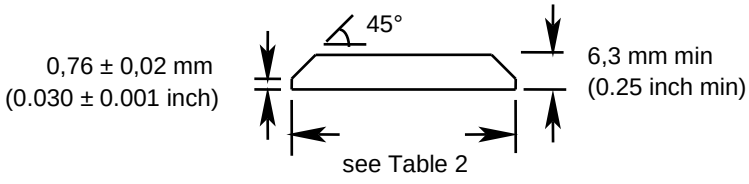


Figure 8 - Cross section - calibration plate

The flexure apparatus is equipped with jaws in which the card is mounted during flexure. Jaw dimensions are specified below:

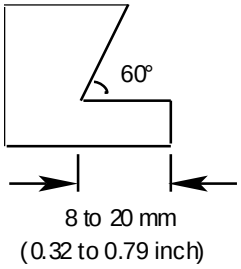


Figure 9 - Jaw details

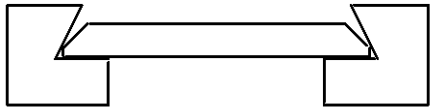


Figure 10 - Calibration plate inside jaws

Table 2 –Calibration plate dimensions

Card Orientation	Minimum flex calibration plate dimension	Jaw Stroke Length
Axis A	85,12 ± 0,05 mm (3.351 ± 0.002 in)	11,21 ± 0,40 mm (0.441 ± 0.015 in)
Axis B	53,67 ± 0,05 mm (2.113 ± 0.002 in)	3,89 ± 0,40 mm (0.153 ± 0.015 in)

Note 1: The use of “calibration plates” or other tooling that provides spacing between the jaws can be helpful in achieving the minimum flex conditions, as shown in Figures 8 and 10. The length of the calibration plate is to be at least the length of the jaw.

Note 2: The apparatus defined in ISO/IEC 10373-1 Dynamic Bending will yield identical card displacement as the apparatus defined above. Use of an apparatus as per ISO/IEC 10373-1 is acceptable for this standard if the flexure rate is adjusted to 60 ± 1 cycles per minute.

The flexure apparatus shall operate at 60 ± 1 cycles per minute and be equipped a reliable means to count the number of cycles. The motion of the moving jaw shall be determined by a steady state circular drive (sinusoidal motion).

5.3.3 Procedure

Mount card in the flexure apparatus in such a manner that when the apparatus is active, the card bends upward in the jaws. If possible, mount the cards when the jaws are in their minimum flex position.

Start the flexure apparatus. Observe the test card after every 1000 cycles (unless experience with the card construction suggests that the card resists fractures for a minimum number of cycles). Unless otherwise specified, the stopping point is achieved when a single fracture of at least 13 mm (0.5 in) long is observed or a combination of 5 fractures or fewer that total at least 13 mm (0.5 in) are observed. Close attention must be paid during the test when cards begin to fracture since fractures can progress rapidly. The test may be stopped after 100000 cycles have occurred without card fracture. Report the number of cycles to stopping point occurred for each card (to the nearest 1000 cycles).

During observations periods, do not permit the card under test to remain under mechanical stress when not being flexed for more than 5 minutes. Remove the cards from the jaws if the test must be suspended before completion.

The following routines have been identified for any card construction.

Axis A Flexure
This routine flexes the card around Axis A with the surface of interest face up in the apparatus.

Axis B Flexure
This routine flexes the card around Axis B with the surface of interest face up in the apparatus.

Note: Test results can vary depending on which side of the card is under extension (side up). Thus, it is recommended to conduct the test on separate cards with each side under extension.

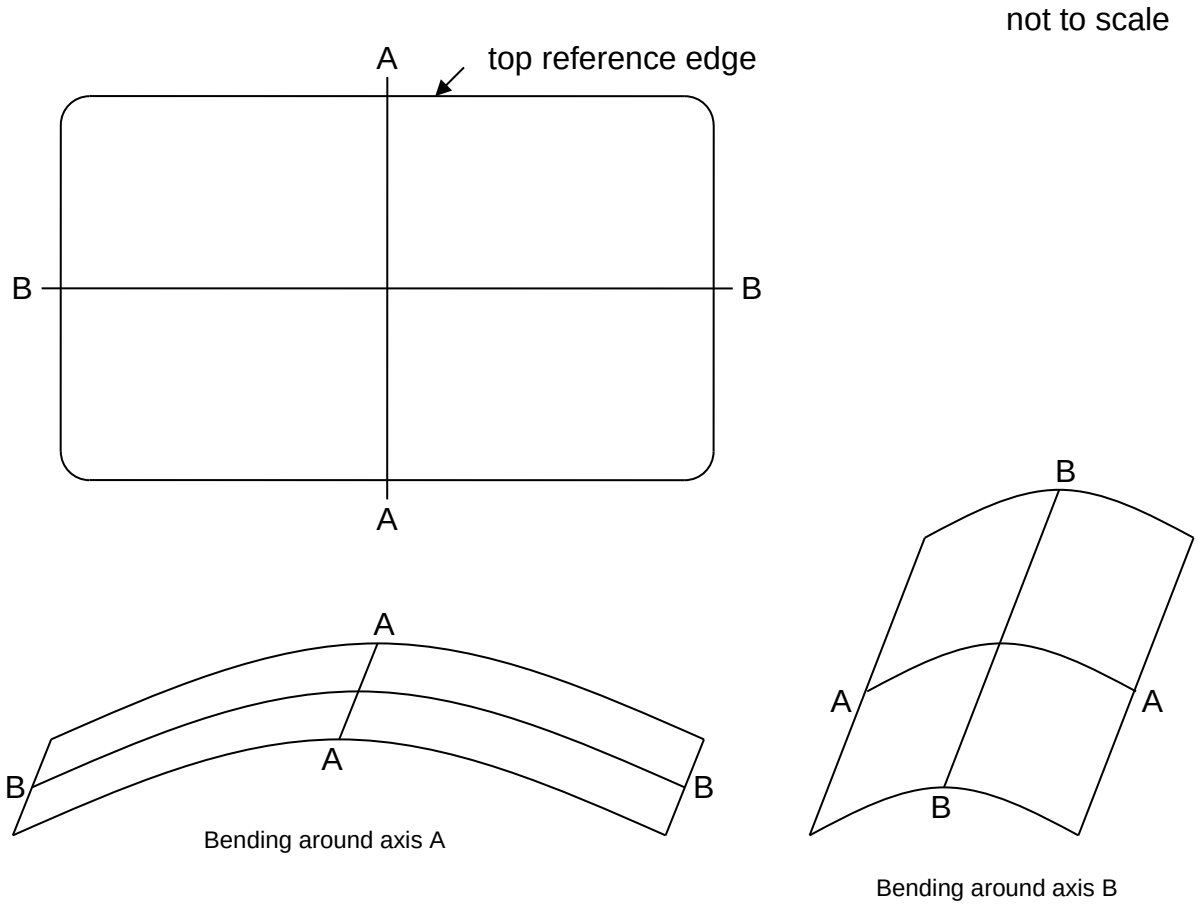


Figure 11 - Card orientation

5.3.4 Test Report

Report the following:

Number of cycles to stopping point to the nearest 1000 cycles for each axis
Description of which card side and location the fracture occurred.
Full description of card design features (printing, IC, photo, mag stripe, embossing, etc.)

5.3.5 Precision and Bias

5.3.5.1 Interlaboratory Test Program

An interlaboratory study of ID-1 Card Flexure was run in 1998. Sixteen sets of samples were run by four different laboratories.

5.3.5.2 Test Results

The precision information given below in the units of measurement (flex cycles until stopping point) is for the comparison of twelve test results for each laboratory, each of which is the average of six test determinations.

5.3.5.3 Precision

	95% confidence interval (cycles)	99% confidence interval (cycles)
Repeatability limit (within laboratory)	+/- 5300	+/- 7000
Reproducibility limit (among laboratories)	+/- 6800	+/- 9000
Test Measurement Tolerance (overall)	+/- 8700	+/- 11000

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.3.5.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.4 ID-1 Card Static Stress

The purpose of this test is to determine the structural integrity of the card after static stress.

5.4.1 Significance and Use

This test method may be used for in-process card fabrication evaluations, material selections and when a card type is suspected of being "brittle" or has experienced early field fractures. Card fractures after a stress period can be influenced by the fabrication process conditions, the card materials, their orientation, card thickness, presence or absence of embossed characters and presence or absence of decorations.

5.4.2 Apparatus

Card Impact fixture as shown in Figure 14.
Stress fixture constructed such to cause the card to be stressed in the following way:

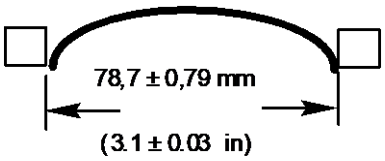


Figure 12 - Stress fixture - Axis A

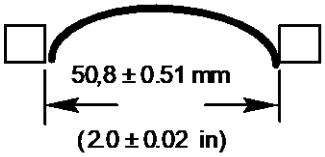


Figure 13 - Stress fixture - Axis B

5.4.3 Procedure

Insert test card in the stress fixture for 24 hours as shown in figures 12 and 13.

Note: Test results can vary depending on which side of the card is under extension (side up). Thus, it is recommended to conduct the test on separate cards with each side under extension (side up).

Remove the test card from the fixture and immediately force the ends of the cards together in the direction of the stress "bow" by the use of the Card Impact Fixture. See Figure 14. Raise the impact weight to the specified drop height and let the impact weight fall.

CAUTION: Use care in operating the Card Impact fixture to avoid injury. Safety glasses should be worn during this test to prevent eye injury.

5.4.4 Test Report

Report the number of cards tested and number of cards fractured (or broken in pieces) after impact for each side tested.

Note: Significant variations within a card lot have been experienced with this test method. Caution must be taken when drawing conclusions based on a small number of test cards.

5.4.5 Precision and Bias

5.4.5.1 Interlaboratory Test Program

An interlaboratory study of ID-1 Card Static Stress was run in 1999. Twelve sets of samples were run by four different laboratories.

5.4.5.2 Test Results

The precision information given below in the units of measurement (number of broken cards) is for the comparison of twelve test results for each laboratory, each of which is the result of 25 test determinations.

5.4.5.3 Precision

$$p_o = 0.92, \text{ or } 92\%$$

The observed proportion of overall agreement, denoted p_o, or A_o, is the proportion of cases for which results of binary, or dichotomous, rating agree. In instances of multiple evaluators, the average of the agreeing and disagreeing cases for each evaluating pair are used to determine p_o.

5.4.5.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

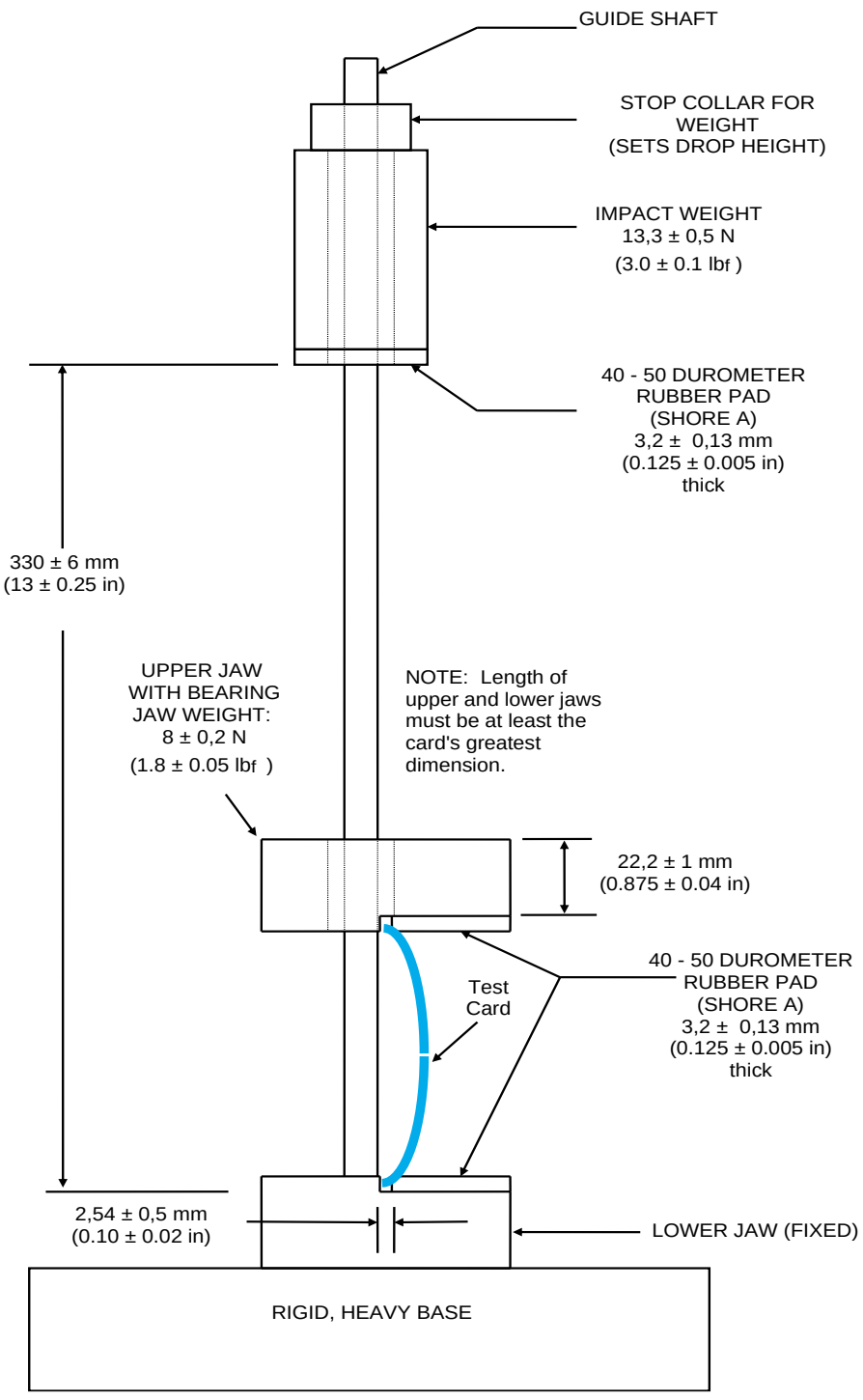


Figure 14 - Card impact fixture

The above apparatus or construction drawings may be obtained from QCard 301 Reagan Street, Sunbury, PA. 17801. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.5 ID-1 Card Stress and Plasticizer Exposure

The purpose of this test is to determine the resistance to cracking of a card while under a combination of mechanical stress and plasticizer exposure.

5.5.1 Significance and Use

This test method may be used for materials selection. Plasticizers have been known to migrate into card materials and can cause card embrittlement.

5.5.2 Apparatus

Dioctyl terephthalate (DOTP) Plasticizer (liquid)
Solvent Blue 59 dye
Clear polyester sheet 23 µm (0.00091 in) thickness uncoated, untreated
Sheet size 25 mm x 50 mm (1 in x 2 in)

Stress fixture – See Figure 13.

Note: Solvent Blue 59 dye in a concentration of 0.1% by weight is used to help see depth of cracks.

CAUTION: DOTP is used in this test. The Safety Data Sheet (SDS) must be read and understood before proceeding with testing. Use of protective gloves is required whenever handling DOTP. Any spills or contaminated equipment must be immediately cleaned to prevent exposure to others. Safely dispose of all cards, polyester film and gloves to avoid accidental contact with DOTP. Hands should be thoroughly washed with soap and water after handling DOTP.

5.5.3 Procedure

Mount the test cards into the stress fixtures.

Note: Test results can vary depending on which side of the card is under extension (side up). Thus, it is recommended to conduct the test on separate cards with each side under extension (side up).

Place 1 drop of DOTP (0,03 – 0,05 g) on the center of each test card.

Immediately place the 23 µm (0.00091 in), clear polyester cover sheet over the drop of DOTP so that the DOTP wets the test card. (The 50 mm length is parallel to the apex of the card.)

Examine the cards every 15 minutes for the first 2 hours, then every 30 minutes for the next 2 hours and then every hour for the next 20 hours. (If hourly examination during the next 20 hours is not achievable, examine the cards again at the next opportunity. If the stopping point was reached during the period of no examination, re-test a new card and stage the test such that the stopping point can be observed during the hourly inspection times.) If additional exposure time is warranted, examine the cards daily.

The stopping point is defined when a fracture has progressed at least 13 mm (0.5 in) long. The test may be stopped after 100 hours have elapsed without card fracture.

5.5.4 Test Report

Report the exposure time to the stopping point of the cards tested in each axis orientation and side of card exposed to the plasticizer.

5.5.5 Precision and Bias

Test repeatability has not been established for this method.

5.6 Impact Resistance

The purpose of this test is to determine the impact resistance of the test card or card material.

5.6.1 Significance and Use

This test method was developed for card fabrication evaluations, material selections and when a card type is suspected of being "brittle" or has experienced early field fractures. Impact resistance values can be influenced by card material properties, card thickness, and/or the presence or absence of decorations or internal card components.

5.6.2 Apparatus

The apparatus is shown in Figure 16 and comprises the following:

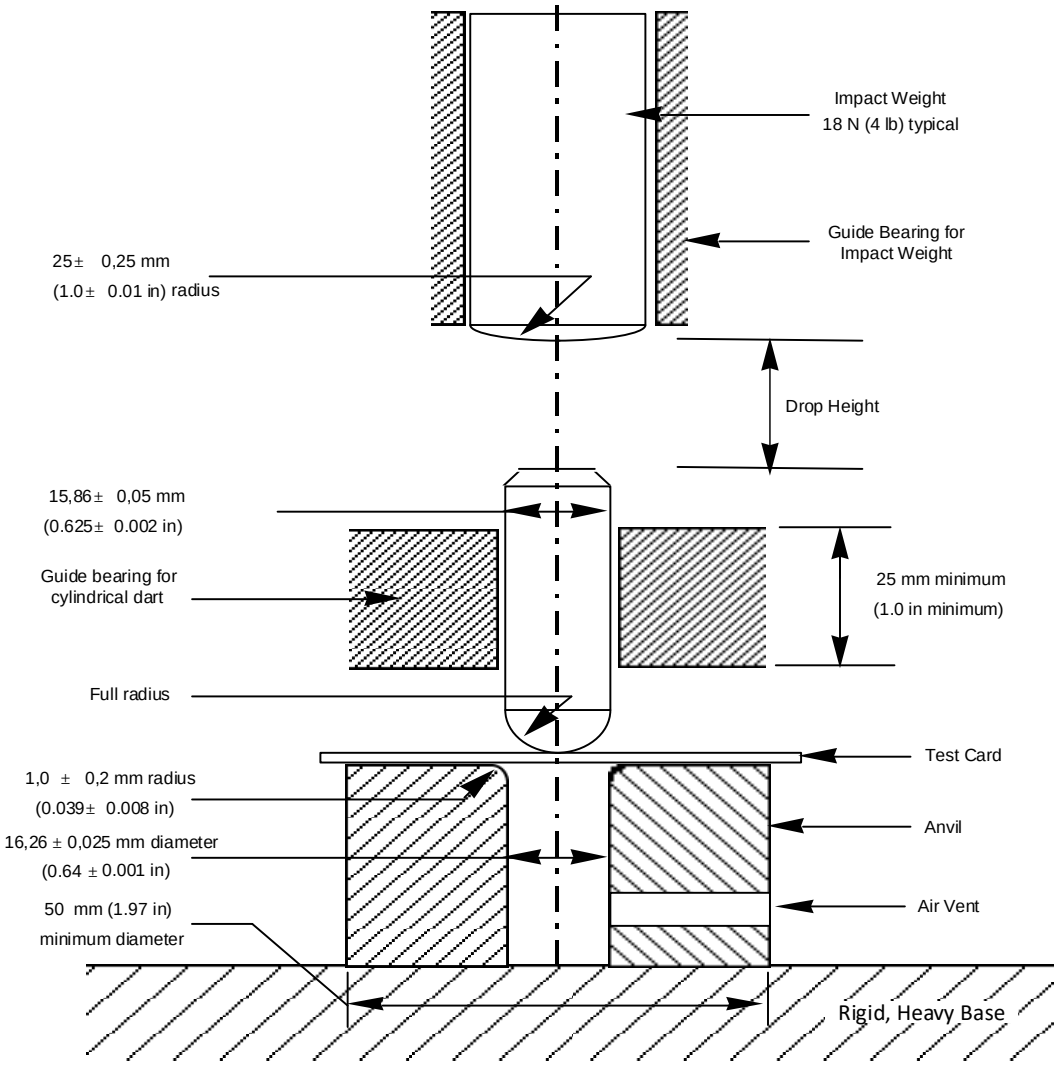


Figure 15 - Impact apparatus

The above apparatus may be obtained from BYK Gardner. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Card support anvil made of steel and mounted to a rigid, heavy base. A vent must be provided at the bottom of the anvil to allow air to escape during the impact.

Cylindrical dart made of steel supported in a bearing.

Impact weight made of steel and supported in a guide bearing. It should be noted that an 18 N (4 lb_f) weight is typical for test cards.

Portions of the apparatus that contact the test card must have a hardness of Rc = 50-55 and a surface finish Ra = 0,2 ± 0,06 µm (7.9 ± 2.4 µin). See ISO 3274 for surface roughness measurement parameters.

Thickness gauge accurate to 0,01 mm (0.0005 in)

5.6.3 Procedure

Measure the thickness of the test card in the area where the impact testing will be performed.

Note: The presence of external card features such as ICs, signature panels, magnetic stripes, etc. or internal elements such as IC modules, antenna wire, etc. near the impact area may affect test results.

CAUTION: Use care in operating the Impact apparatus to avoid injury. Safety glasses are recommended to be worn during this test to prevent eye injury. Fingers and hands should be kept clear of the impact area.

Place the test card under the cylindrical dart centerline at least 20 mm (0.8 inches) from any sample edge. Raise the weight in the tube to the approximate failure energy value for the specific sample and release it so that the weight drops on the impactor (see note below if the approximate failure energy is unknown).

Remove the card from the tester and look for tears around the shoulder of the depression formed from the impact. If there are no tears, then increase the drop energy by 225 mm-N (2 in-lb_f) and test another card. If there are tears, then decrease the drop energy by 225 mm-N (2 in-lb_f) and test another card. Record drop energies in mm-N (in-lb_f) and pass/tear impact results for each drop.

Repeat the above procedure until the drop energy has transitioned from increasing to decreasing at least 4 times. The impact resistance shall be reported as the average drop energy for the tests, excluding initial data points used to determine approximate impact energy (see example that follows).

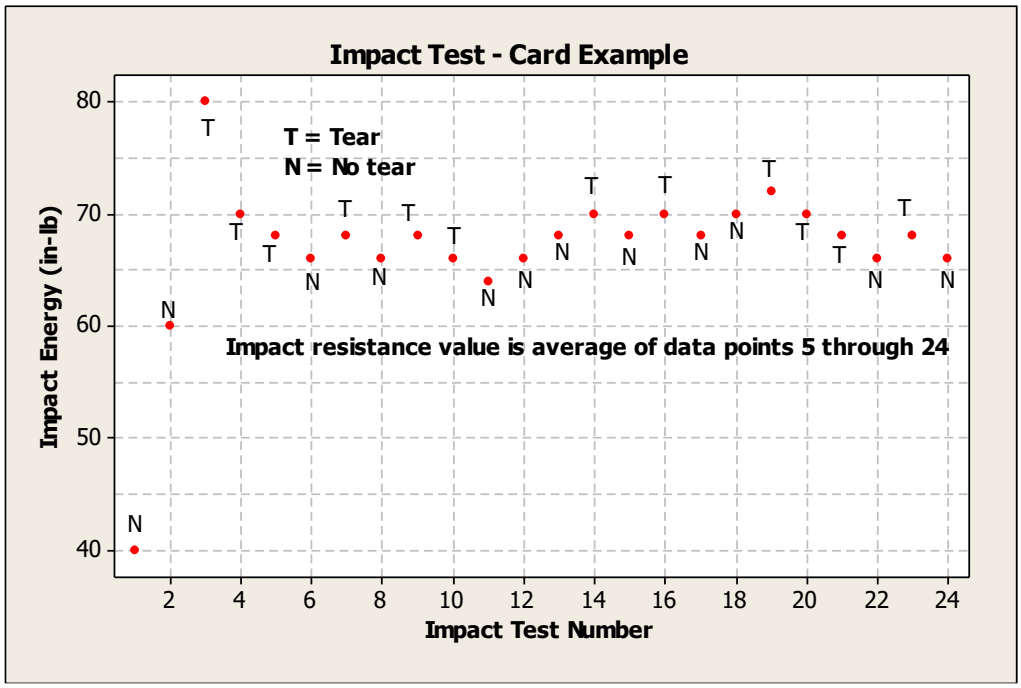


Figure 16 - Impact test data point example

Note: If the approximate failure energy value for the sample is unknown, start testing at 4500 mm-N (40 in-lb_f). Depending upon the result, increase/decrease impact resistance by 2250 mm-N (20 in-lb_f) until a change in test result occurs. After that, reduce change intervals by 1125 mm-N (10 in-lb_f) followed by 450 mm-N (4 in-lb_f) and then 225 mm-N (2 in-lb_f). At this point proceed as per the test procedure.

Note: Test results can vary depending on which side of the card is impacted. Thus, it is recommended to conduct the test on separate cards with each side impacted.

5.6.4 Test Report

Report the impact resistance in mm-N (in-lb_f), card thickness, impact weight used, location of impact area and side of card facing dart.

Note: The use of an alternate impact weight may be required to achieve results.

5.6.5 Precision and Bias

This test method should be restricted to one laboratory when numbered values are used because of poor reproducibility of the method. Interlaboratory agreement is improved when ranking is used in place of numerical values.

5.7 Elevated Temperature & Humidity Exposure

The purpose of this test is to evaluate the ability of a card to withstand an elevated temperature/humidity environment.

5.7.1 Significance and Use

This test method employs elevated temperature and humidity exposure to simulate accelerated aging of card construction and materials. It may also be used as a "preconditioning aging test" prior to performing other tests, such as peel strength and flexure.

5.7.2 Apparatus

Laboratory chamber capable of controlling set temperature within ± 2°C (± 3.6°F) and controlling relative humidity to 95 ± 5%, noncondensing, or an oven plus a sealable test container with a saturated aqueous solution of potassium sulfate.

Test Card Holder that is constructed in such a way that permits exposure of the humid air to both surfaces of the card.

NOTE: Redbrand hardware cloth (¼ in x ¼ in wire spacing. 23 gauge wire; metric equivalent is 6,25 mm x 6,25 mm wire spacing with 0,6 mm wire diameter) or stainless steel welded wire cloth (McMaster Carr) has shown to provide proper card support.

5.7.3 Procedure

Two procedures are detailed here, corresponding to the two types of chambers that may be utilized to control the relative humidity level.

5.7.3.1 Procedure Using Temperature and Humidity Controlled Chamber

Mount the test cards that possess all desired information and features in the test card holder such that the cards are separated from each other with the card face horizontal.

Place the cards and card holder in the chamber set for 50°C (122°F) and 95% ± 5% relative humidity, noncondensing. Remove the cards from the chamber after a duration of 5 days, unless otherwise specified.

5.7.3.2 Procedure Using Saturated Aqueous Solution of Potassium Sulfate

Prepare a saturated water solution consisting of 12,0 g (0.026 lb_m) of K_2SO_4 per 100 g (0.22 lb_m) distilled water (saturation is 12,0 g per 100 cm^3 at 25°C).

Pour the saturated K_2SO_4 solution into the bottom of the test container. The depth of the K_2SO_4 solution should be at least 5 mm (0.2 in) deep. Add an additional 6 g (0.013 lb_m) of K_2SO_4 solid per 100 g (0.22 lb_m) of the saturated solution. (Some solid K_2SO_4 will be present in the bottom of the test container.) This will ensure a saturated K_2SO_4 solution is present at the elevated test temperatures.

Mount the test cards that possess all desired information and features in the test card holder such that the cards are separated from each other with the card face parallel to the water line.

Seal the container and place it into the laboratory oven set at 50°C (122°F) for a duration of 5 days, unless otherwise specified.

NOTE 1: Duration and temperature may influence results.
NOTE 2: The container must remain sealed throughout the temperature exposure period.

5.7.4 Test Report

Report any sign of card deterioration. Report temperature and duration of exposure. Report which card face was toward the water line.

5.7.5 Precision and Bias

Test repeatability has not been established for this method.

5.8 Surface Abrasion

The purpose of this test is to provide a general means to produce controlled abrasion on a card surface.

5.8.1 Significance and Use

This test method may be used for material selections and when the ability of a card to resist surface abrasion is desired. Surface abrasion resistance is a function of the card materials and the application process.

5.8.2 Apparatus

- Abraser w/vacuum system and 8 mm vacuum nozzles adjusted to a height of to 1,2 mm ± 0,4 mm (0.047 ± 0.016 in) from the test card
- Abrasive Wheels, pair, (Taber CS-10F or equivalent, shall comply with the expiration date of the abrasion wheels, minimum wheel diameter and side orientation.)
- Resurfacing disks (Taber S-11 or equivalent)
- Dry soft antistatic brush
- Hole punch or equivalent
- 500 g (1.10 lb_m) total load per wheel. Load is per arm (not combined) and includes the mass of the pivot arm no counter weight wheels
- Clamping ring (Outer retaining ring)
- Rubber Pad

NOTE: Some Taber Abraser models have rotational speed settings available for both 60 and 72 RPM. It is suggested to use the 72 RPM setting.

5.8.3 Procedure

Prepare test cards that possess all desired information and features.
Use the notch location as per Figure 15 if the area of interest falls in the wheel path. If the area of interest does not fall inside the wheel path in Figure 17, then:

- The card may be moved to a different location on the turntable, so the area of interest is in the wheel path
- Placeholder cards will need to be used to position the test card on the turntable so the area of interest is abraded. The placeholder cards will also minimize wheel bouncing when running over the test card edges
- Notches/holes for mounting the cards on the turntable will need to be made in the test cards and/or placeholder cards.
- Location of wear pattern tested shall be noted on the test report.

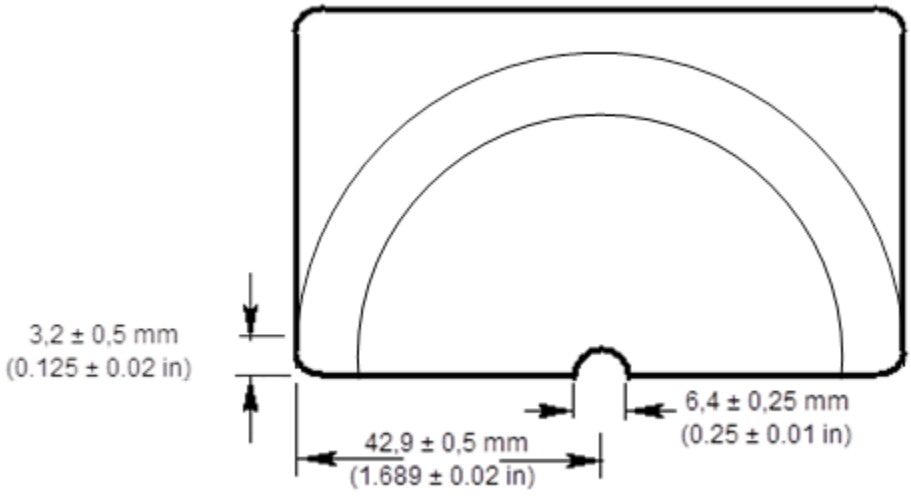


Figure 15 - Test card notch location

Resurface the abrasive wheels for 100 cycles for new unused wheels and 50 cycles for used wheels with resurfacing disk on top of rubber pad before testing begins. Remove all debris from the turntable and wheels by cleaning with a dry soft antistatic brush. Using a gloved finger removed burr from the edge of the abrasive wheel during the last few cycles of resurfacing. Avoid direct finger contact with the abrasion wheels. Replace the S-11 resurfacing disk after a maximum of 10 uses. Use the clamping ring when re-surfacing to avoid damage to vacuum nozzle from contact with the resurfacing disk.

Mount the cards on the turntable using the clamp plate and nut without a rubber pad. Place the abrasive wheels on the cards and lower the vacuum nozzle to 1,2 mm ± 0,4 mm (0.047 ± 0.016 in) above them.

Start the abraser and vacuum.

- The test shall be paused every 50 cycles, the cards shall be cleaned and examined for wear-through (ignoring wear-through within 6 mm (0.25 in) of the card edge).
- The cards and turntable shall be cleaned with a dry soft antistatic brush, avoid direct finger contact with the test cards and abrasion wheels.
- The abrasive wheels shall be resurfaced for 100 cycles if using a new wheels and 50 cycles for used wheels at the beginning of each test and 50 cycles after every 250 cycles and is independent of specified cycles or stopping point.

Stop the test after wear-through of the card feature is observed

- Figure 18 illustrates before and after wear-though of a heat transfer film. This will also be the stopping point for dye printing underneath the heat transfer film.
- Figure 19 illustrates the stopping point for resin-based text. Wear through is defined as the point where any character is no longer legible.
- Figure 20 illustrates the stopping point for a resin-based photograph. Wear through is defined as the point where any facial feature is no longer recognizable
- Figure 21 illustrates the stopping point for a resin based graphical element (logo, seal, etc.). Wear through is defined as the point where the element is no longer completely recognizable or functional.
- The test may be stopped after 2500 cycles have occurred without wear-through. If stopped at this point, the test report should note that wear-through was not observed after 2500 cycles.

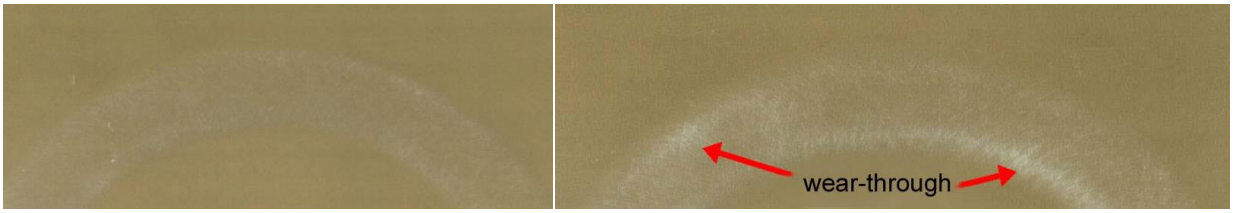


Figure 16 – Before(left) and after(right) wear-through occurs

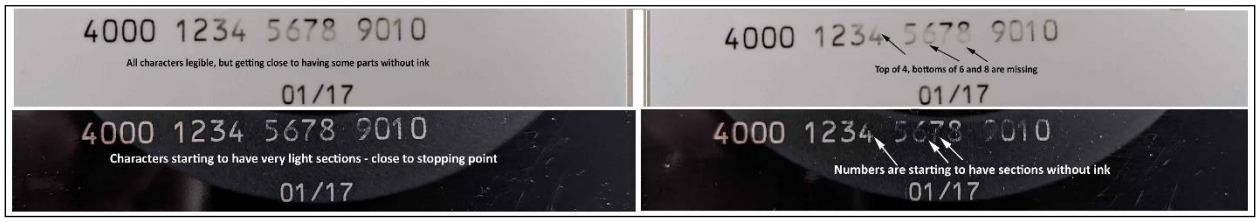


Figure 17 – Before(left) and after(right) wear-through occurs

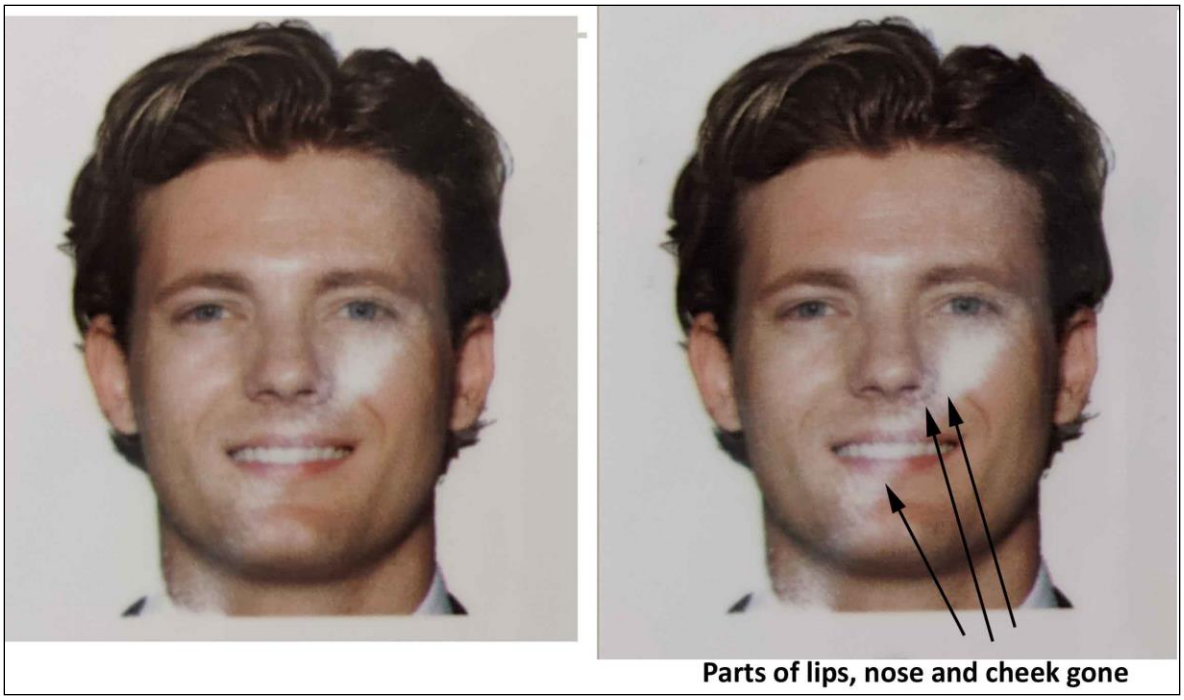


Figure 18 – Before(left) and after(right) wear-through occurs

Figure 19 – Before(left) and after(right) wear-through occurs

5.8.4 Test Report

Compare the wear-through of the test card to a control card or the number of cycles to the specified requirement.

5.8.5 Precision and Bias

Test repeatability has not been established for this method.

The abraser apparatus and abrasive wheels may be obtained from Taber Industries. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.9 Bar Code Abrasion (1D)

The purpose of this test is to determine the extent of 1D bar code abrasion resistance.

5.9.1 Significance and Use

This test method may be used for material selections and when an evaluation of the barcode abrasion resistance of a card is desired. Barcode abrasion resistance is a function of the card materials selected and the application process.

5.9.2 Apparatus

- Abraser w/vacuum system and 8 mm (0.43 in) vacuum nozzles adjusted to a height of to 1,2 mm ± 0,4 mm (0.047 ± 0.016 inches) from the test card
- Abrasive Wheels, pair, (Taber CS-10F or equivalent, shall comply with the expiration date of the abrasion wheels, minimum wheel diameter and side orientation.)
- Resurfacing disks (Taber S-11 or equivalent)
- Dry soft antistatic brush
- Hole punch or equivalent
- 500 g (1.10 lb_m) total load per wheel. Load is per arm (not combined) and includes the mass of the pivot arm no counter weight wheels
- Clamping ring (Outer retaining ring)
- Rubber Pad
- Bar Code Verifier (ISO/IEC 15416 compliant) OR
- Bar Code Verifier (ANSI/INCITS 182 compliant) – 0,13 mm (5 mil) aperture, 675 ± 15 nm

NOTE: Some Taber Abraser models have rotational speed settings available for both 60 and 72 RPM. It is suggested to use the 72 RPM setting.

5.9.3 Precondition

The test cards must be prepared with the 1D bar code within the location described in Figure 20.

5.9.4 Procedure

Measure the resulting overall ANSI Grade (A, B, C, D, or F) or ISO Grade (4, 3, 2, 1, or 0) by averaging the grade of at least 10 scans by the verifier in the middle of the abraser path.

Make a notch in the cards for mounting the cards on the turntable of the abraser as shown in Figure 15.

Resurface the abrasive wheels for 100 cycles if using a new wheels and 50 cycles for used wheels before testing begins and 50 cycles after every 250 cycles. Remove all debris from the turntable and wheels by cleaning with a dry soft antistatic brush. Using a gloved finger removed burr from the edge of the abrasive wheel during the last few cycles of resurfacing. Avoid direct finger contact with the abrasion wheels. Replace the S-11 resurfacing disk after a maximum of 10 uses. Use the outer retaining ring when re-surfacing to avoid damage to the resurfacing disk and vacuum nozzle.

Mount the cards on the turntable using the clamp plate and nut without a rubber pad. Place the abrasive wheels on the cards and lower the vacuum nozzle to 1,2 mm ± 0,4 mm (0.047 ± 0.016 in) above them.

Preset the abraser for 50 cycles and start the abraser and vacuum.

Remove the test cards and clean thoroughly using a dry soft antistatic brush. Re-measure the ANSI grade level per ANSI/INCITS 182 or the ISO grade level per ISO/IEC 15416 at an area of least wear. If barcode verifier is unable to produce a grade, assign a grade of F or 0.

The abraser apparatus and abrasive wheels may be obtained from Taber Industries. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Repeat the process of 50 Taber cycles and re-measure the ANSI grade level until an overall grade of F is achieved for two consecutive tests, or re-measure the ISO grade level until an overall grade less than 0.5 is achieved for two consecutive tests. The test may be stopped after 2500 Taber cycles have occurred without achieving two consecutive ANSI F grades or two consecutive ISO grades less than 0.5.

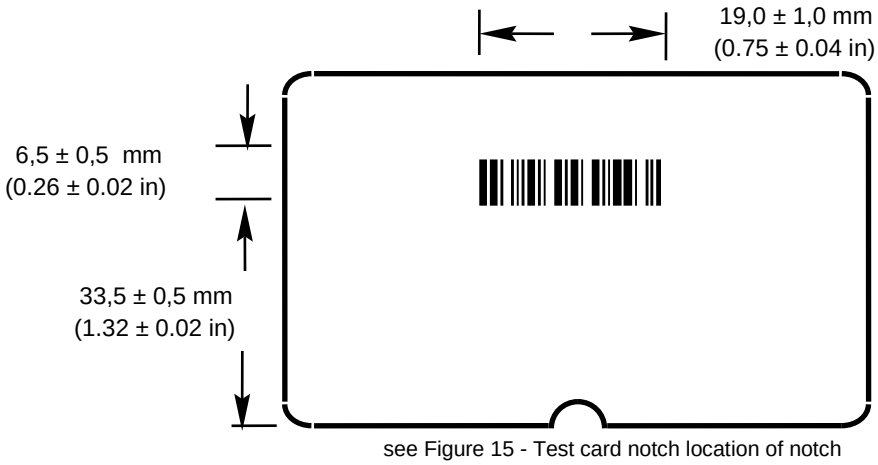


Figure 20 - Bar code test location (abrasion)

Note: If the bar code is required to comply with any established standard, the compliance tests must be conducted and the results acceptable prior to this abrasion test.

5.9.5 Test Report

Report the starting grade and the number of abrasion cycles of each test card (to the nearest 50 cycles) that was required to achieve the second consecutive ANSI F Grade or ISO grades less than 0.5.

5.9.6 Precision and Bias

5.9.6.1 Interlaboratory Test Program

An interlaboratory study of Bar Code Abrasion was run in 1998. Two sets of samples were run by three different laboratories.

5.9.6.2 Test Results

The precision information given below in the units of measurement (cycles to stopping point) is for the comparison of two test results for each laboratory, each of which is the average of six test determinations.

5.9.6.3 Precision

	95% confidence interval (cycles)	99% confidence interval (cycles)
Repeatability limit (within laboratory)	+/- 90	+/- 120
Reproducibility limit (among laboratories)	+/- 100	+/- 140
Test Measurement Tolerance (overall)	+/- 140	+/- 180

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.9.6.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.10 Magnetic Stripe Abrasion

The purpose of this test is to determine the extent of magnetic stripe abrasion resistance.

5.10.1 Significance and Use

This test method may be used for magnetic media selections and when an evaluation of the magnetic stripe abrasion resistance of a card is desired. Magnetic stripe abrasion resistance is a function of the card materials selected and the application process.

5.10.2 Apparatus

- Abraser w/vacuum system and 8 mm (0.43 in) vacuum nozzles adjusted to a height of to 1,2 mm ± 0,4 mm (0.047 ± 0.016 inches) from the test card
- Abrasive Wheels, pair, (Taber CS-10F or equivalent, shall comply with the expiration date of the abrasion wheels, minimum wheel diameter and side orientation.)
- Resurfacing disks (Taber S-11 or equivalent)
- Dry soft antistatic brush
- Hole punch or equivalent
- 500 g total load per wheel. Load is per arm (not combined) and includes the mass of the pivot arm no counter weight wheels
- Clamping ring (Outer retaining ring)
- Rubber Pad
- Mag stripe read test equipment with the following characteristics:
- ISO/IEC 10373-2 compliant
- Capable of reporting average signal amplitude (U_A) on middle third of Track 2.

NOTE: Some Taber Abraser models have rotational speed settings available for both 60 and 72 RPM. It is suggested to use the 72 RPM setting.

5.10.3 Procedure

Prepare the test card by encoding on ISO Track 2 with a 200 ± 10% flux transitions per mm (5080 flux transitions per inch) frequency at a recording current of I_{min} (See ISO/IEC 7811-2 or -6 and ISO/IEC 10373-2 for details).

Note: If the magnetic stripe material is required to comply with any established standard, the compliance tests must be conducted and the results acceptable prior to this abrasion test.

Punch a hole in the card as shown in Figure 21.

For each card, immediately before initiating abrasive wear, measure the average signal amplitude ($U_{A\ initial}$) in the read area shown in Figure 21.

Resurface the abrasive wheels for 100 cycles if using a new wheels and 50 cycles for used wheels before testing begins and 50 cycles after every 100 cycles. Remove all debris from the cards and turntable by cleaning with a dry soft antistatic brush. Using a gloved finger removed burr from the edge of the abrasive wheel during the last few cycles of resurfacing. Avoid direct finger contact with the abrasion wheels . Replace the S-11 resurfacing disk after a maximum of 10 uses. Use the outer retaining ring when re-surfacing to avoid damage to the resurfacing disk and vacuum nozzle.

Mount the test card and a placeholder card (same thickness as the test card) on the turntable using the clamp plate and nut without a rubber pad. Place the abrasive wheels on the cards and lower the vacuum nozzle to 1,2 ± 0,4 mm (0.047 ± 0.016 in) above them.

Preset the abraser for 50 cycles and start the abraser and vacuum.

Remove and clean both the test card and filler card surfaces thoroughly, using a clean soft antistatic brush, to remove debris.

Re-measure average signal amplitude (U_A).

Repeat the process of 50 abraser cycles and measure average signal amplitude (U_A) until a U_A of 70% of $U_{A\ initial}$ or less is achieved in the read area shown in Figure 21. The test may be stopped after 2500 Taber cycles have occurred without achieving a U_A of 70% of $U_{A\ initial}$.

The abraser apparatus and abrasive wheels may be obtained from Taber Industries. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

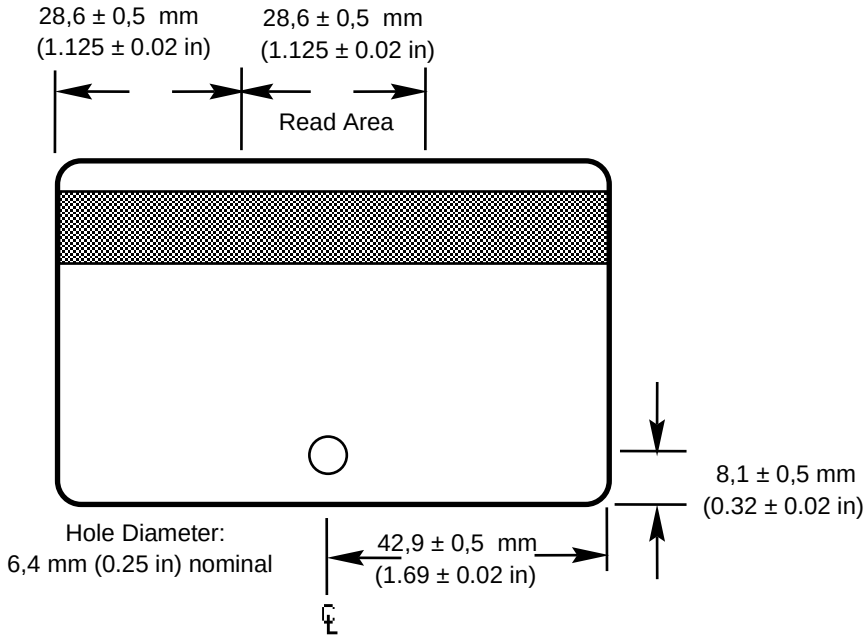


Figure 21 - Mag stripe read area and hole location

5.10.4 Test Report

Report the number of abraser cycles (to the nearest 50 cycles) that was required to reduce U_A to 70% of $U_{A\ initial}$) or less.

Note: Graphical results (average signal amplitude vs. abraser cycles) have been shown to be useful in showing abrasion characteristics.

5.10.5 Precision and Bias

5.10.5.1 Interlaboratory Test Program

An interlaboratory study of Magnetic Stripe Abrasion was run in 2001. Three sets of samples were run by three different laboratories.

5.10.5.2 Test Results

The precision information given below in the units of measurement (cycles to stopping point) is for the comparison of three test results for each laboratory, each of which is the average of six test determinations.

5.10.5.3 Precision

	95% confidence interval (cycles)	99% confidence interval (cycles)
Repeatability limit (within laboratory)	+/- 34	+/- 44
Reproducibility limit (among laboratories)	+/- 54	+/- 71
Test Measurement Tolerance (overall)	+/- 64	+/- 84

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.10.5.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.11 Image Abrasion

The purpose of this test is to determine the extent of image abrasion resistance.

5.11.1 Significance and Use

This test method may be used for material selections and when an evaluation of the image abrasion resistance of a card is desired. Image abrasion resistance is a function of the card materials selected and the application process.

5.11.2 Apparatus

- Abraser w/vacuum system and 8 mm vacuum nozzles adjusted to a height of to 1,2 mm ±0,4 mm (0.047 ± 0.016 inches) from the test card
- Abrasive Wheels, pair, (Taber CS-10F or equivalent, shall comply with the abrasion wheel's expiration date, minimum wheel diameter and side orientation.)
- Resurfacing disks (Taber S-11 or equivalent)
- Dry soft antistatic brush
- Hole punch or equivalent
- 500 gm total load per wheel. Load is per arm (not combined) and includes the mass of the pivot arm no counter weight wheels
- Clamping ring (Outer retaining ring)
- Rubber Pad
- Reflection Densitometer (status I response)*

* Recommended Reflection Densitometer characteristics - aperture 4 – 6 mm (0.16 – 0.25 in) white base absolute, polarized filter D65 light source and 10 degree standard observer angle.

NOTE: Some Taber Abraser models have rotational speed settings available for both 60 and 72 RPM. It is suggested to use the 72 RPM setting.

5.11.3 Precondition

The test cards shall be prepared with the image in the location described in figure 24.

Note: Typical (not required) dot color densities on cards printed for this test are:

Yellow	1.8 to 2.4	Composite black (YMC)	1.5 to 2.1
Magenta	1.4 to 2.0	Resin black (K)	1.7 to 2.3
Cyan	1.2 to 1.8		

5.11.4 Procedure

Measure and record the reflection density of the yellow, magenta, cyan, composite black (YMC) and resin black (K) dots using the appropriate filters. Measure in the center of the dots. Record the densities.

Note: Density measurements taken on areas covered by security features may produce inconsistent results.

Make a notch in the card for mounting on the turntable as shown in Figure 15.

Resurface the abrasive wheels for 100 cycles if using a new wheels and 50 cycles for used wheels before testing begins and 50 cycles after every 250 cycles. Remove all debris from the cards and turntable by cleaning with a dry soft antistatic brush. Using a gloved finger removed burr from the edge of the abrasive wheel during the last few cycles of resurfacing. Avoid direct finger contact with the abrasion wheels. Replace the S-11 resurfacing disk after a maximum of 10 uses. Use the outer retaining ring when re-surfacing to avoid damage to the resurfacing disk and vacuum nozzle.

Mount the cards on the turntable using the clamp plate and nut without a rubber pad. Place the abrasive wheels on the cards and lower the vacuum nozzle to 1,2 ± 0,4 mm (0.047 ± 0.016 in) above them
Run the abraser and vacuum for 50 cycles.

Remove the test cards and clean the cards and turntable thoroughly, using a dry soft antistatic brush, to remove all debris. Re-measure the reflection densities at the same location as previously measured. Record the densities.

If any of the reflection densities on a card drops below 50% of its original value, the stopping point has been reached for the card under test. The test may be stopped after 2500 Taber cycles have occurred without achieving reflection densities below 50% of its original value.

If the stopping point has been reached for both cards, the test is complete.

If the stopping point has not been reached for both cards, abrade the cards (run the abraser and vacuum for an additional 50 cycles). Repeat until the stopping point is reached for both cards.

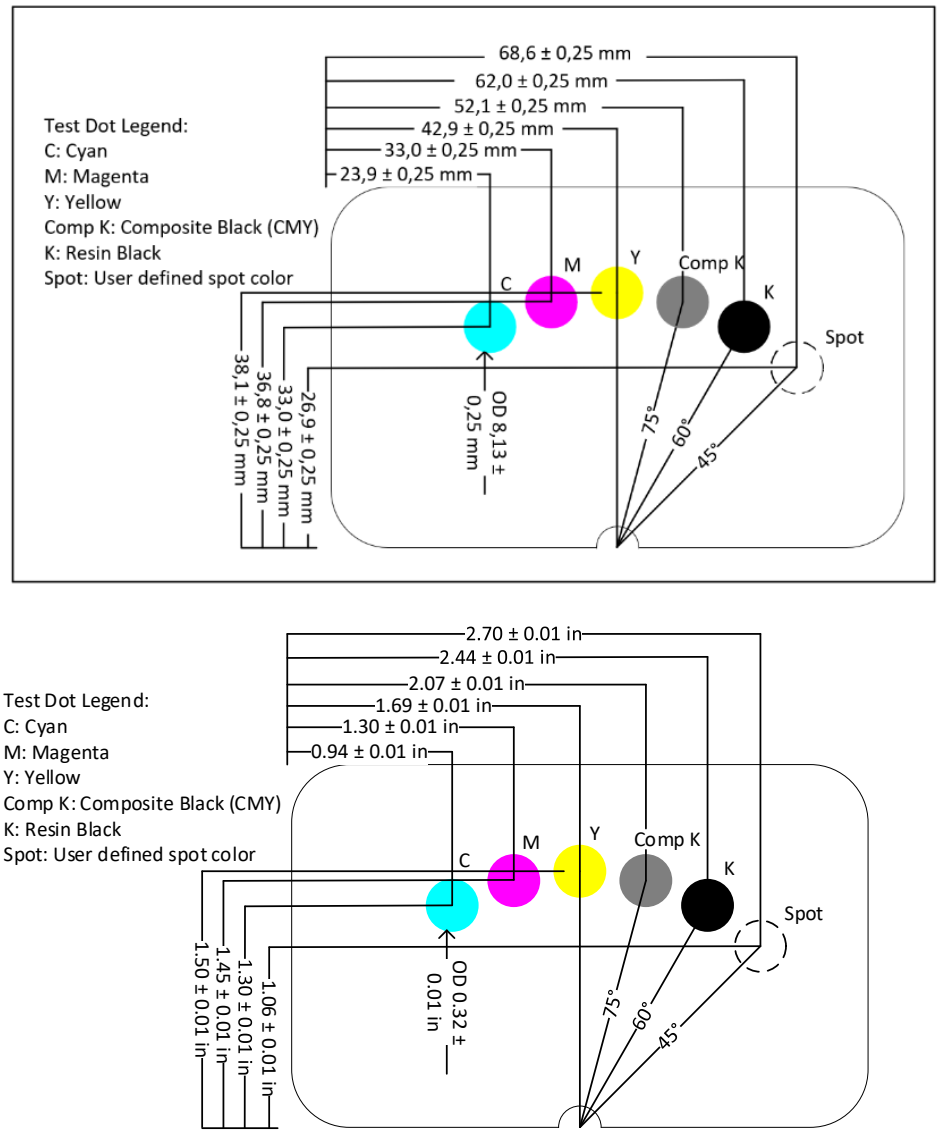


Figure 22 - Image test location

NOTE: Additional color dots may be positioned outside the abrasion path to provide control areas.

5.11.5 Test Report

Report the number of abrasion cycles required to reach the stopping point for each card tested.

5.11.6 Precision and Bias

Test repeatability has not been established for this method.

The abraser apparatus and abrasive wheels may be obtained from Taber Industries. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.12 Temperature & Humidity Induced Dye Migration

The purpose of this test is to determine the extent of dye migration (blurring) of printed information on a card. Elevated temperature/humidity can accelerate the dye migration.

5.12.1 Significance and Use

This test method measures the ability of print dyes to migrate laterally within the card construction (resulting in blurred images).

5.12.2 Apparatus

Laboratory chamber capable of controlling set temperature within ± 2°C (± 3.6°F) and controlling relative humidity to 95 ± 5%, noncondensing, or an oven plus a sealable test container with a saturated aqueous solution of potassium sulfate.

If laboratory chamber capable of controlling temperature and humidity is used:

Test Card Holder that is constructed in such a way that permits exposure of the humid air to both surfaces of the card.

NOTE: Redbrand hardware cloth (¼ in x ¼ in wire spacing. 23 gauge wire; metric equivalent is 6,25 mm x 6,25 mm wire spacing with 0,6 mm wire diameter) or stainless steel welded wire cloth (McMaster-Carr) has shown to provide proper card support.

Reflection Densitometer (status I response)*

* Recommended Reflection Densitometer characteristics - aperture 4 – 6 mm (0.16 – 0.25 in), white base absolute, polarized filter D65 light source and 10 degree standard observer angle

If an oven plus a sealable container with a saturated aqueous solution of potassium sulfate is used:

Laboratory Oven capable of maintaining 50°C ± 2°C (122°F ± 4°F)

Test Container – a sealable test container equipped with a water reservoir above which test cards are mounted in such a way to insure the cards are not touching each other.

Test Card Holder - constructed in such a way that permits exposure of the humid air to both surfaces of the card and sufficient to support cards with the face of the card parallel to the water line, while minimizing card warpage.

Potassium Sulfate (K_2SO_4)

Reflection Densitometer (status I response)*

* Recommended Reflection Densitometer characteristics - aperture 4 – 6 mm (0.16 – 0.25 in), white base absolute, polarized filter D65 light source and 10 degree standard observer angle.

5.12.3 Precondition

The test cards must be prepared with the halftone (checkerboard) images as described in Figure 23 (position of images does not matter, as long as they do not overlap).

Note: Typical (not required) color densities on cards printed for this test are:

Yellow	0.45 to 0.65	Magenta	0.40 to 0.60
Cyan	0.40 to 0.60	Composite black	0.40 to 0.60

The black test sample must be made using the YMC ribbon (composite black).

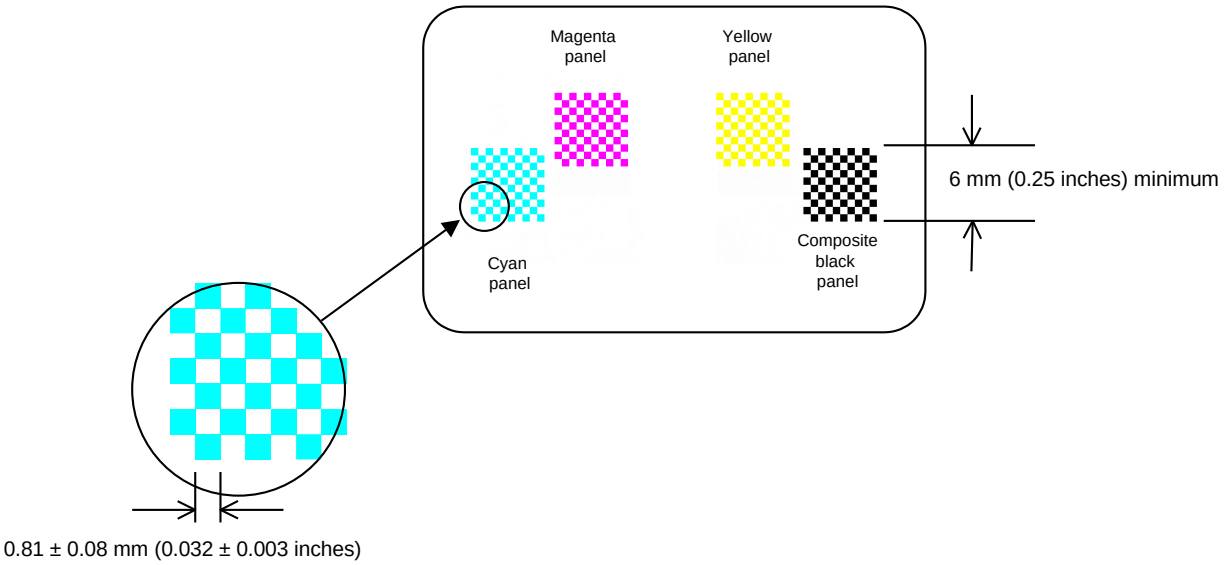


Figure 23 - Temp/Humidity dye migration test pattern

5.12.4 Procedure

Two procedures are detailed here, corresponding to the two types of chambers that may be utilized to control the relative humidity level.

5.12.4.1 Procedure Using Temperature and Humidity Controlled Chamber

Measure and record the reflection density of the black, yellow, magenta and cyan test areas using the appropriate filters. Measure in the center of the test area. Record the densities.

NOTE: Density measurements taken on areas covered by security features may produce inconsistent results.

Place cards, image side up, on the card holder. Insert the cards and card holder into a 50°C (122°F) and 95% ± 5% RH, noncondensing, chamber for a period of 168 hr (7 days).

Remove the cards from the chamber and allow them to equilibrate at room temperature/humidity for greater than 1 hr.

Re-measure and record the reflection density of the black, yellow, magenta and cyan test areas using the appropriate filters. Measure in the center of the test area. Record the densities.

5.12.4.2 Procedure Using Saturated Aqueous Solution of Potassium Sulfate

Prepare a saturated water solution consisting of 12,0 g (0.026 lb_m) of K_2SO_4 per 100 g (0.22 lb_m) distilled water (saturation is 12,0 g (per 100 cm^3 at 25°C).

Pour the saturated K_2SO_4 solution into the bottom of the test container. The depth of the K_2SO_4 solution should be at least 5 mm (0.2 in) deep. Add an additional 6 g (0.013 lb_m) of K_2SO_4 solid per 100 g (0.22 lb_m) of the saturated solution. (Some solid K_2SO_4 will be present in the bottom of the test container. This will ensure a saturated K_2SO_4 solution is present at the elevated test temperatures.)

Measure and record the reflection density of the black, yellow, magenta and cyan test areas using the appropriate filters. Measure in the center of the test area. Record the densities.

NOTE: Density measurements taken on areas covered by security features may produce inconsistent results.

Place cards, image side up, in the holder that keeps the cards parallel to the water line. The bottom of the cards should be a minimum of 5 mm (0.2 in) above the K_2SO_4 solution.

Seal the test container and place it into a 50°C (122°F) oven for a period of 168 hr (7 days). (Some solid K_2SO_4 shall remain in the bottom of the test chamber.) The K_2SO_4 solution will keep the relative humidity at 95 ± 5 percent and will minimize the possibility of condensing humidity.

Remove the cards from the oven and allow them to equilibrate at room temperature/humidity for greater than 1 hr.

Re-measure and record the reflection density of the black, yellow, magenta and cyan test areas using the appropriate filters. Measure in the center of the test area. Record the densities.

5.12.5 Test Report
Report the percent increase or decrease in reflection density of the black, yellow, magenta and cyan test areas.

5.12.6 Precision and Bias

5.12.6.1 Interlaboratory Test Program
An interlaboratory study of Temperature and Humidity Induced Dye Migration was run in 2000. Four sets of samples were run by two different laboratories.

5.12.6.2 Test Results
The precision information given below in the units of measurement (% Increase in density) is for the comparison of sixteen test results for each laboratory, each of which is the average of six test determinations.

5.12.6.3 Precision

	95% confidence interval (% increase)	99% confidence interval (% increase)
Repeatability limit (within laboratory)	+/- 12	+/- 16
Reproducibility limit (among laboratories)	+/- 7	+/- 10
Test Measurement Tolerance (overall)	+/- 14	+/- 19

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.12.6.4 Bias
No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.13 Plasticizer Induced Dye Migration

The purpose of this test is to determine the resistance of a card to plasticizer attack. Cards with inadequate resistance can have printed dye degradation, especially if stored in plasticized vinyl sleeves.

Phthalates have historically been used as plasticizers for vinyl sleeves and have been observed to cause degradation of print on cards.

5.13.1 Significance and Use

This test simulates the effect of storing a card in a plasticized vinyl pouch.

5.13.2 Apparatus

Dioctyl terephthalate (DOTP) Plasticizer (liquid)
#10 Wire wound rod
Laboratory oven capable of 40°C ± 1°C (104°F ± 2°F)
Steel oven sheet
1 mil Polyester (non-treated) sheet cut to card size
Card flexure apparatus as described in Clause 5.3 ID-1 Card Flexure
The horizontal displacement dimensions below are intended to replicate the vertical displacement dimensions specified in the Dynamic Bending Stress test method described in ISO/IEC 10373-1. This flexure method differs from ISO/IEC 10373-1 in rate of flex and is intended to assess the structural integrity of a card.

5.3.1 Significance and Use

This test method may be used for in-process card fabrication evaluations, material selections, when the flexure characteristics of a card is desired to be tested and when a card type is suspected of being "brittle" or have experienced early field fractures. Flexure characteristic of a card is a function of fabrication process conditions, card materials, card thickness, presence or absence of embossed characters, or presence or absence of surface applied decorations.

5.3.2 Apparatus

ID-1 Card flexure apparatus is constructed to meet the extent of flexure and jaw dimensions as described in ISO/IEC 10373-1.

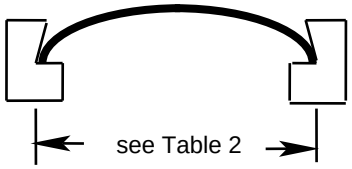


Figure 7 - Full flex condition

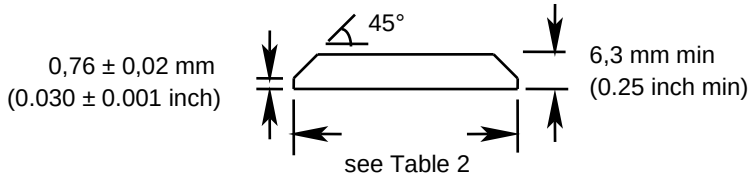


Figure 8 - Cross section - calibration plate

The flexure apparatus is equipped with jaws in which the card is mounted during flexure. Jaw dimensions are specified below:

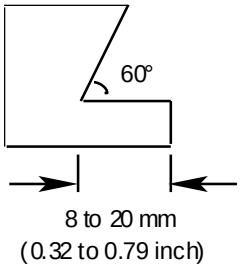


Figure 9 - Jaw details

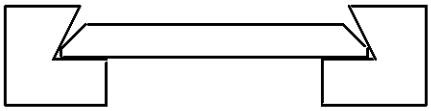


Figure 10 - Calibration plate inside jaws

Table 2 –Calibration plate dimensions

Card Orientation	Minimum flex calibration plate dimension	Jaw Stroke Length
Axis A	85,12 ± 0,05 mm (3.351 ± 0.002 in)	11,21 ± 0,40 mm (0.441 ± 0.015 in)
Axis B	53,67 ± 0,05 mm (2.113 ± 0.002 in)	3,89 ± 0,40 mm (0.153 ± 0.015 in)

Note 1: The use of “calibration plates” or other tooling that provides spacing between the jaws can be helpful in achieving the minimum flex conditions, as shown in Figures 8 and 10. The length of the calibration plate is to be at least the length of the jaw.

Note 2: The apparatus defined in ISO/IEC 10373-1 Dynamic Bending will yield identical card displacement as the apparatus defined above. Use of an apparatus as per ISO/IEC 10373-1 is acceptable for this standard if the flexure rate is adjusted to 60 ± 1 cycles per minute.

The flexure apparatus shall operate at 60 ± 1 cycles per minute and be equipped a reliable means to count the number of cycles. The motion of the moving jaw shall be determined by a steady state circular drive (sinusoidal motion).

5.3.3 Procedure

Mount card in the flexure apparatus in such a manner that when the apparatus is active, the card bends upward in the jaws. If possible, mount the cards when the jaws are in their minimum flex position.

Start the flexure apparatus. Observe the test card after every 1000 cycles (unless experience with the card construction suggests that the card resists fractures for a minimum number of cycles). Unless otherwise specified, the stopping point is achieved when a single fracture of at least 13 mm (0.5 in) long is observed or a combination of 5 fractures or fewer that total at least 13 mm (0.5 in) are observed. Close attention must be paid during the test when cards begin to fracture since fractures can progress rapidly. The test may be stopped after 100000 cycles have occurred without card fracture. Report the number of cycles to stopping point occurred for each card (to the nearest 1000 cycles).

During observations periods, do not permit the card under test to remain under mechanical stress when not being flexed for more than 5 minutes. Remove the cards from the jaws if the test must be suspended before completion.

The following routines have been identified for any card construction.

Axis A Flexure
This routine flexes the card around Axis A with the surface of interest face up in the apparatus.

Axis B Flexure
This routine flexes the card around Axis B with the surface of interest face up in the apparatus.

Note: Test results can vary depending on which side of the card is under extension (side up). Thus, it is recommended to conduct the test on separate cards with each side under extension.

Figure 11 - Card orientation

5.3.4 Test Report

Report the following:
Number of cycles to stopping point to the nearest 1000 cycles for each axis

Description of which card side and location the fracture occurred.
Full description of card design features (printing, IC, photo, mag stripe, embossing, etc.)

5.3.5 Precision and Bias

5.3.5.1 Interlaboratory Test Program

An interlaboratory study of ID-1 Card Flexure was run in 1998. Sixteen sets of samples were run by four different laboratories.

5.3.5.2 Test Results

The precision information given below in the units of measurement (flex cycles until stopping point) is for the comparison of twelve test results for each laboratory, each of which is the average of six test determinations.

5.3.5.3 Precision

	95% confidence interval (cycles)	99% confidence interval (cycles)
Repeatability limit (within laboratory)	+/- 5300	+/- 7000
Reproducibility limit (among laboratories)	+/- 6800	+/- 9000
Test Measurement Tolerance (overall)	+/- 8700	+/- 11000

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.3.5.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

Bar Code Verifier (ISO/IEC 15416 compliant) OR
Bar Code Verifier (ANSI/INCITS 182 compliant) – 0,13 mm (0.005 in) aperture, 675 ± 15 nm

CAUTION: DOTP is used in this test. The Safety Data Sheet (SDS) must be read and understood before proceeding with testing. Use of protective gloves is required whenever handling DOTP. Any spills or contaminated equipment must be immediately cleaned to prevent exposure to others. Safely dispose of all cards, polyester film and gloves to avoid accidental contact with DOTP. Hands should be thoroughly washed with soap and water after handling DOTP.

5.13.3 Precondition

The test cards must possess an ISO/IEC 15416 or ANSI/INCITS 182 compliant, dye diffusion printed 1D bar code generally in the center of the card. See Figure 24.

5.13.4 Procedure

Use the barcode verifier to determine edge contrast for each test card. Mark each card with an identifier and record the edge contrast value (record edge contrast value, not ISO or ANSI grade).

Using the flexure apparatus, flex the test cards face up and face down for 300 cycles in each axis orientation (1200 cycles total). See Clause 5.3 ID-1 Card Flexure
The horizontal displacement dimensions below are intended to replicate the vertical displacement dimensions specified in the Dynamic Bending Stress test method described in ISO/IEC 10373-1. This flexure method differs from ISO/IEC 10373-1 in rate of flex and is intended to assess the structural integrity of a card.

5.3.1 Significance and Use

This test method may be used for in-process card fabrication evaluations, material selections, when the flexure characteristics of a card is desired to be tested and when a card type is suspected of being "brittle" or have experienced early field fractures. Flexure characteristic of a card is a function of fabrication process conditions, card materials, card thickness, presence or absence of embossed characters, or presence or absence of surface applied decorations.

5.3.2 Apparatus

ID-1 Card flexure apparatus is constructed to meet the extent of flexure and jaw dimensions as described in ISO/IEC 10373-1.

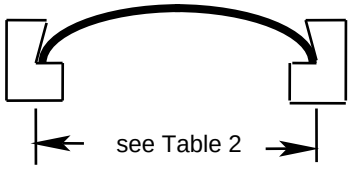


Figure 7 - Full flex condition

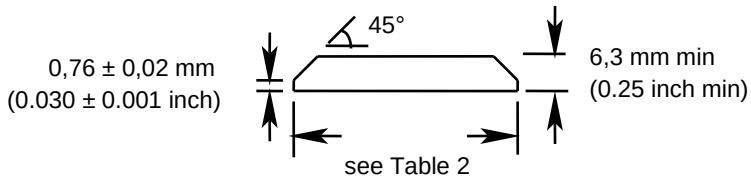


Figure 8 - Cross section - calibration plate

The flexure apparatus is equipped with jaws in which the card is mounted during flexure. Jaw dimensions are specified below:

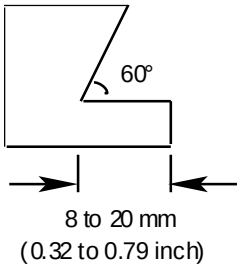


Figure 9 - Jaw details

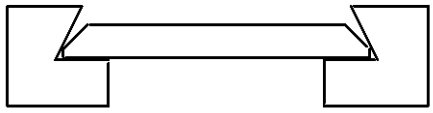


Figure 10 - Calibration plate inside jaws

Table 2 –Calibration plate dimensions

Card Orientation	Minimum flex calibration plate dimension	Jaw Stroke Length
Axis A	85,12 ± 0,05 mm (3.351 ± 0.002 in)	11,21 ± 0,40 mm (0.441 ± 0.015 in)
Axis B	53,67 ± 0,05 mm (2.113 ± 0.002 in)	3,89 ± 0,40 mm (0.153 ± 0.015 in)

Note 1: The use of “calibration plates” or other tooling that provides spacing between the jaws can be helpful in achieving the minimum flex conditions, as shown in Figures 8 and 10. The length of the calibration plate is to be at least the length of the jaw.

Note 2: The apparatus defined in ISO/IEC 10373-1 Dynamic Bending will yield identical card displacement as the apparatus defined above. Use of an apparatus as per ISO/IEC 10373-1 is acceptable for this standard if the flexure rate is adjusted to 60 ± 1 cycles per minute.

The flexure apparatus shall operate at 60 ± 1 cycles per minute and be equipped a reliable means to count the number of cycles. The motion of the moving jaw shall be determined by a steady state circular drive (sinusoidal motion).

5.3.3 Procedure

Mount card in the flexure apparatus in such a manner that when the apparatus is active, the card bends upward in the jaws. If possible, mount the cards when the jaws are in their minimum flex position.

Start the flexure apparatus. Observe the test card after every 1000 cycles (unless experience with the card construction suggests that the card resists fractures for a minimum number of cycles). Unless otherwise specified, the stopping point is achieved when a single fracture of at least 13 mm (0.5 in) long is observed or a combination of 5 fractures or fewer that total at least 13 mm (0.5 in) are observed. Close attention must be paid during the test when cards begin to fracture since fractures can progress rapidly. The test may be stopped after 100000 cycles have occurred without card fracture. Report the number of cycles to stopping point occurred for each card (to the nearest 1000 cycles).

During observations periods, do not permit the card under test to remain under mechanical stress when not being flexed for more than 5 minutes. Remove the cards from the jaws if the test must be suspended before completion.

The following routines have been identified for any card construction.

Axis A Flexure
This routine flexes the card around Axis A with the surface of interest face up in the apparatus.

Axis B Flexure
This routine flexes the card around Axis B with the surface of interest face up in the apparatus.

Note: Test results can vary depending on which side of the card is under extension (side up). Thus, it is recommended to conduct the test on separate cards with each side under extension.

Figure 11 - Card orientation

5.3.4 Test Report

Report the following:
Number of cycles to stopping point to the nearest 1000 cycles for each axis

Description of which card side and location the fracture occurred.
Full description of card design features (printing, IC, photo, mag stripe, embossing, etc.)

5.3.5 Precision and Bias

5.3.5.1 Interlaboratory Test Program

An interlaboratory study of ID-1 Card Flexure was run in 1998. Sixteen sets of samples were run by four different laboratories.

5.3.5.2 Test Results

The precision information given below in the units of measurement (flex cycles until stopping point) is for the comparison of twelve test results for each laboratory, each of which is the average of six test determinations.

5.3.5.3 Precision

	95% confidence interval (cycles)	99% confidence interval (cycles)
Repeatability limit (within laboratory)	+/- 5300	+/- 7000
Reproducibility limit (among laboratories)	+/- 6800	+/- 9000
Test Measurement Tolerance (overall)	+/- 8700	+/- 11000

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.3.5.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

for apparatus.

Stack the test cards together and apply a 1 to 2 N (0.22 to 0.45 lb_f) load to the stack of cards. Allow the test cards to relax in this condition for a minimum of 16 hours.

Using the #10 wire rod, evenly coat the DOTP on the card surface of interest. Cover the DOTP coated surface with the polyester sheet.

Place the test cards on the steel oven sheet and place into the laboratory oven set at 40°C (104°F).

The test cards (separate cards for each exposure period) are exposed to 40°C (104°F). Initial exposure recommendations are for 2, 4, 8, 16, 24, 32 and 48 hr. Other exposure times may be warranted depending upon initial test results. After the appropriate exposure periods, remove the cards from the oven. Discard the cover sheet and wash the cards with soap/water to remove the plasticizer and any dissolved dye.

Determine edge contrast for the tested/washed cards. Calculate percent of original edge contrast for each tested card. If the barcode degrades to the point that it does not read, record the retained edge contrast as 25%.

Plot % retained edge contrast versus exposure time. Determine the time for the edge contrast to fall to 75% of its original value via the plot. Record this time as the stopping point.

Notes:
1. A medium density Code 39 bar code is recommended as a test pattern.
2. The 1D bar code must be positioned in the center of the card as the center of the card receives the greatest stress from flexing.

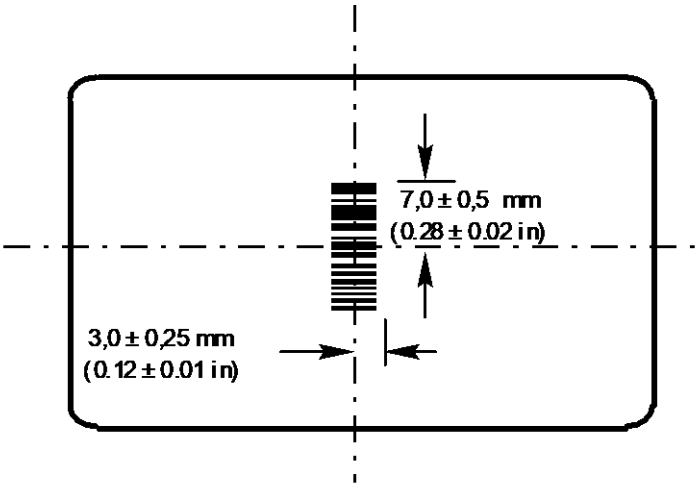


Figure 24 - Bar code print location

5.13.5 Test Report
Report the time to stopping point along with a graph of edge contrast versus exposure time.

5.13.6 Precision and Bias

5.13.6.1 Interlaboratory Test Program
An interlaboratory study of Plasticizer Induced Dye Migration was run in 2000. Three sets of samples were run by two different laboratories.

5.13.6.2 Test Results
The precision information given below in the units of measurement (Hours to stopping point) is for the comparison of two test results for each laboratory, each of which is the average of six test determinations.

5.13.6.3 Precision

	95% confidence interval (hours)	99% confidence interval (hours)
Repeatability limit (within laboratory)	+/- 3	+/- 4
Reproducibility limit (among laboratories)	+/- 0	+/- 0
Test Measurement Tolerance (overall)	+/- 3	+/- 4

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177 The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.13.6.4 Bias
No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.14 Ultraviolet (UV) Light Exposure

The purpose of this test is to determine the extent of card material degradation primarily due to breakdown of physical properties and/or discoloration after exposure to UV light & elevated temperature.

5.14.1 Significance and Use

A change in the physical and coloration properties of a card when it is exposed to UV light can be significant for many card applications. This method is useful for comparing card materials and may be used in a sequence of tests (see clause 6).

Light stability characterization of a card may be achieved by subjecting one card set to this ultraviolet light exposure test method. Accelerated test devices provide only relative indications of which card material components perform best under a specific set of test conditions.

5.14.2 Apparatus

Test Chamber - a chamber constructed in which a bank of four lamps are mounted on 70 mm (2.75 in) centers. A chamber temperature of 50°C ± 5°C (122°F ± 9°F) is to be maintained during the test period. See ASTM G154 for additional discussion of the test chamber.

Lamps - UVA-340 lamps - 40 watt, 1220 mm (48 in) long fluorescent with peak emissions at 343 nm and spectral energy distribution as shown in ASTM D4329 -figure 1.

For equipment with irradiance control, set to 0.72 W/m^2.

Card Mounts - The cards under test are to be mounted on a rigid plate 50 mm (2.0 in) from the surface of the lamps. Only the center 900 mm (35 in) of the fluorescent lamps are to be used for card exposure.

Note: In the case where an unprinted area exists on the card, either a Reflection Densitometer (Status I response) or Spectrophotometer can be used to measure a change in base card color.

5.14.3 Procedure

Keep a set of control cards of the same type under test for visual comparison after the UV light exposure.

Mount the cards on the rigid plate with the card surface of interest exposed and place the test cards in the test chamber. Close the chamber to prevent UV radiation leakage.

Expose the cards to the UV light for 168 hr (7 days).

CAUTION: UV light exposure may cause severe sunburn or eye damage. Avoid looking at the illuminated lamps. Deactivate lamps when placing or removing cards.

5.14.4 Test Report

Report the physical appearance of the cards before and after the UV light exposure with the control cards. Report observations using light booth with D65 lighting. Report number of hours of UV light exposure. Report the densitometer model and calibration standards, if used.

5.14.5 Precision and Bias

Test repeatability has not been established for this method.

The above apparatus may be obtained from Q-Panel and Atlas Material Testing. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.15 Daylight Exposure Image Stability - Xenon Arc

The purpose of this test is to determine the extent of color change after exposure to artificial sunlight.

The test may be performed using a window glass filter for simulating sunlight through a window and without the window glass filter for simulating outdoor exposure.

5.15.1 Significance and Use

Color images and variable print data are often susceptible to fading when exposed to sunlight. In addition, yellowing and physical deterioration of the base card may occur.

The stability of color print data and images (including composite black), is primarily affected by the intensity of illumination, the duration of the light exposure, the spectral distribution of the illuminant and the ambient environmental conditions.

5.15.2 Apparatus

Xenon Arc Test Chamber shall comply with ISO 4892-1, ISO 4892-2 and shall include a xenon-arc lamp with daylight (Test Cycle A) or window glass filters (Test Cycle B) in accordance with ISO 4892-2.
A black-standard thermometer (BST) or a black panel thermometer (BPT) in accordance with ISO 4892-1 and EN ISO 4892-2.
A device to determine the spectral irradiance and the radiant exposures in the band pass of 300 nm to 800 nm, or a spectral irradiance in the band pass of 300 nm to 400 nm or a spectral irradiance at 340 nm or a spectral irradiance at 420 nm according to ISO 9370.
Specimen holders according to ISO 4892-2:2013, 4.6 with a stainless steel or aluminum backing.

Reflection Densitometer (Status I response) – optional*

* Recommended Reflection Densitometer characteristics - aperture 4 –6 mm, (0.16 – 0.25 in)white base absolute, polarized filter, D50 light source and 2 degree standard observer angle.

Spectrophotometer to measure Lab color space as per ISO 11664. Spectrophotometer shall have ability to measure with D50 light source, 2 degree observer angle, polarized filter and absolute white base reference.

5.15.3 Precondition

If color change measurements are needed, the test card must possess the three process colors (cyan, magenta and yellow) in a minimum 8 mm square area (or 8 mm diameter circle) for each color located on one of the card surfaces.

5.15.4 Procedure

If needed, measure the color density and Lab color of each color before Xenon arc exposure. (Refer to the densitometer manual for proper filter selection for each color.) Measure color and Lab color density on base card color. Note location of measurements.

Mount the cards in the specimen holders with the card surface of interest exposed and place the test cards in the test chamber. Close the chamber to prevent leakage. Expose the cards to the Xenon arc for 168 hrs (7 days) outdoor conditions (Test Cycle A) or indoor conditions (Test Cycle B)

Note: The resulting irradiance depends on the type and age of the optical system and might cause variation in the results.

Test Cycle A: Exposure using daylight filters according to ISO 4892-2					
Irradiance			Black standard temperature [°C][1]	Chamber temperature [°C]	Relative humidity %
Broadband UV 300-400 nm [W/m2]	Narrowband [W/(m2•nm)] (@340 nm)	Wideband 300–800 nm [W/m2]			
60 ± 2	0,51 ± 0,02	550 ±55	50 ± 3	35 ± 3	30 ± 10

[1]If a black panel sensor is used, the set point temperature shall be 47°C with allowable fluctuation ± 3 °C.

Note 1: Recommended for chambers that control these parameters. If other values are used, they shall be included in the test report. For instruments without chamber air temperature or relative humidity control these parameters are allowed to find their own level

Note 2: SI to US customary unit conversions: 1 W/m^2 = 0.316998 Btu(IT)/ft^2 ; 50°C = 113°F, 35°C = 95°F

Test Cycle B: Exposure using window glass filters according to ISO 4892-2						
Irradiance				Black standard temperature [°C][1]	Chamber temperature [°C]	Relative humidity %
Broadband UV 300-400 nm [W/m2]	Narrowband [W/(m2 •nm)] (@340 nm)	Narrowband [W/(m2 •nm)] (@420 nm)	Wideband 300–800 nm [W/m2]			
50 ± 2	0,35 ± 0,02	1,1 ± 0,02	550 ± 55	50 ± 3	35 ± 3	30 ± 10

[1]If a black panel sensor is used, the set point temperature shall be 47°C with allowable fluctuation ± 3 °C.

Note 1: Recommended for chambers that control these parameters. If other values are used, they shall be included in the test report. For instruments without chamber air temperature or relative humidity control these parameters are allowed to find their own level.

Note 2: SI to US customary unit conversions: 1 W/m^2 = 0.316998 Btu(IT)/ft^2 ; 50°C = 113°F, 35°C = 95°F

Re-measure the color density and Lab color of each color and base card color, at the same location, after Xenon light exposure.

5.15.5 Test Report

Report number of hours of Xenon arc light exposure and any color change observations.

(for color change measurement option)
Report the color densities and Lab colors before and after Xenon arc light exposure. Report percent color density change and ΔE_{2000} color change. Report the densitometer and spectrophotometer models and calibration standards used for each.

5.15.6 Precision and Bias

Test repeatability has not been established for this method.

5.16 Laundry Test

The purpose of this test is to determine the physical effects on cards when accidentally subjected to conditions encountered during the process of washing and drying clothing.

5.16.1 Significance and Use

The physical properties of a card may degrade when accidentally exposed to a clothes washer and dryer. This method is useful for comparing card materials.

Substantial variability in the operating conditions of automatic clothes washer and dryer equipment is known to exist. However, this test procedure has been of interest in certain card applications where such exposure results in damage that requires unscheduled re-issuance of the card.

5.16.2 Apparatus

Multi-cycle, top loading agitating washing machine
Multi-cycle clothes dryer (household model)
Detergent - AATCC 1993 Standard Detergent or recommended detergent
Test Fabrics - 4 pairs of long pants, men's poly/cotton blend, color fast, 4 pockets each
Safety pins
Water softening agents if conducting the test in area known to have hard water.

5.16.3 Procedure

Place the test cards in the pants, 1 per pocket, and close the pocket with a safety pin if needed.
Set washer to medium water level, hot wash, permanent press cycle, 10-minute wash cycle, allow washer to start filling.
Add washer manufacturers recommended amount of detergent.
Add pants containing cards to washer. Always add all 4 pairs of pants, even if the pockets are not filled.
Water temperature in the washing machine drum is to be 50°C ± 5°C (122°F ± 10° F) before adding clothes. Record temperature.
When cycle is complete, remove all the clothing and transfer into the dryer.
Operate the dryer using the permanent press cycle, until dry. Note – the permanent press cycle consists of heat, followed by cool down, some preliminary testing will need to be done to determine the time needed to dry the clothes, and allow the clothes to cool down. Record total dryer cycle time.

5.16.4 Test Report

Report extent of delamination, cracking, warpage, abrasion or water penetration that prevents card usability. Report water temperature, dryer cycle time, name or type and amount of water softening agent, if used.

5.16.5 Precision and Bias

Test repeatability has not been established for this method.

The detergent may be obtained from American Association of Textile Chemists and Colorists (website: AATCC.org Order # 8349 10 pound bucket) This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.17 Embossed Character Retention - Pressure

The purpose of this test is to determine the change in embossed character relief height after application of pressure.

5.17.1 Significance and Use

This test method can be used for card material evaluations where embossed character height retention is important for the card application. Pressure and heat are the two known causes for loss of embossed character relief height. The ability of a card to retain its embossed character relief height when used in card imprinters is a function of the card materials, card thickness, imprinter and the carbon/carbonless forms. This method simulates the pressure of a "typical" card imprinter on an embossed character without the variations inherent in imprinters and forms.

5.17.2 Apparatus

Test stand that applies 245 ± 4 N (55 ±1 lb_f) on a steel anvil possessing a round flat of 6,4 mm (0.25 in) diameter.
Micrometer or Dial Caliper accurate to ± 0,01 mm (± 0.0005 in) equipped with the collar detailed in Figure 26 and Figure 27 or similar measuring device.

5.17.3 Precondition

Emboss the test card with at least 5 OCR (Farrington 7B) "0" characters spaced apart by one space located on the Account Number line as defined in ISO/IEC 7811-1. See Figure 25 below.

Gauge calibration: Place the character height gauge anvil in direct contact with a flat surface. Make necessary adjustments to the gauge/collar to obtain a reading of zero (0).

5.17.4 Procedure

Measure the relief height of the OCR embossed characters of the test card. Place the test card character side up on the flat surface previously used for calibration. Position the character height gauge over the embossed character to be measured and press down with the collar of the gauge to obtain the maximum dial reading.

Place the embossed test card on the Test stand in such a manner that one of the embossed characters is placed under the anvil.

Apply the 245 ± 4 N (55 ± 1 lb_f) force on the embossed character for a period of one minute.

Wait at least 5 min before measuring the resulting character height after the force is removed. Measurement shall be made with the Micrometer or Dial Caliper by touch without ratcheting (if feature present).

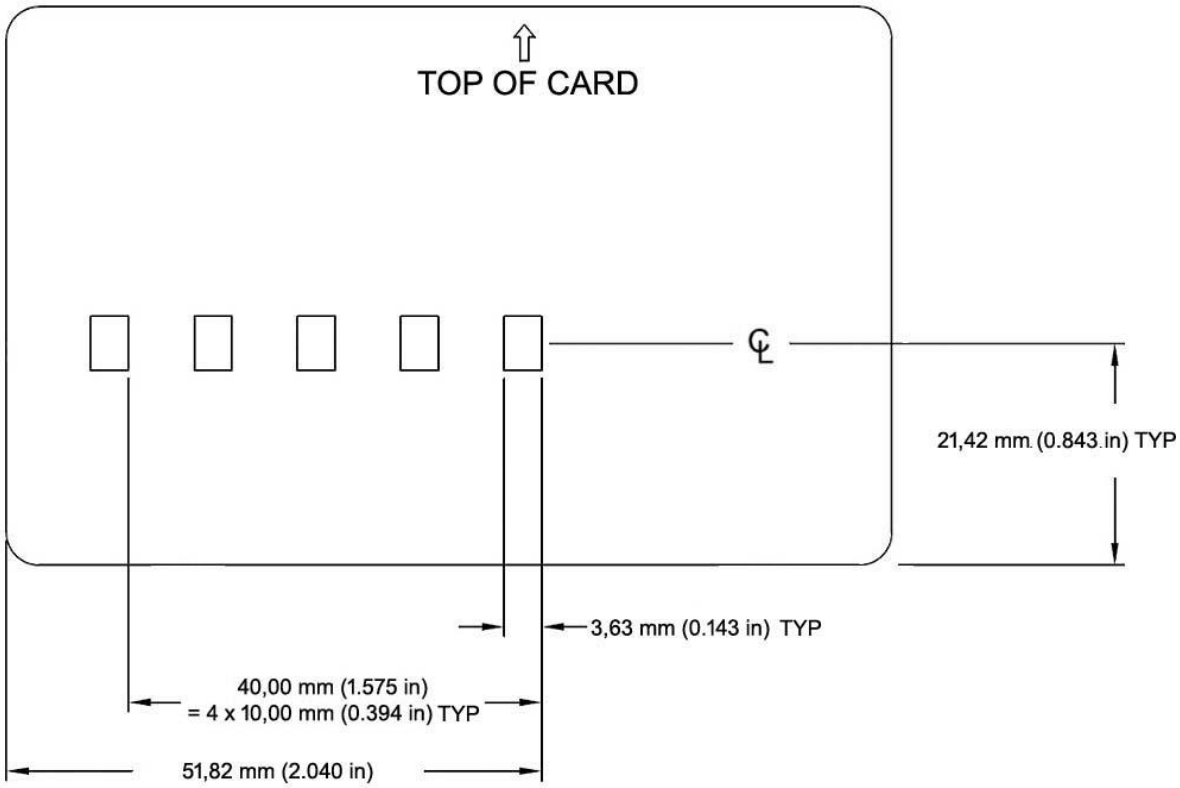


Figure 25 - Embossed character test locations

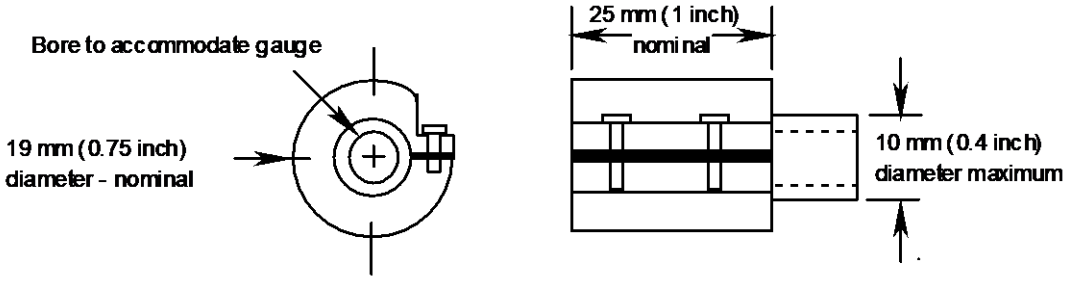


Figure 26 - Gauge collar

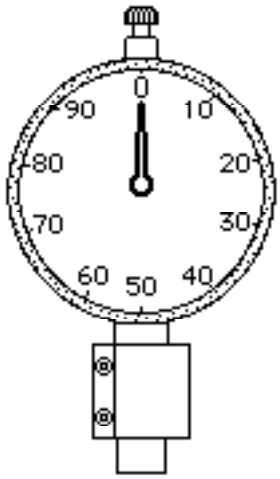


Figure 27 - Embossed character height gauge

5.17.5 Test Report

Record character relief height loss (Relief height before - Relief height after) in millimeters (inches).

5.17.6 Precision and Bias

5.17.6.1 Interlaboratory Test Program

An interlaboratory study of Embossed Character Retention - Pressure was run in 1999. Two sets of samples were run by two different laboratories.

5.17.6.2 Test Results

The precision information given below in the units of measurement (Character Height Loss (in mils or μm)) is for the comparison of six test results for each laboratory, each of which is the average of five test determinations.

The above apparatus may be obtained from Eclipse Laboratories, Inc. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.17.6.3 Precision

	95% confidence interval		99% confidence interval	
	mil	μm	mil	μm
Repeatability limit (within laboratory)	+/- 0.8	+/- 20	+/- 1.1	+/- 28
Reproducibility limit (among laboratories)	+/- 0.2	+/- 5	+/- 0.3	+/- 8
Test Measurement Tolerance (overall)	+/- 0.8	+/- 20	+/- 1.1	+/- 28

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.17.6.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.18 Embossed Character Relief Height Retention - Heat

The purpose of this test is to determine the change in embossed character relief height after application of heat.

5.18.1 Significance and Use

This test method may be used for card material evaluations where embossed character height retention is important for the card application. Pressure and heat are the two known causes for loss of embossed character relief height. The ability of a card to retain its embossed character relief height when exposed to elevated temperatures is a function of the card materials and card thickness. This method simulates a typical temperature obtainable on an automobile dashboard.

5.18.2 Apparatus

Laboratory oven capable of maintaining 65°C ± 2°C (149°F ± 4°F)
Card rack with card slots spaced at least 16 mm (0.625 in) apart.
Micrometer or Dial Caliper accurate to ± 0,01 mm (± 0.0005 in) with a spring force of 0,7 N to 1,4 N (0.2 to 0.3 lb_f) and equipped with the collar detailed in Figure 26 and Figure 27 or similar measuring device.

5.18.3 Precondition

Emboss the test card with at least 5 OCR (Farrington 7B) "0" characters spaced apart by one space located on the account number line as defined in ISO/IEC 7811-1. See Figure 25.

Gauge calibration: Place the character height gauge anvil in direct contact with a flat surface. Make necessary adjustments to the gauge/collar to obtain a reading of zero (0).

5.18.4 Procedure

Measure the relief height of the OCR embossed characters of the test card. Place the test card character side up on the flat surface previously used for calibration. Position the character height gauge over the embossed character to be measured and press down with the collar of the gauge to obtain the maximum dial reading.

Place the test cards in the rack such that each card is separated by at least 16 mm (0.625 in) from any adjacent card.

Place the card rack in the laboratory oven, set at 65°C (149°F) for 4 hours.

After a minimum of 1 hour cooling period, measure the resulting embossed character relief height.

5.18.5 Test Report

Record character relief height loss (Relief height before - Relief height after) in millimeters (inches).

5.18.6 Precision and Bias

5.18.6.1 Interlaboratory Test Program

An interlaboratory study of Embossed Character Retention - Heat was run in 1999. Two sets of samples were run by three different laboratories.

5.18.6.2 Test Results

The precision information given below in the units of measurement (Character Height Loss (in mil or μm)) is for the comparison of six test results for each laboratory, each of which is the average of five test determinations.

5.18.6.3 Precision

	95% confidence interval		99% confidence interval (mil)	
	mil	μm	mil	μm
Repeatability limit (within laboratory)	+/- 0.5	+/- 13	+/- 0.6	+/- 15
Reproducibility limit (among laboratories)	+/- 1.3	+/- 33	+/- 1.7	+/- 43
Test Measurement Tolerance (overall)	+/- 1.4	+/- 36	+/- 1.8	+/- 46

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177. The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.18.6.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.19 Corner Impact Test

The purpose of this test is to evaluate the ability of a card to resist delamination and cracking when subjected to an impact directed at a corner.

5.19.1 Significance and Use

This test method may be used for in-process card fabrication evaluations, material selections and when a card type is suspected of delaminating or being "brittle".

5.19.2 Apparatus

Card impact fixture (see Figure 28)

5.19.3 Procedure

Mount the card in the impact weight, as shown in Figure 28.

Raise the impact weight to the specified height and let the impact weight fall.

Remove the test card and inspect for signs of delamination and/or fracture.

NOTE: The presence of internal elements such as antenna wire near the impact area may affect test results.

CAUTION: Safety glasses are recommended to be worn during this test to prevent eye injury.

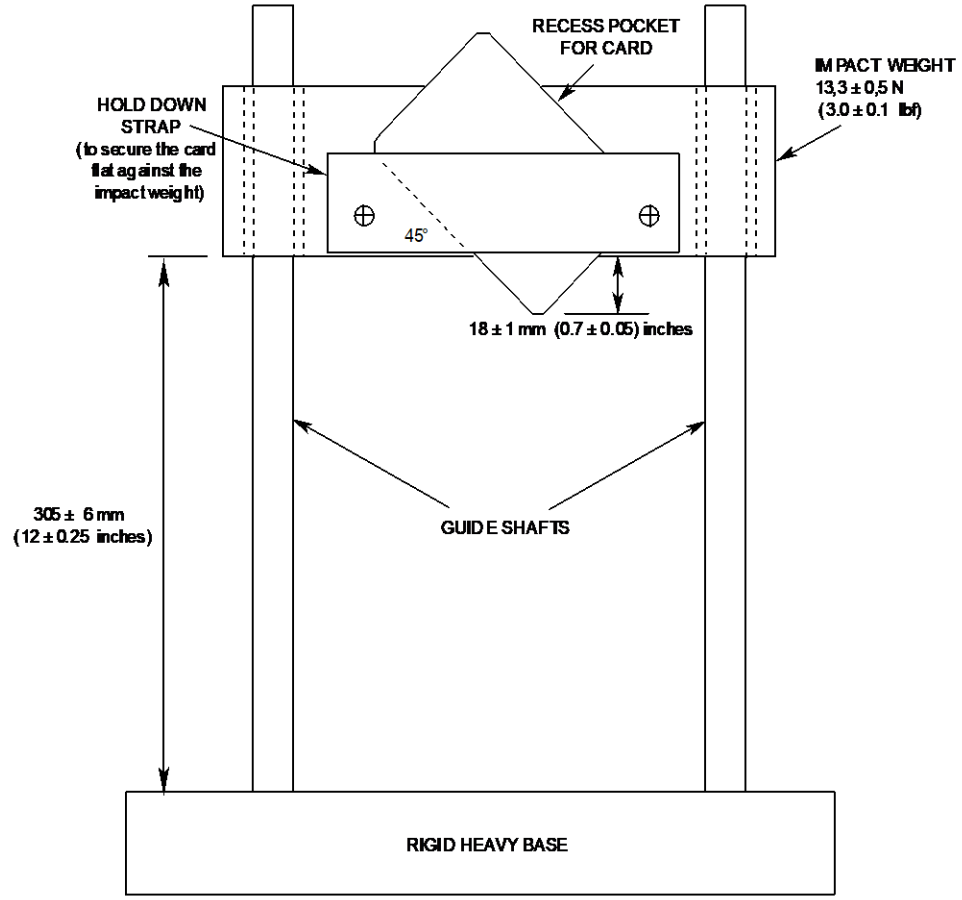


Figure 28 - Card corner impact fixture

5.19.4 Test Report

Report the extent of any delamination or fracture that occurred.

5.19.5 Precision and Bias

Test repeatability has not been established for this method.

The above apparatus or construction drawings may be obtained from QCard 301 Reagan Street, Sunbury, PA. 17801. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.20 Wet Abrasion Test

The purpose of this test is to evaluate the ability of a card to withstand being shaken with water and sand. This method may also be used within a sequence of tests (see clause 6).

5.20.1 Significance and Use

This test method was developed for card fabrication evaluations, material selections and when a card type is suspected of delaminating.

5.20.2 Apparatus

Shaker possessing the following characteristics.

Angle of oscillation: ± 15°
Reciprocating distance: 16 mm (0.63 in)
Speed: 650 to 690 strokes per minute

Medium gauge stainless steel cylindrical can 4,5 to 5 L (4 qt) with lid
Filler Cards - ID-1 size, plastic cards (to maintain a total count of 16 cards)
Distilled water
Standard grade ASTM C778 sand – 150 to 600 μm particle type
Optional: Tape to seal can

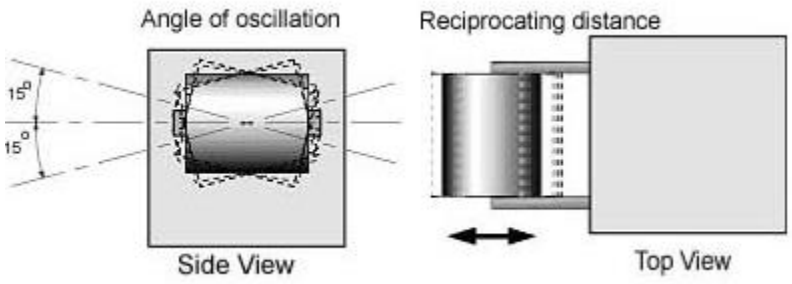


Figure 29 - Paint shaker

5.20.3 Procedure

Place up to 16 test cards into the can containing 30 ml of distilled water and 10 g of sand (1 oz of distilled water and 0.022 lb_m of sand).. If there are less than 16 test cards, then add filler cards to achieve a total of 16 cards.

Seal the can and mount into the shaker.
Shake can/cards for 3 hours, unless otherwise specified.
Remove the test cards, rinse with water and towel dry.

Note: Thoroughly wash can before re-use.

CAUTION: It is recommended to wear ear protection and to locate the equipment in a sound isolated room.

5.20.4 Test Report

Report the extent of any delamination that occurred. Report any other signs of visual card deterioration.

5.20.5 Precision and Bias

Test repeatability has not been established for this method.

The shaker apparatus may be obtained from Paul N. Gardner Company. The stainless steel can may be obtained from Cole-Parmer. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named.

5.21 IC Card with Contacts Micromodule Adhesion

The purpose of this test is to provide a means to determine the bond strength between the card and micromodule (IC module with surface contacts).

5.21.1 Significance and Use

This test method may be used for material selections and when a measure of the bond strength between micromodule and card is desired. Micromodule to card adhesion is a function of the card material, micromodule, adhesive employed and the assembly process.

5.21.2 Apparatus

Force measuring device which displays maximum force achieved and equipped with grip to affix the test block.
Test block - a metal block with one end sized to fit onto the micromodule contact surface without overlap and as flat and smooth as the micromodule, and with block shape designed to interface with the force measuring device.
Card restraint fixture (See Figure 30)
Cyanoacrylate adhesive, or equivalent (accelerator may be used)

Note: Carbon steel test blocks and Loctite 380 adhesive have shown to produce sufficient bonding to the micromodule.

5.21.3 Procedure

Place a drop of cyanoacrylate adhesive on the surface of the micromodule. Press the contact surface of the test block on the micromodule surface and apply approximately 2N (0.5 lb_f) force on the test block during the curing time of the adhesive.

Caution: Care must be exercised when using cyanoacrylate adhesive so that only the surfaces intended to be bonded are only in contact with the adhesive.

Note: The micromodule and test block contact surface must be clean in order to achieve the optimal bond between the micromodule and test block.

Allow adhesive/test block to cure before performing the force measurement.

Mount the IC card with the test block attached in the card restraint fixture and affix the force measuring device to the test block. Pull the test block at a rate of 30 mm/min (1.12 in/min), until separation occurs (after the peak force is achieved).

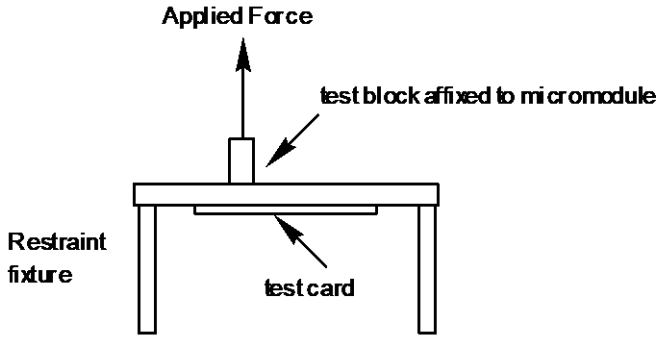


Figure 30 - Micromodule adhesion fixture

5.21.4 Test Report

Record the peak (maximum) force achieved during the pull. Record whether the micromodule was removed in whole or in part or if the test block released from the micromodule.

5.21.5 Precision and Bias

Test repeatability has not been established for this method.

An adhesive that has shown to provide excellent bond strength between test block and micromodule is Loctite 380, available from Loctite Corporation. This information is given for the convenience of users of this ANSI standard and does not constitute an endorsement by ANSI or INCITS of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.22 Water Soak Test

The purpose of this test is to provide a means to qualitatively assess the susceptibility of any interlayer bond strength to weaken from exposure to water.

5.22.1 Significance and Use

This test may be used to evaluate the effect of moisture on any card layer.

5.22.2 Apparatus

Distilled water at 23°C ± 3°C (73°F ± 5°F)
Container suitable to submerge cards
Sharp cutting knife or razor blade

5.22.3 Procedure

Obtain test cards of the same construction in multiples of three.

Secure 1/3 of the cards as the “control”.

Submerge the other two-thirds of the test card(s) in the water for 24hr.

Remove half of the cards from the water container, one at a time. While still wet, manually bend or manipulate the card, (without creasing) in all directions (Axis A and B in extension and compression), to assess whether any layers bond has loosened from the card surface. Use the knife to attempt to loosen a corner of a layer. If successful, manually grab the loose corner and attempt to peel the layer from the card surface.

Remove the other half of the cards from the water container, dry and set aside for 24 hours

Attempt to remove the layer from the “control” cards and the soaked-then-dried cards using the knife as described above.

5.22.4 Test Report

Report for all three test conditions (“control” cards, soaked cards, soaked then dried cards) any layer that could be removed. Report whether the security feature was removed with the top layer or was affixed to the card body. Report any damage that occurred to the card body, top layer and security feature.

5.22.5 Precision and Bias

Test repeatability has not been established for this method.

5.23 Dimensional Change after Elevated Temperature Exposure

This test method gives an indication of uniformity with regard to the degree of internal strains in the card. This procedure may provide an indication of cracking susceptibility of certain card structures.

5.23.1 Significance and Use

This test may be used to measure the linear dimensional changes of a card at elevated temperatures.

5.23.2 Apparatus

Card dimension measuring device with a precision of 2,5 micron (0.0001 inches)
Laboratory oven capable of maintaining 150°C +/- 2°C (302°F +/- 5°F)
Heavy paper sheets (20 to 60 lb/ream or 33 to 98 g/m^2), with smooth, wrinkle- and crease-free surfaces. Paper dimensions must be at least 50 mm (2 inches) greater than the test card dimensions.
Talc, finely ground
Two thin metal sheets with dimensions greater than the test card. Each sheet shall have a mass of 60 ± 6 g (0.13 ± 0.013 lb$_m$).

5.23.3 Procedure

Measure the test card height and width dimension, edge to edge at the approximate middle of the card, taking care to flatten out any card warpage that may be present.

Place each test card between the heavy paper that has been lightly dusted with talc.

Place the paper stack horizontally between the thin metal sheets. Place the assembly on a center wire rack in the preheated oven set at 150°C for 30 min ± 30 sec. Do not place the cards on the oven floor.

Remove the paper/card stack assembly from the oven and allow cards to cool to ambient conditions.

Re-measure the height and width of the exposed cards by the same procedure as was used to obtain the original measurements.

5.23.4 Test Report

Report for the exposed cards the dimensional change of the height and width as a percentage of the original measurements. Negative numbers are shrinkage, positive numbers are expansion.

Note: Field and laboratory test results of PVC and PVC/PET composite cards have indicated that card structures may be susceptible to cracking when substantial shrinkage is measured. Shrinkage on the height may indicate a propensity to crack in the vertical (A axis) direction. Shrinkage in the width may indicate a propensity to crack in the horizontal direction (B axis). Shrinkage greater than 10% may be considered substantial, but is not a definitive limit. Absence of shrinkage does not necessarily indicate that the card will not crack in field usage.

5.23.5 Precision and Bias

5.23.5.1 Interlaboratory Test Program

An interlaboratory study of Dimensional Change after Elevated Temperature Exposure was run in 2004. Three sets of samples were run by six different laboratories.

5.23.5.2 Test Results

The precision information given below in the units of measurement (Linear Dimensional Change (%)) is for the comparison of six test results for each laboratory, each of which is the average of two test determinations.

5.23.5.3 Precision

	95% confidence interval (%)	99% confidence interval (%)
Repeatability limit (within laboratory)	+/- 1.4	+/- 1.8
Reproducibility limit (among laboratories)	+/- 0.9	+/- 1.2
Test Measurement Tolerance (overall)	+/- 1.6	+/- 2.2

The above terms (repeatability limit and reproducibility limit) are used as specified in ASTM Practice E177 The respective standard deviations among test results may be obtained by dividing the values in the 95% confidence interval column by 1.96 or by dividing the values in the 99% confidence interval column by 2.57.

5.23.5.4 Bias

No statement of bias can be made for this test method because there is no accepted reference material or absolute test method for use as a comparison basis.

5.24 Three Roller IC Card Test

This test is intended to simulate cards processed through mail sorting machines. The card is manipulated between three 50 mm (2 in) diameter rollers characteristic of some mail sorting machines.

5.24.1 Significance and Use

This test method can be used for card material and IC module selections. Test repeatability has not been established for this method.

5.24.2 Apparatus

The three roller test apparatus must possess the following characteristics:

The three rollers arranged as shown in Figure 31.
Diameter of all rollers: 50 ± 1 mm (1.97 ± 0.04 in)
Roller A – Steel (or equivalent metal)
Rollers B and C – Nylon (or equivalent plastic) – horizontally spaced 0,2 to 0,8 mm apart (0.01 to 0.03 in)
Force applied by top roller: 38,1 ± 0,5 N (8.6 ± 0.1 lb_f)
Length of rollers: 88 mm (3.5 in) minimum

Caution: Care must be given to prevent flat spots to form on the rollers when not in use.

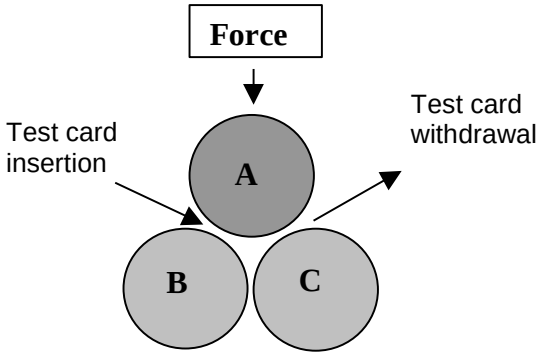


Figure 31 - Three roller arrangement

5.24.3 Procedure

Insert the short end of the test card, closest to the IC module, (front side up) between the Roller A and B until the card makes contact with Roller C. Rotate Roller A until test card exits the roller assembly between Roller A and C.

Insert the short end of the test card, furthest from the IC module, (front side up) between the Roller A and B until the card makes contact with Roller C. Rotate Roller A until test card exits the roller assembly between Roller A and C.

Repeat both procedures with the front side down.

Repeat all four procedures with inserting the long ends of the test card.

Test IC card for functionality.

5.24.4 Test Report

Report each stage observations. Report IC card functionality after test.

5.24.5 Precision and Bias

Test repeatability has not been established for this method.

5.25 Hole Tear Test

The purpose of this test is to assess the tear resistance of a card with a punched hole.

5.25.1 Significance and Use

This test method can be used for comparing different card constructions for punched hole (round or slotted) resistance to key ring wear and tear.

5.25.2 Apparatus

Tensile tester with suitable chart recorder or equivalent

Gripper

Hook with a nominal 3,3 mm (0.13 in) shaft diameter and a nominal 15 mm (0.6 in) internal diameter as shown in Figure 32 below.

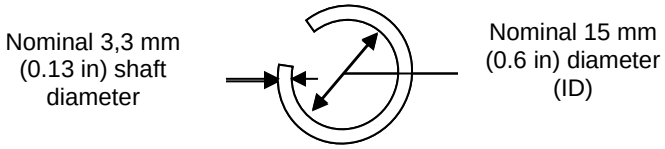


Figure 32 - Hook diagram

Note: The ring #8894T1 from McMaster Carr has shown to meet diameter requirements

5.25.3 Procedure

Thread the hole of the card on to the hook secured to the Tensile tester crosshead. If a slotted hole is to be tested, center the hook at the approximate center of the punched slot.

Clamp the opposite card end to the fixed gripper. Align the card in the gripper such that the hook will tear the card at the closest edge or as the card would hang naturally in the hook without the gripper attached.

Operate the tensile tester according to the manufacturer's instructions at 300 mm/min (11.8 in/min) to determine the tear strength in Newtons (pounds force).

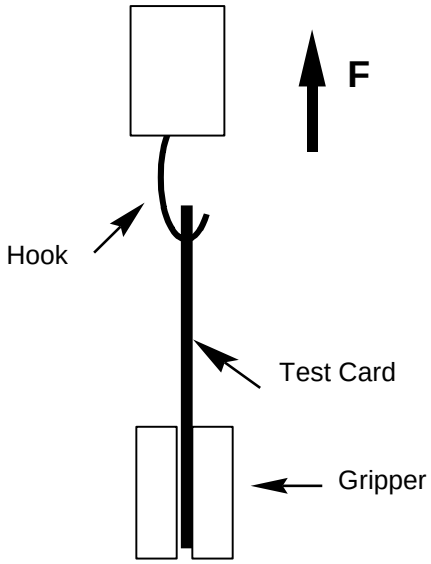


Figure 33 - Card mounted for hole tear

5.25.4 Test Report

Report the peak force it took for the card to tear free of the hook. Report card thickness.

Describe the card, shape of hole and hole orientation relative to the hook. (Examples. Round hole located in the corner of the card and the hook tore the card at the card corner. Or, a slotted hole located at the approximate middle of the short dimension of the card and the hook tore the card at the short dimension.)

Note: Comparison tests have shown that round holes and oblong slots produce different results using this method. The user is cautioned not to compare results from different hole/slot configurations.

5.25.5 Precision and Bias

Test repeatability has not been established for this method.

6 TEST SEQUENCES

The purpose of these sequences is to cause accelerated stresses to better simulate the kinds of stresses that cards are exposed to with actual use.

6.1 Card Structure Integrity Test Sequence

The purpose of this test is to evaluate the resistance of a card to delamination when subjected to an elevated temperature/humidity, corner impact and a wet abrasion & impact environment.

6.1.1 Significance and Use

This test method was developed for card fabrication evaluations, material selections and when a card type is suspected of delaminating or being "brittle".

6.1.2 Apparatus

Refer to each of the test methods specified below for the equipment required.

6.1.3 Procedure

Stage 1

Conduct test method: **Elevated Temperature & Humidity Exposure Test** with the exception of duration of elevated temperature & humidity exposure shall be 168 hr (7 days).

After exposure, divide the number of cards into two sets. Within 5 minutes of removing the cards from the sealed container, conduct Stage 2A with one set and Stage 2B with the other set.

Stage 2A

Conduct test method: **Corner Impact Test**

Stage 2B

Conduct test method: **Wet Abrasion & Impact Test**

Note: A total of 16 cards are required to be in the sealed can for shaking. Add filler cards, if necessary, to fulfil the 16 card requirement.

6.1.4 Test Report

Report each stage observations. Report the extent of any delamination that occurred. Report any other visual signs of card deterioration. Report elevated temperature and the duration of the exposure.

6.1.5 Precision and Bias

Test repeatability has not been established for this method.

6.2 Card Flexure and Peel Strength Sequence

The purpose of this test is to evaluate the resistance of a card to delamination after having been subject to flexure.

6.2.1 Significance and Use

This test method was developed for card fabrication evaluations, material selections and when a card type is suspected of delaminating.

6.2.2 Apparatus

Refer to each of the test methods specified below for the equipment required.

6.2.3 Procedure

Stage 1

Flex the test card as described below using the technique described in: **ID-1 Card Flexure Test**

Flex the card for:

1250 cycles in Axis A front side up
1250 cycles in Axis A front side down
1250 cycles in Axis B front side up
1250 cycles in Axis B front side down

Stage 2

Conduct test method: **Peel Strength - 90°peel angle** within 24 hours of completing Stage 1.

6.2.4 Test Report

Report each stage observations. Report the number of flex cycles for each axis the card was subjected. Report the location and width of test strip along with the measured values of peel strength in N/mm (lbf/in) or report any inability to separate the layers.

6.2.5 Precision and Bias

Test repeatability has not been established for this method.

6.3 Elevated Temperature/Humidity and Peel Strength Sequence

The purpose of this test is to evaluate the resistance of a card to delamination after having been subject to elevated temperature and humidity.

6.3.1 Significance and Use

This test method was developed for card fabrication evaluations, material selections and when a card type is suspected of delaminating.

6.3.2 Apparatus

Refer to each of the test methods specified below for the equipment required.

6.3.3 Procedure

Stage 1

Expose the test card, as described below, using the technique described in **Elevated Temperature and Humidity Exposure.**

Set temperature at 50°C (122°F) for 24 hr unless otherwise specified or if experience with the particular card construction suggests a more suitable temperature and/or exposure period.

Stage 2

Complete test method: **Peel Strength - 90° peel angle** within 5 minutes after completing Stage 1.

6.3.4 Test Report

Report each stage observations. Report number of hours the cards were exposed to elevated temperature. Report the location and width of test strip along with the measured values of peel strength in N/mm (lbf/in) or report any inability to separate the layers.

6.3.5 Precision and Bias

Test repeatability has not been established for this method.

6.4 Wet Abrasion and Peel Strength Sequence

The purpose of this test is to evaluate the resistance of a card to delamination after having been subject to wet abrasion.

6.4.1 Significance and Use

This test method was developed for card fabrication evaluations, material selections and when a card type is suspected of delaminating.

6.4.2 Apparatus

Refer to each of the test methods specified below for the equipment required.

6.4.3 Procedure

Stage 1

Conduct test method: **Wet Abrasion Test**

Stage 2

Remove one card at a time from the container, reseal the container, and complete test method**: Peel Strength - 90° peel angle** for each card within 5 minutes after Stage 1.

6.4.4 Test Report

Report each stage observations. Report the location and width of test strip along with the measured values of peel strength in N/mm (lb_f/in) or report any inability to separate the layers.

6.4.5 Precision and Bias

Test repeatability has not been established for this method.

6.5 Card Flexure, Wet Abrasion and Peel Strength Sequence

The purpose of this test is to evaluate the resistance of a card to delamination after having been subject to flexure and wet abrasion.

6.5.1 Significance and Use

This test method was developed for card fabrication evaluations, material selections and when a card type is suspected of delaminating.

6.5.2 Apparatus

Refer to each of the test methods specified below for the equipment required.

6.5.3 Procedure

Stage 1

Flex the test card as described below using the technique described in: **ID-1 Card Flexure Test**

Flex the card for:

1250 cycles in Axis A front side up
1250 cycles in Axis A front side down
1250 cycles in Axis B front side up
1250 cycles in Axis B front side down

Stage 2

Conduct test method: **Wet Abrasion** within 24 hours after completing Stage 1.

Stage 3

Remove one card at a time from the container, reseal the container, and complete test method**: Peel Strength - 90° peel angle** for each card within 5 minutes after Stage 2.

6.5.4 Test Report

Report each stage observations. Report the number of flex cycles for each axis the card was subjected. Report the location and width of test strip along with the measured values of peel strength in N/mm (lbf/in) or report any inability to separate the layers.

6.5.5 Precision and Bias

Test repeatability has not been established for this method.

6.6 Ultraviolet Light Exposure and Corner Impact Sequence

The purpose of this test is to evaluate the resistance of a card to corner cracking after having been exposed to ultraviolet light.

6.6.1 Significance and Use

This test method was developed for card fabrication evaluations, material selections and when a card type is suspected of delaminating.

6.6.2 Apparatus

Refer to each of the test methods specified below for the equipment required.

6.6.3 Procedure

Stage 1
Conduct test method: **Ultraviolet (UV) Light Exposure**

Stage 2
Conduct test method: **Corner Impact Test** within 1 hour after completing Stage 1.

6.6.4 Test Report

Report each stage observations. Report number of hours the cards were exposed to the UV light.

6.6.5 Precision and Bias

Test repeatability has not been established for this method.

Annex A
(informative)

Bibliography

ASTM D618-08	*Standard Practice for Conditioning Plastics for Testing*[1]
ASTM D903-98	*Standard Test Method for Peel or Stripping Strength of Adhesive Bonds*[1]
ASTM D907-12A	*Standard Terminology of Adhesives*[1]
ASTMD1204-08	*Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevating Temperature*[1]
ASTM D3359-09	*Standard Test Methods for Measuring Adhesion by Tape Test*[1]
ASTM D4060-10	*Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser*[1]
ASTM E6-09be1	*Standard Terminology Relating to Methods of Mechanical Testing*[1]
ASTM E691-12	*Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method*[1]
ASTM E177-10	*Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods*[1]
ASTM G155-5a	*Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*[1]
ASTM G195-08	*Standard Guide for Conducting Wear Tests Using a Rotary Platform, Double-Head Abraser*[1]
NIST Series 172	*Methodologies for predicting the service lives of coating system*[2]
ISO 1302	*Geometrical product specifications (GPS) - Indication of surface texture in technical product documentation*[3]
ISO 5-3	*Photography - Density Measurements - Part 3 Spectral conditions*[3]
ISO/IEC 10373-1	*Identification Cards – Test Methods – Part 1: General Characteristics Tests*[3]
ISO 6330	*Textiles-- Domestic washing and drying procedures for textile testing*.[3]
ISO/IEC 15416	*Information technology -- Automatic identification and data capture techniques -- Bar code print quality test specification -- Linear symbols*[3]
ANSI/INCITS 440	*Card Durability / Service Life*[3]

[1] Available from ASTM
[2] Available from National Institute of Standards and Technology, Office of Standards Reference Materials
[3] Available from American National Standard Institute