



Designation: D7932 – 17

Standard Specification for Printed, Pressure-Sensitive Adhesive Labels for Use in Extreme Distribution Environments¹

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1. Scope

1.1 This specification provides a standard means to test and measure performance characteristics of printed, pressure-sensitive adhesive labels for containers, particularly containers to be used in extreme distribution environments (for example, hazardous materials labels, aerospace, military containers). For the purposes of this specification, an extreme distribution environment is one in which it can be reasonably expected to experience direct exposure to deteriorating chemicals, weather, elevated/cold temperatures, and other environmental and physical elements for an extended period of time.

1.2 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

A666 Specification for Annealed or Cold-Worked Austenitic

Stainless Steel Sheet, Strip, Plate, and Flat Bar
D374/D374M Test Methods for Thickness of Solid Electrical Insulation
D975 Specification for Diesel Fuel Oils
D996 Terminology of Packaging and Distribution Environments
D1000 Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D3611 Practice for Accelerated Aging of Pressure-Sensitive Tapes
D3951 Practice for Commercial Packaging
D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing
D4814 Specification for Automotive Spark-Ignition Engine Fuel
D6210 Specification for Fully-Formulated Glycol Base Engine Coolant for Heavy-Duty Engines
D6252/D6252M Test Method for Peel Adhesion of Pressure-Sensitive Label Stocks at a 90° Angle
G195 Guide for Conducting Wear Tests Using a Rotary Platform Abraser

2.2 Department of Defense Standards:³

MIL-STD-810 Environmental Engineering Considerations and Laboratory Tests
MIL-STD-2073-1 Standard Practice for Military Packaging
MIL-DTL-83133 Turbine Fuel, Aviation, Kerosene Type, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)

2.3 Society of Automotive Engineers Standards:⁴

SAE J183 Engine Oil Performance and Engine Service Classification
SAE J300 Engine Oil Classification

¹ This specification is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.14 on Tape and Labels.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Copies of these documents are available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil.

⁴ Copies of these documents are available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

2.4 Other:

ISO/IEC 15415 Information Technology – Automatic Identification and Data Capture Techniques – Bar Code Print Quality Test Specification – Two Dimensional Symbols⁵

ISO/IEC 15416 Information Technology – Automatic Identification and Data Capture Techniques – Bar Code Print Quality Test Specification – Linear Symbols⁵

ISO/IEC 15426-1 Information Technology – Automatic Identification and Data Capture Techniques – Bar Code Verifier Conformance Specification – Part 1: Linear Symbols⁵

ISO/IEC 15426-2 Information Technology – Automatic Identification and Data Capture Techniques – Bar Code Verifier Conformance Specification – Part 2: Two-Dimensional Symbols⁵

ANSI MH10.8.1 Linear Bar Code & 2-Dimensional Symbols⁶

ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes⁷

during transportation and storage. This specification provides minimum performance requirements for printed, pressure-sensitive labels for use in extreme distribution environments. In addition, standard laboratory test methods are provided to simulate exposure to various conditions and measure associated degradation of required performance characteristics. The data from these methods can be used as acceptance criteria between a supplier and customer.

4.2 The test methods described in this specification are performed on standard stainless steel test surface panels. If specified by the customer, another material may be used for test surface panels in lieu of the standard stainless steel (see 10.3).

4.2.1 When a test surface panel other than stainless steel is specified, the customer shall also provide minimum acceptable performance criteria which may differ from the values provided in Tables 2 and 3.

4.3 Type I labels are intended for use on container outer surfaces where direct contact with physical and environmental factors is unavoidable. Material strength and resistance to abrasion, sunlight, rain, extreme temperatures, chemicals, and other deteriorating environmental elements are required. Type I labels may be used on porous surfaces (Class 1) or non-porous surfaces (Class 2).

4.4 Type II labels are intended for use on inner containers where there will be a physical barrier to outside elements, such as an overpack. Since not all barriers are hermetically sealed, material strength and resistance to abrasion, extreme temperatures, and other deteriorating environmental elements are required. Type II labels may be used on porous surfaces (Class 1) or non-porous surfaces (Class 2).

4.5 Type III labels are intended for applications not covered by Type I or II labels. The performance requirements and testing shall be tailored by the customer. Type III labels may be used on porous surfaces (Class 1) or non-porous surfaces (Class 2).

5. Classifications

5.1 Type:

5.1.1 *Type I*—Heavy Duty.

5.1.2 *Type II*—Medium Duty.

5.1.3 *Type III*—Custom requirements.

5.2 Classes:

5.2.1 *Class 1*—For use on porous surfaces.

5.2.2 *Class 2*—For use on non-porous surfaces.

6. Ordering Information

6.1 *The inquiry or order shall include the following:*

6.1.1 ASTM designation and date of issue.

6.1.2 Type and Class required (see Section 5).

6.1.3 *For Type III Labels*—Required tests from **Table 1** and minimum performance criteria for each.

6.1.4 Label form (for example, in sheets, rolls, etc.).

6.1.5 Individual label size.

6.1.6 Printing requirements, as necessary.

6.1.7 When testing and inspection certification is required (see Section 13).

3. Terminology

3.1 General definitions for packing and distribution environments are found in Terminology **D996**.

3.2 Definitions:

3.2.1 *porous*—possessing or full of pores or openings that permit solids, liquids, or gases to permeate or penetrate an outer surface or membrane.

3.2.2 *non-porous*—possessing a non-permeable outer surface or membrane that does not permit solids, liquids, or gases to penetrate an outer surface or membrane.

3.2.3 *printed, pressure-sensitive adhesive label*—the combination of a release liner, pressure-sensitive adhesive, and facestock (face material) which has been printed with an image.

3.2.4 *label sample*—used to describe a facestock and its pressure-sensitive adhesive while still adhered to its release liner only.

3.2.5 *test surface panel*—used to describe the solid material surface onto which the label samples are adhered for the purpose of testing (see 4.2).

3.2.6 *label test specimen*—used to describe a test surface panel with a label sample applied by way of its pressure-sensitive adhesive.

4. Significance and Use

4.1 Degradation of pressure-sensitive adhesive labels due to environmental and physical factors is a common occurrence

⁵ Copies of these documents are available at www.iso.org or www.ansi.org or from the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036.

⁶ A copy of this document is available Available from American Architectural Manufacturers Association (AAMA), 1827 Walden Office Square, Suite 550, Schaumburg, IL 60173-4268, <http://www.aamanet.org> at www.mhi.org or from the Material Handling Industry, 8720 Red Oak Boulevard, Suite 201, Charlotte, NC 28217-3992.

⁷ A copy of this document is available from American Society for Quality (ASQ), 600 North Plankinton Ave., Milwaukee, WI 53203.

TABLE 1 Minimum Number of Test Samples

Test Method	Minimum Number of Test Samples		Reference Paragraph
	Type I	Type II	
Print Quality	5	5	11.2
Peel Adhesion	5	5	11.3
Thickness	5	5	11.4
Abrasion	15	15	11.5
High Temperature	5	5	11.6
Low Temperature	5	5	11.7
Rain	5	Not Required	11.8
Salt Fog	5	Not Required	11.9
Blowing Dust	5	Not Required	11.10
Humidity	5	5	11.11
Freeze and Thaw	5	5	11.12
Accelerated Aging	5	5	11.13
Contamination by Fluids	40	Not Required	11.14
Solar Radiation	5	Not Required	11.15

TABLE 2 Physical Property Requirements

Property	Units	Type I		Type II	
		Class 1	Class 2	Class 1	Class 2
Thickness, max	(mm) (mils)	0.22 8.5	0.22 8.5	0.22 8.5	0.22 8.5
Initial Adhesion, min	(N/100 mm) (oz/in.)	66 60	66 60	55 50	55 50
Abrasion resistance, minimum cycles to failure:					
At low temperature (-67° F)		500	500	100	100
At ambient temperature (73.4° F)		500	500	100	100
At high temperature (140° F)		500	500	100	100
Post-exposure adhesion, min:					
High temperature	(N/100 mm) (oz/in.)	66 60	66 60	55 50	55 50
Low temperature	(N/100 mm) (oz/in.)	66 60	66 60	55 50	55 50
Rain	(N/100 mm) (oz/in.)	66 60	66 60	N/A N/A	N/A N/A
Salt fog	(N/100 mm) (oz/in.)	66 60	66 60	N/A N/A	N/A N/A
Blowing dust	(N/100 mm) (oz/in.)	66 60	66 60	N/A N/A	N/A N/A
Humidity	(N/100 mm) (oz/in.)	66 60	66 60	55 50	55 50
Freeze and thaw	(N/100 mm) (oz/in.)	66 60	66 60	55 50	55 50
Accelerated aging	(N/100 mm) (oz/in.)	66 60	66 60	55 50	55 50
Contamination by Fluids	(N/100 mm) (oz/in.)	See Table 3 See Table 3	See Table 3 See Table 3	N/A N/A	N/A N/A

6.1.8 Acceptance quality limit and sample size code letter (see Section 9),

6.1.9 Report requirements, as necessary (see Section 12).

6.1.10 Packing and marking requirements (see Section 15).

7. Physical Properties

7.1 All labels shall comply with the requirements listed in Table 2 and Table 3 when tested in accordance with Section 11.

8. Workmanship, Finish, and Appearance

8.1 All labels shall be uniformly constructed and free from defects that impair the usefulness of the label for the purpose intended (see Section 4). The label adhesive coating shall be uniform, covering entirely the adhesive side of the label and shall be mounted on a release liner. The adhesive shall be pressure-sensitive, water insoluble, and shall require no moisture, heat, or other preparation prior to, or after, application to clean, dry surfaces. The labels shall be furnished in the form of individual labels, sheets, rolls, or as specified by the customer. The label edges shall be clean, straight, unbroken, and shall display no excessive bleeding of adhesive. The finished product shall conform to the levels of quality established herein.

9. Acceptance Criteria

9.1 First Article of Manufacture—When a product is first manufactured in a plant, it shall be tested and inspected to determine compliance with all examinations and tests of this specification by an independent laboratory. First article of manufacture examinations need only be repeated when there is a change in materials or processes.

9.2 Unless otherwise specified, the minimum number of label test samples shall be as specified in Table 1, with an acceptable quality limit (AQL) of 4.0 % in accordance with ANSI/ASQC Z1.4.

9.2.1 Prior to start of testing, the customer and supplier shall agree upon any increase to the sample size, if necessary, and deviation to the acceptance quality limit (AQL) in accordance with ANSI/ASQC Z1.4.

10. Procedures

10.1 Unless otherwise specified, prior to label application, each label sample and test surface panel shall be conditioned in

the standard conditioning atmosphere described in Practice D4332 until equilibrium moisture content is achieved as measured by weight.

10.2 Each requirement shall be tested in accordance with the test methods listed in Section 11. The total test quantities shall follow sequential testing as described in Figs. 1 and 2 for Type I and Type II labels, respectively. Unless otherwise noted in the applicable test method, tests shall be conducted in the standard conditioning atmosphere described in Practice D4332.

10.3 Test Surface—Except for abrasion resistance, each test sequence, unless otherwise specified by the customer, shall be conducted on panels of stainless steel 302 or 304 in accordance with Specification A666 having a bright-annealed finish. The stainless steel surface roughness height shall be 2.0 ± 0.2-µin. or 50 ± 5-nm arithmetical average deviation from the mean line. Testing conducted on a stainless steel surface may not provide meaningful performance results for various other materials. If specified by the customer, it is acceptable to use a test surface other than the specified stainless steel (that is, plastic, lumber, paperboard, etc.) to increase validity of results

TABLE 3 Contamination by Fluids Requirements

Test Chemical	Specification	Number of Test Samples	Minimum Adhesion to Stainless Steel
		Type I	
Water, distilled		5	55 N/100 mm (50 oz/in.)
Engine oil: SAE 15W-40, API CI-4, CI-4 Plus, or CJ-4	SAE J300 SAE J183	5	55 N/100 mm (50 oz/in.)
Gasoline (Petrol), unleaded, Anti-knock Index 87, min	ASTM D4814	5	38 N/100 mm (35 oz/in.)
Turbine Fuel JP-8	MIL-DTL-83133	5	38 N/100 mm (35 oz/in.)
Diesel fuel, Grade No. 1-D S15 or 2-D S15	ASTM D975	5	38 N/100 mm (35 oz/in.)
Automatic Transmission Fluid	Dexron VI	5	38 N/100 mm (35 oz/in.)
Coolant Type III-FF or IV-FF	ASTM D6210	5	38 N/100 mm (35 oz/in.)
Brake fluid, DOT 3, 4, or 5	FMVSS 116 49 CFR 571.116	5	38 N/100 mm (35 oz/in.)

(see 4.2). All test surface panels, regardless of material, shall be a minimum 2 by 5-in. and no less than 0.032-in. thick or 50 by 125-mm and no less than 1.1-mm thick. Any panels showing stains, discoloration, numerous scratches, or other surface imperfections are not acceptable.

10.4 Test Surface Panel Preparation:

10.4.1 Stainless steel and other non-porous test surface panels shall be prepared as specified in Test Method D6252/D6252M.

10.4.2 If used for testing, wooden test surface panels shall be lightly sanded using at least 220 grit sandpaper to provide a smooth test surface. A clean surgical sponge, gauze, or tissue free of lint shall be used to clean all residue before label sample adhesion.

10.4.3 All other porous test surface panels used for testing shall be cleaned of any residue using a clean surgical sponge, gauze, or tissue free of lint before label sample adhesion.

10.4.4 Label samples shall be applied to test surface panels as specified in Test Method D6252/D6252M.

10.5 Label Marking—Prior to application, each label sample shall be printed with, at a minimum, the word “Sample,” the label manufacturer, and the label stock or model number. In addition to the human-readable printing, each label sample shall have a linear or 2-dimensional barcode, as specified by the customer, encoded with the same minimum information. Linear and 2-dimensional barcodes shall be encoded in accordance with ANSI MHI MH10.8.1. The method of printing shall be representative of the intended method to be used by the customer.

NOTE 1—Label facestock (face material) will react differently to varying types of thermal transfer printer ribbons. Use of incompatible thermal transfer ribbons and label facestock may result in decreased performance during the testing specified within this specification. It is the responsibility of the party performing the testing specified herein to ensure that all label samples are printed in a method approved by the label manufacturer.

NOTE 2—At the request of the customer, a label without a barcode may be tested. In such instances, it is up to the customer to define the acceptance criteria for print quality (see 11.2).

10.6 Evaluation of Results—Within 3 h following completion of 11.6 – 11.14, all label test specimens shall be examined for print quality and peel adhesion in accordance with 11.2 and 11.3, for compliance with minimum requirements of Tables 2 and 3. Within 3 h following completion of 11.5 and 11.15, the label test specimen shall be examined for compliance with print quality in accordance with 11.2 only.

10.7 Blotting—If necessary to protect test equipment, moist or contaminated label test specimens may be blotted dry before examination in accordance with 11.2. Lay the label test specimen face up on a flat surface and place a piece of absorbent surgical gauze, sponge, or tissue on top. Suitable material shall be absorbent and lint-free. Using the hand roller described in Test Method D6252/D6252M, remove excess moisture and contaminants by rolling over the absorbent material once in each direction. Take care not to increase the mass of the roller or apply any additional pressure onto the label test specimen as this may affect the results of the peel adhesion test.

11. Test Methods

11.1 Responsibility for Inspection—Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection requirements as specified herein.

11.2 Print Quality—The print quality test shall be performed on each label sample after conditioning, prior to any additional testing, to obtain baseline results. The test shall be repeated on each label sample immediately following completion (within 3 h) of exposure to conditions specified in 11.5 – 11.15. A commercial bar code reader or scanner in accordance with ISO/IEC 15426-1 for linear symbols and ISO/IEC 15426-2 for 2-dimensional symbols shall be used to test barcode print quality. Print quality shall be assessed in accordance with ISO/IEC 15416 for linear symbols or ISO/IEC 15415 for 2-dimensional symbols. Minimum acceptable print quality for baseline scans shall be 2.5 (Grade B) for both linear and 2-dimensional barcodes. Minimum acceptable print quality following any test method shall be 1.5 (Grade C) for both linear and 2-dimensional barcodes. Aperture, light, and angle shall be as required by the size and format of the printed barcode image. When evaluating labels without a machine readable barcode Practice D2244 is offered as a possible test method. It is up to the customer to define pass/fail criteria.

11.3 Peel Adhesion—The peel adhesion test shall be performed on five samples after conditioning, prior to any additional testing to obtain baseline results. In addition, the peel adhesion test shall be performed on each label sample immediately following completion (within 3 h) of exposure to