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American National Standard

Medium Density Fiberboard (MDF) For Interior Applications

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American National Standard

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Abstract

This Standard sets forth requirements and test methods for dimensional tolerances, physical and mechanical properties and formaldehyde emissions for medium density fiberboard (MDF). Methods of identifying products conforming to the Standard are specified. Property requirements are described in metric and English.

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ANSI A208.2-2002 Medium Density Fiberboard (MDF) For Interior Applications

Foreword (This foreword is not part of American National Standard A208.2-2002.)
The first American National Standard for Medium Density Fiberboard For Interior Use was published in 1980 as ANSI A208.2-1980, under combined sponsorship by the National Particleboard Association and the American Hardboard Association. It was reapproved in 1986 as Medium Density Fiberboard For Interior Use, ANSI A208.2-1986 under the sponsorship of the National Particleboard Association. The Standard was revised in 1994 as Medium Density Fiberboard (MDF), ANSI A208.2-1994 under the sponsorship of the National Particleboard Association.

In 1997 the National Particleboard Association and the Canadian Particleboard Association consolidated into the Composite Panel Association.

This Standard is the 2002 revision of ANSI A208.2, Medium Density Fiberboard (MDF) for Interior Applications. It incorporates several significant modifications to the 1994 standard. New interior applications are addressed for which expanded evaluation criteria may be required. Specifically, the following major changes have been made:

- Deletion of references to density classifications in order to avoid potential confusion caused by the terms "Low Density," "Medium Density," and "High Density" Medium Density Fiberboard. Grades in this Standard are based solely on performance and are independent of density. The availability of a specific desired density for a given grade and panel thickness may vary by manufacturer.

- Addition of thickness swell requirements including specifications for "Reduced Thickness Swell" characteristics.

- Substitution of the term "Advanced Bond Integrity" in place of "Exterior Glue Bonding System".

- Substitution of the term "Specified Thickness" in place of the sometimes confusing "Nominal Thickness".

- Inclusion of "Moisture Resistant" classifications defined by "Thickness Swell" and/or "Bond Integrity Characteristics".

- Deletion of references to "Exterior Grade" products.

- A reduction of allowable deviation for physical and mechanical properties.

- Addition of "Linear Expansion" in the property requirements tables.

- Creation of two property tables based on different test methods with each defining unique grades. Table 1 applies to all thicknesses of MDF as evaluated by ASTM D1037-99 Part A - General Test Methods for Evaluating The Basic Properties of Wood-Base Fiber and Particle Panel Materials. Table 2 is new, and applies to thin MDF [≤ 9.5mm (3/8 inch) thick] as evaluated by ASTM D1037-99 Part B - Acceptance and Specification Test Methods for Hardboard. Because test methods in Part A and Part B of D1037-99 use different specimen dimensions and testing speeds, property values may differ for the same thickness.

This Standard has three Annexes. Annex A is normative and is part of this Standard; Annexes B and C are informative and are not part of this Standard.

Consensus for this standard was achieved by use of the Canvass Method. The following organizations, recognized as having an interest in MDF standards, were contacted prior to the approval of this standard. Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposed standard to ANSI.

American Hardboard Association
APA - The Engineered Wood Association
Architectural Woodwork Institute
Canadian Council of Furniture Manufacturers
Canadian Wood Council
Flakeboard Company Ltd.
Forintek Canada Corporation
Georgia-Pacific Corporation
Hardwood Plywood and Veneer Assn.
Intech Consulting, Inc.
Kimball International
Kitchen Cabinet Manufacturers Assn.
Langboard,Inc.
L-P
Manufactured Housing Institute
Mississippi State University
National Council of the Paper Industry for Air and Stream Improvement
Norbord Industries, Inc.
North Carolina State University
Panolam Industries Ltd.
Pan Pacific Products, Inc.
Plum Creek MDF, Inc.
Woodcraft Industries (PrimeWood)
Sacopan Inc.
Sauder Woodworking, Inc.
SierraPine, Ltd.
Temple
TECO/PFS
Uniboard Canada Inc.
University of Laval
West Fraser Mills Ltd.
Willamette Industries, Inc.
Woodwork Institute of California

American National Standard, Medium Density Fiberboard (MDF) For Interior Applications

1 Purpose and scope

1.1 Purpose

The purpose of this Standard is to establish a nationally recognized voluntary consensus standard for medium density fiberboard (MDF) for interior applications which can serve as a common basis for understanding among those manufacturing, specifying or using MDF products.

1.2 Scope

1.2.1 General

This Standard covers MDF for interior applications, and includes definitions, dimensional tolerances, physical and mechanical property requirements, and a maximum formaldehyde emission level for different grades of MDF. Also included are references to test methods and means of identifying conforming products. The mechanical property requirements are not engineering design values.

1.2.2 Suitability for certification

The Standard was revised with reference to ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) ISO/IEC Guide 7:1994 (E) and is suitable for certification purposes.

2 Definitions

2.1 Additive: A material, other than the bonding system, added during the MDF manufacturing process, which enhances desired properties (e.g., resistance to moisture, dimensional stability, fire retardance, and resistance to fungi and insects).

2.2 Advanced Bond Integrity: The characteristic that allows MDF to meet the modulus of rupture requirement after accelerated aging cycles as referenced in Subsection 3.3.5 of this Standard.

2.3 Bonding System: A system that, when added to cellulosic fibers, constitutes the primary source of inter-fiber adhesion..

2.4 Fiber: A discrete element of cellulosic material.

2.5 Medium Density Fiberboard (MDF): A composite panel product composed primarily of cellulosic fibers and a bonding system cured under heat and pressure. MDF density is typically between 500 kg/m^3 (31 lbs/ft^3) and 1000 kg/m^3 (62 lbs/ft^3).

2.6 Moisture Resistance (MR): The term moisture resistance (MR) refers to the thickness swell and bond integrity characteristics of MDF, used in interior applications, when subjected to periodic exposure to moisture. The moisture resistance categories of MDF are identified by the following designations:

MR10	MDF that meets the reduced thickness swell criteria in Subsection 3.3.4.
MR30	MDF that meets the modulus of rupture criteria for advanced bond integrity in Subsection 3.3.5.
MR50	MDF that meets both the reduced thickness swell criteria in Subsection 3.3.4 and the modulus of rupture criteria for advanced bond integrity in Subsection 3.3.5.

2.7 Panel: A flat, rectangular piece of MDF with all trimmed edges $\geq$ 0.61 m (2 feet).

2.8 Panel Average Thickness: Average of eight measurements taken 25.4 mm (1.0 inch) in from the edge at each panel corner and taken 25.4 mm (1.0 inch) in from the edge at the mid-length point of each panel edge.

2.9 Panel Average Thickness from Specified: The difference between the panel average thickness and the specified thickness.

2.10 Reduced Thickness Swell: The characteristic that allows MDF to meet the thickness swell requirements in Subsection 3.3.4.

2.11 Specified Thickness: Thickness specified by either the manufacturer or the purchaser.

2.12 Variance from Panel Average Thickness: The maximum difference between the panel average thickness and the individual thickness measurements.

3 Requirements

3.1 General

Physical and Mechanical Property Tables 1 and 2 are based on different test methods with each defining unique grades. Grades in Table 1, determined in accordance with American Society for Testing and Materials (ASTM) Standard D1037-99 Part A - General Test Methods for Evaluating The Basic Properties of Wood-Base Fiber and Particle Panel Materials, may be used to identify panels of any thickness. Grades in Table 2, determined in accordance with ASTM D1037-99 Part B - Acceptance and Specification Test Methods for Hardboard, may be used to identify thin panels with thickness $\leq$ 9.5 mm (3/8 inch). Because test methods in Part A and Part B of D1037-99 use different specimen dimensions and testing speeds, property values may differ for the same thickness.

MDF panels represented as conforming to any grade in this standard at the time of shipment from the manufacturer, shall meet the requirements specified for that grade when tested in accordance with the provisions of this section. After shipment from the manufacturer, MDF that has been subjected to varying conditions of environment, storage, handling, or manufacture, may not continue to conform to the Standard when subsequently tested.

3.2 Dimensional tolerances

3.2.1 Width and length. The trimmed width and length tolerance of MDF panels shall not exceed $\pm$ 2.0 mm (0.080 inch) for panel dimensions $\geq$ 0.61 m (2 feet) as specified in Tables 1 and 2. Width and length shall be determined in accordance with Section 7 of ASTM D 1037-99.

3.2.2 Thickness. Panel average from specified thickness shall not exceed $\pm$ 0.125 mm (0.005 inch) as specified in Tables 1 and 2. Variance from panel average thickness shall not exceed $\pm$ 0.125 mm (0.005 inch) as specified in Tables 1 and 2.

3.2.3 Squareness. The two diagonal measurements of a trimmed panel shall not differ more than 3 mm per meter (0.036 inch per foot) of panel width (shortest edge) when trimmed to finished length and width.

3.2.4 Edge straightness. A trimmed edge of a panel $\geq$ 0.61 m (2 feet) shall not deviate more than 1 mm per 1.5 meters (0.016 inch per 2 feet). Edge straightness shall be determined by measuring to the nearest 0.5 mm (0.020 inch) the maximum deviation from a straight line extending from corner to corner on the same edge.

3.3 Physical and mechanical properties. Physical and mechanical property requirements are listed in Tables 1 and 2. These requirements represent 5 panel averages. However, for the properties in Subsections 3.3.2, 3.3.3, and 3.3.4 no single panel average shall be greater than 10% above the requirements for that grade. For the properties in Subsections 3.3.5 through 3.3.9, no single panel average shall be greater than 10% below the requirements for that grade.

3.3.1 Moisture content. The average moisture content at time of shipment from the manufacturer shall not exceed nine percent. The moisture content shall be determined in accordance with Sections 9, 120, and 121.1 of ASTM D 1037-99, from two specimens per panel and their test results averaged to determine the moisture content for the panel.

3.3.2 Linear expansion (LE). The LE between 50% and 80% relative humidity (RH) shall be determined in accordance with sections 108 through 111 and footnotes 38 through 40 of ASTM D1037-99. One specimen shall be cut parallel to the length of each panel to be tested, and one shall be cut perpendicular to the length of the same panel. The results of the two tests shall be averaged to determine the LE for the panel.

3.3.3 Thickness swell (TS). The TS shall be determined in accordance with sections 100 through 103 and sections 105 through 107 of ASTM D 1037-99 after 24-hour submersion. Two specimens per panel shall be cut and the test results averaged to determine the TS for the panel.

3.3.4 Reduced thickness swell. MDF represented as having a reduced TS characteristic (MR10) shall have a TS $\leq$ 50% of the TS requirement listed for a particular grade in Table 1 or 2. TS shall be measured according to Subsection 3.3.3.

3.3.5 Advanced bond integrity. MDF represented as having advanced bond integrity (MR30), when tested in accordance with Sections 112 through 118 of ASTM D 1037-99, shall have an average modulus of rupture after the accelerated aging cycles of at least 50 percent of the applicable modulus of rupture requirement of a particular grade in Table 1 or 2. The modulus of rupture shall be calculated using the original sample thickness before the accelerated aging test cycles.

3.3.6 Modulus of rupture (MOR) and modulus of elasticity (MOE). The MOR and MOE values in Table 1 shall be determined in accordance with Sections 12, 14 through 17, 20.1 and 20.3 of ASTM D 1037-99 Part A. Alternatively, the following approaches are acceptable for determining MOE: (1) It is not necessary to obtain a full force-deflection curve as specified in 17.1; only two force values (and corresponding deflections) within the elastic range need to be recorded; and (2) in 20.3, P1 shall be the difference between the two recorded forces and Y1 shall be the difference between the two corresponding recorded deflections. Three specimens shall be cut parallel to the length of the panel and three specimens shall be cut perpendicular to the length of the same panel. The results of the six tests shall be averaged to determine the MOR and MOE of the panel.

The MOR values in Table 2 shall be determined in accordance with Sections 156 through 159, of ASTM D 1037-99 Part B. Three specimens shall be cut parallel to the length of the panel and three specimens shall be cut perpendicular to the length of the same panel. The results of the six tests shall be averaged to determine the MOR of the panel.

3.3.7 Internal bond (IB). The IB values in Table 1 shall be determined in accordance with Sections 28 through 32 of ASTM D 1037-99 Part A. The IB values in Table 2 shall be determined in accordance with Sections 162 and 163 of ASTM D 1037-99 Part B. Five specimens per panel shall be cut and the test results averaged to determine the IB for the panel.

3.3.8 Face screw-holding. The face screw-holding values in Table 1 shall be determined in accordance with Sections 61 through 67, and notes 25 through 27 of ASTM D 1037-99 Part A, except that: (1) Sections 62.2 and 64 shall not apply; (2) if the panel is less than 19 mm (3/4 inch) thick, the specimen shall be made up of two thicknesses bonded together with an adhesive; and (3) lead holes shall be predrilled a minimum of 19 mm (3/4 inch) deep, using a bit 3.2 mm (1/8 inch) in diameter. Four specimens per panel shall be cut and the test results averaged to determine the face screw-holding for the panel.

Panels of thickness less than 9.5 mm (3/8 inch) shall not be tested for face screw-holding.

3.3.9 Edge screw-holding. The edge screw-holding values in Table 1 shall be determined in accordance with Sections 61 through 67, and notes 25 through 27 of ASTM D 1037-99, except that: (1) Sections 62.1 and 64 shall not apply; and (2) lead holes shall be predrilled a minimum of 19 mm (3/4 inch) deep, using a bit 3.2 mm (1/8 inch) in diameter. Four specimens per panel shall be cut and the test results averaged to determine the edge screw-holding for the panel.

Panels of thicknesses less than 16 mm (5/8 inch) shall not be tested for edge screw-holding.

3.4 Formaldehyde

Formaldehyde emissions from MDF bonded with a resin system containing formaldehyde, other than an exclusively phenol-formaldehyde resin system, shall be tested in accordance with ASTM E 1333-96. The loading ratio for MDF shall be 0.260 m^2/m^3 (0.08 ft^2/ft^3). Emissions shall not exceed the maximum limit of 0.30 ppm as specified in Tables 1 or 2.

4 Identification

4.1 Grade designation

The MDF grades in this standard are identified by a three digit number. Table 1 grades are designated by 100 series numbers and Table 2 grades are designated by 200 series numbers. The grade number designates the property value level first based on MOR and secondarily on IB.

4.2 Moisture resistance designation

MDF with moisture resistant characteristics shall be identified by using a grade designation followed by a hyphen and a moisture resistance designation in Subsection 2.6. Using grade 140 for example: 140-MR10; 140-MR30; 140-MR50.

4.3 Product identification

All MDF which is represented as conforming to this American National Standard shall be identified with at least the following information:

a) ANSI Standard A208.2-2002

b) Thickness

c) Grade

d) Other applicable designations

MR10 for products meeting the requirements of Subsection 3.3.4

MR30 for products meeting the requirements of Subsection 3.3.5

MR50 for products meeting both requirements of Subsection 3.3.4 and Subsection 3.3.5

4.4 Identification methods

The information required by Subsection 4.3 shall be provided either by:

a) a shipping or package label with the conforming product(s), or

b) an invoice or other commercial document, or

c) stamping or labeling each conforming panel.

Table 1

Physical and Mechanical Property Requirements for MDF When Determined in Accordance with ASTM D 1037-96a Part A [1,2]

Grades	Physical and Mechanical Properties[3]											
	Modulus of Rupture (MOR)		Modulus of Elasticity (MOE)		Internal Bond (IB)		Screw-holding[4]				Thickness Swell (TS)	
							Face		Edge		Panel Thickness	
	N/mm^2	(psi)	N/mm^2	(psi)	N/mm^2	(psi)	N	(pounds)	N	(pounds)	≤15 mm mm (inch)	>15mm percent
110	14.0	2030	1400	203100	0.30	44	780	175	670	151	1.5 (0.059)	10%
120	14.0	2030	1400	203100	0.50	73	875	197	775	174	1.5 (0.059)	10%
130	24.0	3481	2400	348100	0.60	87	1100	247	875	197	1.5 (0.059)	10%
140	24.0	3481	2400	348100	0.75	109	1325	298	1000	225	1.5 (0.059)	10%
150	31.0	4496	3100	449600	0.90	131	1400	315	1200	270	1.5 (0.059)	10%
160	31.0	4496	3100	449600	1.05	152	1555	350	1335	300	1.5 (0.059)	10%

Property Requirements Common to all MDF

Properties	Tolerance Limits
Panel Length or Width ≥ 0.61 m (2 feet)	± 2.0 mm (0.080 inch)
Panel Average from Specified Thickness[3,5]	± 0.125 mm (0.005 inch)
Variance from Panel Average Thickness[3,5]	± 0.125 mm (0.005 inch)
Linear Expansion (LE)[3,6]	≤ 0.3 percent
Formaldehyde Emissions[7]	≤ 0.30 ppm

1) Grades shall also meet the requirements listed in Section 3 of this Standard. Panels designated as MR10 shall have a TS ≤ 50% of the TS value specified in the Table. Panels designated as MR30 shall retain at least 50% of the MOR value after tested in accordance with ASTM D 1037-96a Accelerated Aging Test. Panels designated as MR50 shall have a TS ≤ 50% of the TS value specified in the Table and shall retain at least 50% of the MOR value after tested in accordance with ASTM D 1037-96a Accelerated Aging Test.

2) MDF bonded with a resin system containing formaldehyde, other than an exclusively phenol-formaldehyde resin system, is subject to the formaldehyde emission limit.

3) Property values represent a five panel average.

4) Panels of thickness less than 9.5 mm (3/8 inch) shall not be tested for face screw-holding. Panels of thickness less than 16 mm (5/8 inch) shall not be tested for edge screw-holding.

5) Thickness tolerance values only apply to sanded panels.

6) LE shall be measured between 50% and 80% RH in accordance with ASTM D 1037-96a.

7) Tested in accordance with ASTM E 1333-96 at 0.26 m^2/m^3 (0.08 ft^2/ft^3) loading ratio.

Table 2

Physical and Mechanical Property Requirements for Thin MDF (≤ 9.5 mm (3/8 inch) Thick) When Determined in Accordance with ASTM D 1037-96a Part B Test Methods for Hardboard[1,2]

Grades	Physical and Mechanical Properties[3]				
	Modulus of Rupture (MOR)[4]		Internal Bond (IB)[4]		Thickness Swell (TS)
	N/mm^2	(psi)	N/mm^2	(psi)	mm (inch)
210	21.0	3046	0.35	51	2.0 (0.080)
220	31.0	4496	0.60	87	2.0 (0.080)
230	31.0	4496	1.00	145	2.0 (0.080)
240	45.0	6527	1.50	218	2.0 (0.080)

Property Requirements Common to all MDF

Properties	Tolerance Limits
Panel Length or Width ≥ 0.61 m (2 feet)	± 2.0 mm (0.080 inch)
Panel Average from Specified Thickness[3,5]	± 0.125 mm (0.005 inch)
Variance from Panel Average Thickness[3,5]	± 0.125 mm (0.005 inch)
Linear Expansion (LE)[3,6]	≤ 0.3 percent
Formaldehyde Emissions[7]	≤ 0.30 ppm

1) Grades shall also meet the requirements listed in Section 3 of this Standard. Panels designated as MR10 shall have a TS ≤ 50% of the TS value specified in the Table. Panels designated as MR30 shall retain at least 50% of the MOR value after tested in accordance with ASTM D 1037-96a Accelerated Aging Test. Panels designated as MR50 shall have a TS ≤ 50% of the TS value specified in the Table and shall retain at least 50% of the MOR value after tested in accordance with ASTM D 1037-96a Accelerated Aging Test.

2) MDF bonded with a resin system containing formaldehyde, other than an exclusively phenol-formaldehyde resin system, is subject to the formaldehyde emission limit.

3) Property values represent a five panel average.

4) MOR and IB shall be tested in accordance with part B of ASTM D 1037-96a

5) Thickness tolerance values only apply to sanded panels.

6) LE shall be measured between 50% and 80% RH in accordance with ASTM D 1037-96a.

7) Tested in accordance with ASTM E 1333-96 at 0.26 m^2/m^3 (0.08 ft^2/ft^3) loading ratio.

Annex A
(Normative)

References

The materials identified below are referenced in this American National Standard and are part of the Standard.

American Society for Testing and Materials (ASTM):

ASTM D 1037-99, Standard Test Methods for Evaluating the Properties of Wood Based Fiber and Particle Panel Materials (Vol 04.10)

ASTM D 1037 - Part A - General Test Methods for Evaluating The Basic Properties of Wood-Base Fiber and Particle Panel Materials

ASTM D 1037 - Part B - Acceptance and Specification Test Methods for Hardboard

ASTM E 1333-96, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Under Defined Test Conditions Using a Large Chamber (Vol 11.03)

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission):

ISO/IEC Guide 7:1994 (E), Guidelines for drafting of standards suitable for use for conformity assessment

Annex B
(Informative)

Metric values

The 1975 Metric Conversion Act, as amended by the Omnibus Trade and Competitiveness Act of 1988, states that metric (SI) is the preferred system of measurement in the U.S. All Federal agencies must conduct their business in metric by September 1992, to the extent feasible.

The testing and property requirements in this Standard were converted during the last revision from English to metric, in most instances using a "rationalized" conversion where the new metric values are rounded to an appropriate degree of precision[1]. English units are shown in parentheses after the metric value and are generally precise mathematical conversions from the metric.

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[1] ASTM E 29-93a, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (Vol 14.02)

The conversion factors for the units found in this Standard are as follows:

Dimensions	
1 inch	= 0.0254 meter (m)
1 inch	= 25.4 millimeters (mm)
1 m	= 39.370 inch
Mass	
1 gram (g)	= 0.0022046 pound (lb)
1 lb	= 453.5924 g
Force (newtons)	
1 newton (N)	= 101.9716 g
1 N	= 0.2248029 lb
1 g	= 0.0098067 N
1 lb	= 4.448222 N
Stress (force/area)	
1 pascal (Pa)	= 1 N/m^2
1 kilopascal (kPa)	= 0.001 N/mm^2
1 megapascal (MPa)	= 1 N/mm^2
1 N/mm^2	= 145.037 pounds per square inch (psi)
1 psi	= 0.0068948 N/mm^2

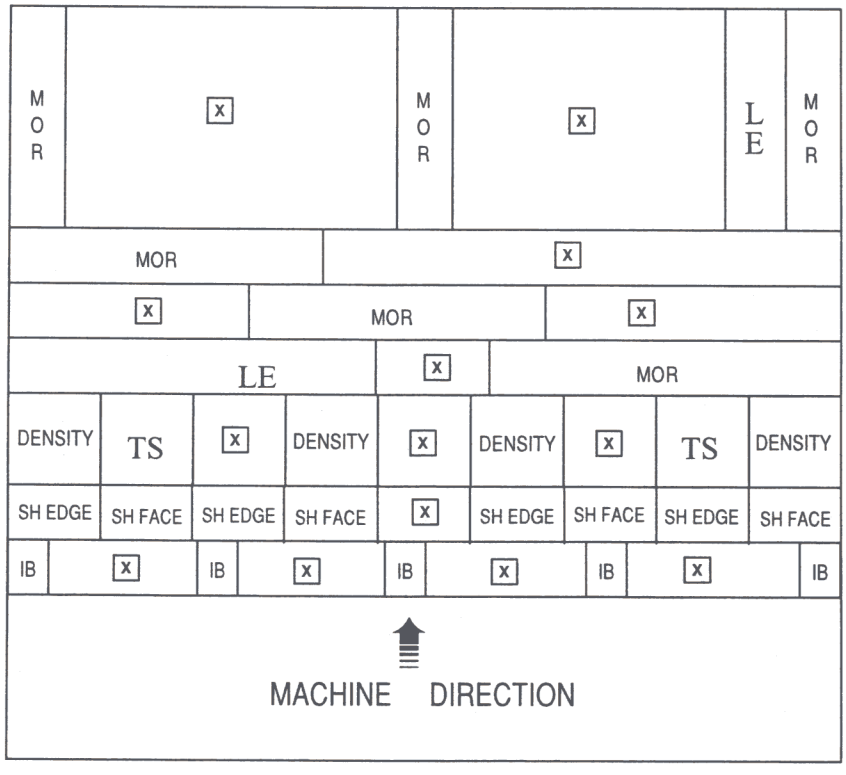
Metric Values

Conversions for:		Rounded to:
Dimensions	less than 50 mm	nearest 0.025 mm
	between 50 and 500 mm	nearest 0.1 mm
	greater than 500 mm	nearest 1 mm
Force (newtons)	less than 100 N	nearest 1 N
	greater than 100 N	nearest 10 N
Stress (force/area) (N/mm^2)	less than 2 N/mm^2	nearest 0.01 N/mm^2
	between 2 and 30 N/mm^2	nearest 0.1 N/mm^2
	greater than 30 N/mm^2	nearest 1 N/mm^2

Annex C
(Informative)

Cut-up pattern guide

This cut-up pattern is a guide for specimen preparation.



Property Test[1,2,3]		
IB	-	Internal Bond
MOR	-	Modulus of Rupture - Modulus of Elasticity
LE	-	Linear Expansion
SH	-	Screw-holding - Edge and Face
TS	-	Thickness Swell
X	-	Discard/Extra

1) Refer to the appropriate ASTM D 1037-99 test procedure for specimen size.
2) Exact dimensions of MOR/MOE specimens depend on specimen thickness.
3) Moisture content can be obtained from the MOR, density or other specimens.

COMPOSITE PANEL ASSOCIATION℠

Association des fabricants de panneaux de composites

The Composite Panel Association (CPA) is the trade association for North American Producers of particleboard, medium density fiberboard and other compatible products.

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