

## GA-235-2019

### GYPSUM BOARD TYPICAL MECHANICAL AND PHYSICAL PROPERTIES

The properties described herein were either obtained from laboratory tests conducted under controlled test conditions as set forth in appropriate standards, compiled from manufacturers' literature, or taken from the minimum requirements of appropriate ASTM Standard Specifications. The values reported below are provided for information and convenience only. Consult manufacturer for more specific values.

#### MECHANICAL PROPERTIES

<b>Flexural Strength (minimums)</b>									
<i>ASTM C473 Standard Test Method for Physical Testing of Gypsum Panel Products; tested face up and face down</i>									
<b>Type of Gypsum Board</b> <small>(Note 1)</small>	<b>Thickness in. (mm)</b>	<b>Method A</b> <small>(Note 2)</small>				<b>Method B</b> <small>(Note 2)</small>			
		<b>Bearing Edges Perpendicular to Length</b>		<b>Bearing Edges Parallel to Length</b>		<b>Bearing Edges Perpendicular to Length</b>		<b>Bearing Edges Parallel to Length</b>	
		<b>lbf</b>	<b>N</b>	<b>lbf</b>	<b>N</b>	<b>lbf</b>	<b>N</b>	<b>lbf</b>	<b>N</b>
a, b	1/4 (6.4)	50	222	20	89	46	205	16	71
a	5/16 (7.9)	65	289	25	111	62	276	21	93
g	3/8 (9.5)	60	267	25	111	56	249	21	93
a, b, e, f	3/8 (9.5)	80	356	30	133	77	343	26	116
e	4/10 (10.2)	88	391	32	142	85	378	28	125
g	1/2 (12.7)	100	445	35	156	97	431	31	138
a, b, c, d, e, f, h	1/2 (12.7)	110	489	40	178	107	476	36	160
a, c, d, e, f	5/8 (15.9)	150	667	50	222	147	654	46	205
b	5/8 (15.9)	140	622	50	222	137	609	46	205
a	3/4 (19.0)	170	756	60	267	167	743	56	249
b	1 (25.4)	230	1020	80	356	228	1010	77	343

<sup>1</sup> ASTM C1396 *Standard Specification for Gypsum Board*:

- a = Gypsum Wallboard and Predecorated Gypsum Board
- b = Gypsum Backing Board and Gypsum Coreboard
- c = Water-Resistant Gypsum Backing Board
- d = Exterior Gypsum Soffit Board
- e = Gypsum Sheathing Board
- f = Gypsum Base for Veneer Plaster
- g = Gypsum Lath
- h = Gypsum Ceiling Board

<sup>2</sup> See ASTM C473 for a description of Methods A and B

**GYPSUM BOARD TYPICAL MECHANICAL AND PHYSICAL PROPERTIES**

<b>Effective Stiffness (EI)*</b> (typical range)		
<b>Board Thickness in. (mm)</b>	<b>lb•in<sup>2</sup>/in of width</b>	<b>kN•mm<sup>2</sup>/mm of width</b>
1/2 (12.7)	1500 to 4000	220 to 580
5/8 (15.9)	3000 to 8000	440 to 1160
<p>* EI is dependent on board density, relative humidity, type of board, paper type, direction of board during testing and the amount of handling prior to measurement. In general the value of EI follows the following relationships:</p> <p style="padding-left: 40px;">Type X Gypsum Board &gt; Regular Gypsum Board                      Denser Gypsum Board &gt; Less Dense Gypsum Board                      Machine Direction &gt; Cross Direction                      Low Relative Humidity &gt; High Relative Humidity</p>		

<b>Effective Modulus of Rupture (MOR) (minimums)</b> Based on Flexural Strengths per ASTM C1396 <i>Standard Specification for Gypsum Board</i>				
<b>Thickness in. (mm)</b>	<b>Machine Direction</b>		<b>Cross Direction</b>	
	<b>psi</b>	<b>MPa</b>	<b>psi</b>	<b>MPa</b>
3/8 (9.5)	970	6.7	350	2.4
1/2 (12.7)	750	5.2	260	1.8
5/8 (15.9)	660	4.6	220	1.5

**GYPSUM BOARD TYPICAL MECHANICAL AND PHYSICAL PROPERTIES**

<p><b>Core, End, and Edge Hardness</b> (minimums)  <i>ASTM C473 Standard Test Method for Physical Testing of Gypsum Panel Products</i></p>	
<b>Method A*</b>	<b>Method B*</b>
15 lbf (67 N)	11 lbf (49 N)
<p>* See ASTM C473 for a description of Methods A and B.</p>	

<p><b>Compressive Strength</b> (typical)                  Ultimate compressive strength at 70°F (21°C) and 50% Relative Humidity (RH)                  Determinations were made from 2" x 2" (50 x 50 mm) or 4" x 4" (100 x 100 mm) samples cut from across the full board width (excluding taper). Samples were conditioned for a minimum of 24 hours and tested in compressive strength machines. Load was applied at a uniform rate until the end point was reached.</p>			
Thickness in. (mm)	Board Type	psi	kPa
5/16 (7.9)	MH gypsum board	400	2750
1/2 (12.7)	regular gypsum board	350	2400
5/8 (15.9)	type X gypsum board	400	2750

## GYPSUM BOARD TYPICAL MECHANICAL AND PHYSICAL PROPERTIES

## Soft-Body Impact Resistance (typical)

ASTM E695 *Standard Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading*

(Using 50 lb (22.7 kg) leather bag, one test per specimen. Impact point located at midpoint between studs. Impact Resistance—Drop height at penetration through impacted membrane.)

Thickness in. (mm)	Board Type	Tested on 2x4 (nominal) wood studs 16" (400mm) o.c.				Tested on 3 5/8" (92 mm), 25 gage steel studs 24" (610 mm) o.c.			
		1 Layer		2 Layers		1 Layer		2 Layers	
		in.	mm	in.	mm	in.	mm	in.	mm
1/2 (12.7)	regular	12	300	30	760	12	300	42	1070
1/2 (12.7)	type X	24	610	54	1370	24	610	54	1370
5/8 (15.9)	type X	30	760	72	1830	24	610	60	1520

## Nail Pull Resistance (minimums)

ASTM C473 *Standard Test Method for Physical Testing of Gypsum Panel Products*

Thickness in. (mm)	Method A*		Method B*	
	lbf	N	lbf	N
1/4 (6.4)	40	178	36	160
5/16 (7.9)	50	222	46	205
3/8 (9.5)	60	267	56	249
4/10 (10.2)	70	312	67	298
1/2 (12.7)	80	356	77	343
5/8 (15.9)	90	400	87	387
3/4 (19.0)	100	445	94	432
1 (25.4)	not required		not required	
* See ASTM C473 for a description of Methods A and B.				

## GYPSUM BOARD TYPICAL MECHANICAL AND PHYSICAL PROPERTIES

<b>Negative Wind Load Resistance</b> (typical)			
<p>ASTM E330 <i>Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference, Procedure A</i>            (Based on tests conducted on single specimens, nominal 4' (1.2 m) wide x 8' (2.4 m) (406 mm) high. Each specimen constructed of a single 4' (1.2 m) x 8' (2.4 m) panel of treated core gypsum sheathing, with no joints, applied parallel to studs spaced 16" (406 mm) o.c. with fasteners spaced 8" (203 mm) o.c. at edges, ends, and intermediate framing members.)</p>			
Thickness In. (mm)	Framing	Fasteners	Negative Wind Load psf (kPa)
1/2 (12.7)	18 gage steel	1" (25 mm) Type S-12 screws	60 (425)
5/8 (15.9)	18 gage steel	1-1/4" (32 mm) Type S-12 screws	100 (700)
1/2 (12.7)	2 x 4 wood	1-1/2" (38 mm) long 11 gage galvanized roofing nails	80 (550)
5/8 (15.9)	2 x 4 wood	1-3/4" (44 mm) long 11 gage galvanized roofing nails	130 ( 885)

### MOISTURE & HUMIDITY RELATED PROPERTIES

<b>Humidified Deflection</b> (maximums)					
<i>ASTM C473 Standard Test Method for Physical Testing of Gypsum Panel Products</i>					
<b>Gypsum Board (except exterior gypsum soffit board)</b>			<b>Exterior Gypsum Soffit Board</b>		
Thickness in. (mm)	Deflection		Thickness in. (mm)	Deflection	
	Eighths of an Inch	mm		Eighths of an Inch	mm
1/4 (6.4)	Not Applicable	Not Applicable	1/2 (12.7)	7	22
5/16 (7.9)	Not Applicable	Not Applicable	5/8 (15.9)	4	13
3/8 (9.5)	15	48	<b>Gypsum Ceiling Board</b>		
4/10 (10.2)	12	38			
1/2 (12.7)	10	32			
5/8 (15.9)	5	16			
3/4 (19.0)	5	16			
1 (25.4)	Not Applicable	Not Applicable	1/2 (12.7)	2.5	8

<p><b>Water Absorption</b> (maximums)  <i>ASTM C473 Standard Test Method for Physical Testing of Gypsum Panel Products – following 2 hours immersion</i></p>
<p>Gypsum Sheathing Board - 10 weight %</p>
<p>Water-Resistant Gypsum Backing Board - 5 weight %</p>

**DIMENSIONAL STABILITY**

<p><b>Thermal Coefficient of Linear Expansion</b> (typical)                  Unrestrained 38°- 90°F (3.3°- 32°C)</p>
<p>9.3x10<sup>-6</sup> in./in.°F (16.7x10<sup>-6</sup> mm/mm•°C)</p>
<p><b>Hygrometric Coefficient of Expansion</b> (typical)                  Unrestrained (10% - 90% RH)</p>
<p>6.5x10<sup>-6</sup> in./in./%RH (mm/mm/%RH)</p>

**FIRE PROPERTIES**

<p><b>Surface Burning Characteristics</b>                  (Independent of thickness)  <i>ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials - CAN/ULC-S102 Surface Burning Characteristics of Building Materials and Assemblies</i></p>		
<b>Board Type</b>	<b>Flame Spread</b>	<b>Smoke Developed</b>
Gypsum board	15	0
<p><b>Fire Resistance</b>  <i>ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials – CAN/ULC-S101-M</i></p>		

<p><b>Noncombustibility</b> (core)  <i>ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C – CAN/ULC-S114-M Standard Method of Test for Determination of Non-Combustibility in Building Materials</i></p>
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**GYPSUM BOARD TYPICAL MECHANICAL AND PHYSICAL PROPERTIES**

<b>Potential Heat</b> From NFPA 220 <i>Standard on Types of Building Construction</i> , Appendix C			
<b>Thickness in. (mm)</b>	<b>Board Type</b>	<b>Potential Heat, Weight Basis</b>	
		<b>(Btu/lb)</b>	<b>(kJ/kg)</b>
3/8 (9.5)	gypsum lath	310	721
3/8 (9.5)	gypsum wallboard	760	1770
1/2 (12.7)	gypsum wallboard	650	1512

**MISCELLANEOUS**

<b>Thermal Properties (typical)</b> R and C values developed using ASTM C177 <i>Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus</i> at 75°F (24°C) mean temperature; Specific Heat from ASHRAE <i>Handbook of Fundamentals</i> .						
<b>Thickness in. (mm)</b>	<b>Resistance (R)</b>		<b>Conductance (C)</b>		<b>Specific Heat</b>	
	$^{\circ}\text{F}\cdot\text{ft}^2\cdot\text{hr}/\text{Btu}$	$\text{K}\cdot\text{m}^2/\text{W}$	$\text{Btu}/\text{hr}\cdot\text{ft}^2\cdot^{\circ}\text{F}$	$\text{W}/\text{m}^2\cdot\text{K}$	$\text{Btu}/\text{lb}\cdot^{\circ}\text{F}$	$\text{J}/\text{kg}\cdot\text{K}$
3/8 (9.5)	0.33	0.058	3.03	17.2	0.26	1090
1/2 (12.7)	0.45	0.079	2.22	12.6	0.26	1090
5/8 (15.9)	0.48	0.085	2.08	11.8	0.26	1090
3/4 (19.0)	0.64	0.12	1.67	8.3	0.26	1090
1 (25.4)	0.83	0.16	1.20	6.3	0.26	1090

**GYPSUM BOARD TYPICAL MECHANICAL AND PHYSICAL PROPERTIES**

<b>Weight per Unit Area</b> (for use in calculating dead loads)		
<b>Thickness in. (mm)</b>	<b>Weight</b>	
	<b>psf</b>	<b>kg/m<sup>2</sup></b>
1/4 (6.4 mm)	1.2	6.0
5/16 (7.9 mm)	1.3	6.4
3/8 (9.5 mm)	1.4	6.8
1/2 (12.7 mm)	2.0	9.8
5/8 (15.9 mm)	2.5	12
1 (25.4 mm)	4.0	20

<b>Permeance (typical)</b> <i>ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials</i>				
<b>Board Type and Thickness</b>	<b>Permeance, Method A</b>		<b>Permeance, Method B</b>	
	<b>Perms</b>	<b>ng/Pa·s·m<sup>2</sup></b>	<b>Perms</b>	<b>ng/Pa·s·m<sup>2</sup></b>
3/8" (9.5 mm) Gypsum Board	31	1800	49	2800
1/2" (12.7 mm) Gypsum Board	27	1600	45	2600
5/8" (15.9 mm) Gypsum Board	25	1400	37	2100
Foil-backed Gypsum Board (from ASHRAE Handbook, 1989)	0.30	17		

The values reported herein are typical values; values derived from samples other than those actually tested may vary from these values. The Gypsum Association and its member companies make no warranties or other representations as to the characteristics, properties, or performance of any materials or systems in actual construction.

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