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UL 4041

Outline of Investigation for Outdoor Furniture

Issue Number: 1

June 29, 2018

Summary of Topics

This first issue of the Outline of Investigation for Outdoor Furniture, UL 4041, provides requirements for construction and testing of outdoor patio furniture such as tables, tables with umbrellas, chairs, multi-seat products, loveseats, benches, hanging chairs or swings and chaise lounge chair.

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Parts of the text and figures (Top load ease cycle test, Concentrated load tests, Distributed load tests, Leg strength test, Test for tables with casters) have been adapted by UL from BIFMA X5.5, Desk Products, with permission from the Business and Institutional Furniture Manufacturers Association (BIFMA).

Parts of the text and figures (Stability disk construction details, Stability tests – Rear and Front, Backrest Strength test – Static – Type I, II and III, Drop test – Dynamic, Swivel Test – Cyclic, Seating Durability tests, Arm Strength test – Vertical - Static, Arm Strength test – Horizontal- Static, Backrest Durability Test – Cyclic – Type I, II and III, Caster/chair base Durability test, Leg Strength Test – Front and Side Application, Footrest Static Load Test – Vertical, Footrest Durability Test – Vertical – Cyclic have been adapted by UL from BIFMA X5.1, Office Seating, and BIFMA X5.4, Lounge and Public Seating, with permission from the Business and Institutional Furniture Manufacturers Association (BIFMA).

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INTRODUCTION

1 Scope

1.1 This outline of investigation provides requirements for construction and testing of outdoor patio furniture such as tables, tables with umbrellas, chairs, multi-seat products, loveseats, benches, hanging chairs or swings and chaise lounge chair. Indoor furniture or outdoor furniture with electrical components should reference the Standard for Household and Commercial Furnishings, UL 962.

2 General

2.1 Units of measurement

2.1.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.2 Undated references

2.2.1 Any undated reference to a code or standard appearing in the requirements of this outline of investigation shall be interpreted as referring to the latest edition of that code or standard.

2.3 Note on figures

2.3.1 Figures provided in this outline are intended as guidelines only and not representative of all possible test configurations.

2.4 Tolerance

2.4.1 Unless otherwise specified, tolerances shall be:

- a) Test Weights, Forces, Velocities, Time, and Cycle requirements are minimums;
- b) Linear measurements, ± 1.5 mm (1/16 in);
- c) Angles, ± 5 degrees; and
- d) Level, within 5 mm per meter (0.06 in per linear foot) or ± 0.3 degrees.

Test weights, forces, dimensions, angles, times, rates and velocities used to perform the test shall be targeted at the nominal values specified and shall be subject to the above tolerances. Devices used to calibrate test devices and/or machines shall be calibrated to one-fourth of the above tolerance, with the exception of Level, which shall be calibrated to one-half.

3 Glossary

3.1 For the purpose of this outline, the following definitions apply.

3.2 AUTOMATIC LOCKING MECHANISM – Mechanism which engages without guidance by the user and prevents unintended movement.

3.3 BENCH – a piece of furniture used for seating that usually holds more than one person.

3.4 CHAIR TYPES:

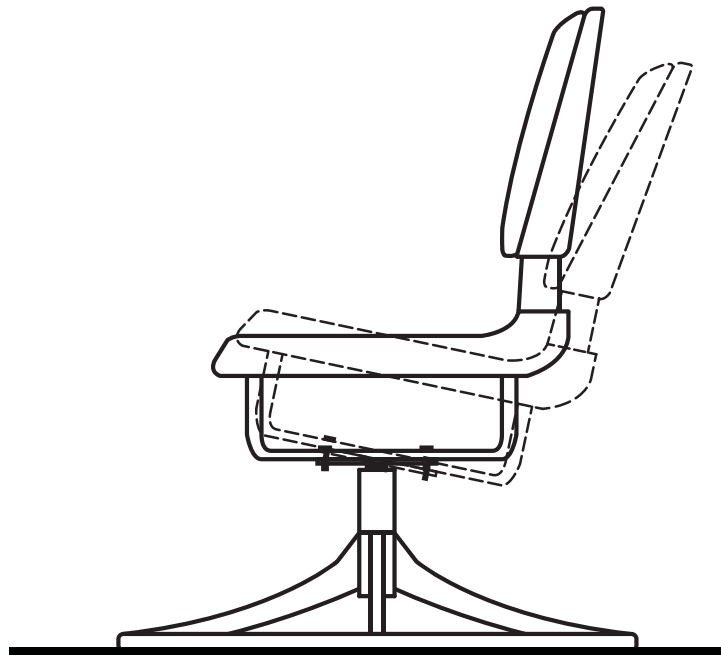
a) CHAIR TYPE I: TILTING CHAIR – A chair with a seat and backrest that tilt (either in unison or in synchronization) with a counterbalancing force. See Figure 3.1.

b) CHAIR TYPE II: FIXED SEAT ANGLE, TILTING BACKREST – A chair that provides a fixed seat angle with a tilting backrest. See Figure 3.2.

c) CHAIR TYPE III: FIXED SEAT ANGLE, FIXED BACKREST – A chair that provides a fixed seat angle with a fixed backrest. See Figure 3.3.

d) CHAISE LOUNGE CHAIR – Chaise lounge chair is any long reclining chair with seat long enough to support the stretched legs. It has an angular back support as shown in Figure 3.4.

Figure 3.1
Type I – Tilting Chair



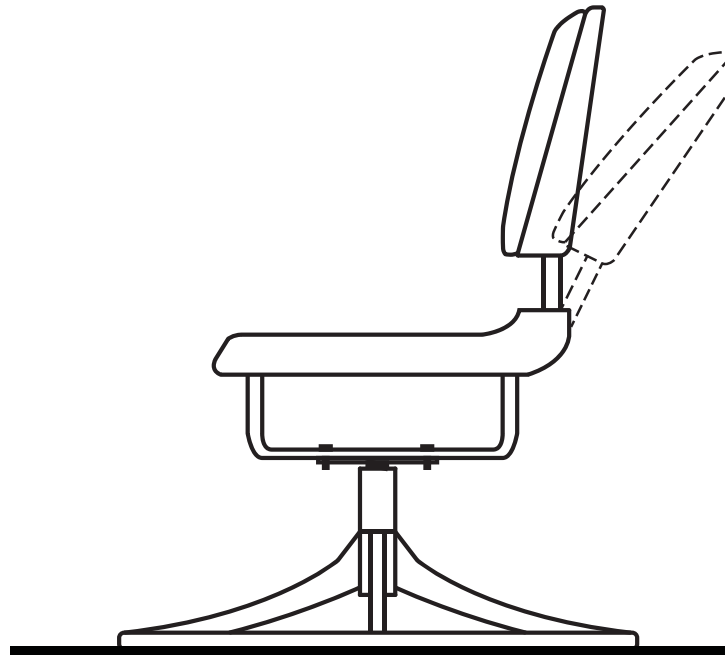
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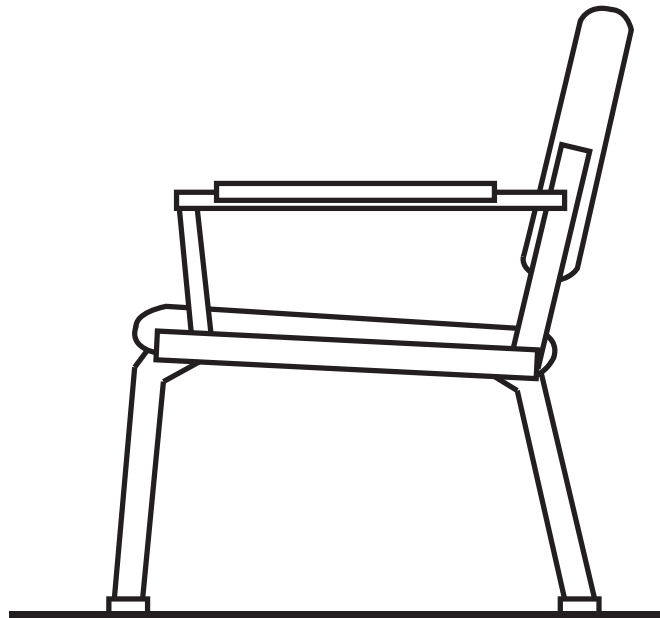
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Figure 3.2
Type II – Fixed seat angle, tilting backrest



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Figure 3.3
Type III – Fixed seat angle, fixed backrest



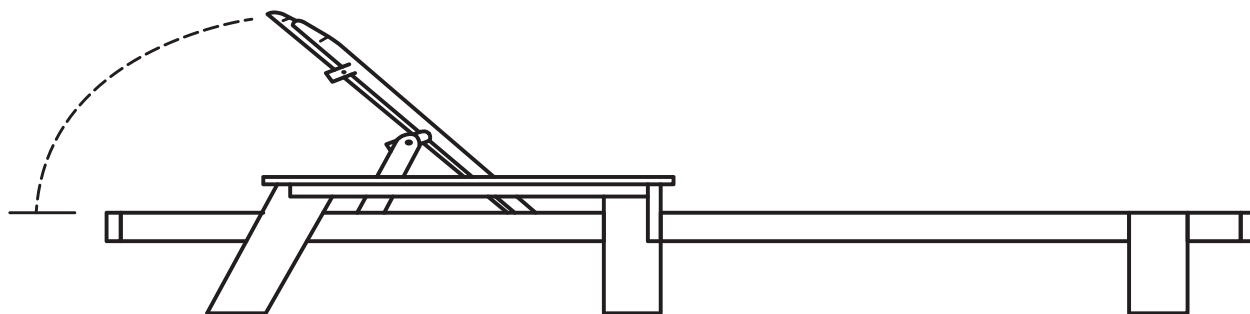
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Figure 3.4
Chaise lounge chair



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3.5 CHAISE LOUNGE SEAT LOADING POINT A – A point 175 mm (6.9 in) forward of the seat/back junction on the longitudinal axis of the chaise lounge chair, or the point closest to this that allows the seat force to be applied.

3.6 CMD – The BIFMA Chair Measuring Device used for the measurement of seating products.

3.7 CYCLE – A complete sequence of operation. This could include loading and unloading, stress reversal; opening and closing; or one complete revolution.

3.8 FORCE – A vector quantity, expressed in newton (N) or pounds force (lbf) that is an interaction with an object.

3.9 FORM FITTING DEVICE – A device that distributes a force over a 305 ± 13 mm $\times$ 89 ± 13 mm (12 ± 0.5 in $\times$ 3.5 ± 0.5 in) area of a backrest. The device will be shaped to approximate the contours of the chair backrest.

3.10 GANGED SEATING UNITS – Multiple seating position units that are made of individual (single seat) units that are mechanically connected.

3.11 LOAD – The weight to which a structure is subjected; a weight or force applied to a product; force acting on a surface, usually caused by the action of gravity.

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3.12 **LOAD-BEARING STRUCTURE/SURFACE** – Any element that supports loads during use. Foam and fabric, for example, are not generally considered load-bearing surfaces, nor are some portions of waterfall edges.

3.13 **LOSS OF SERVICEABILITY** – The failure of the product to support its intended load or to perform all of its normal functions or adjustments.

3.14 **MULTIPLE SEATING** – Seating that has seating positions provided for more than one person.

3.15 **NORMAL USE CONDITION** – For consistency, the midpoint of any adjustment range, such as the height adjustment or counter balancing force adjustment unless otherwise specified in the test method.

3.16 **PEDESTAL BASE** – A base that supports a chair by a single central structural member such as a column.

3.17 **ROCKING MOTION** – Move gently to and fro.

3.18 **SEAT OR SEATING POSITION** – The portion(s) of a unit intended for sitting, approximately 570 mm (22.5 in) in width. Attached table surfaces are not considered seating positions. The number of seating positions shall be as specified by the manufacturer. If no manufacturer's specification is available, or if the number of seating positions is not clearly defined by the design or contours of the seating surface (i.e. bench-type seating units), the number of seating positions shall be determined as follows: divide the width of the seating surface by 570 mm (22.5 in). To determine the number of seating positions round the result down to the nearest integer.

3.19 **SHEAR AND SQUEEZE POINT** – Shear and pinch points exist when the accessible parts are close enough to each other to create a shear point or a pinch point. If two parts can move to create an opening that vary its dimensions from more than 7 mm (0.28 in) to less than 18 mm (0.71 in) they are considered as creating a shear or pinching point. If two parts can move to create an opening that vary its dimensions, but never greater than 7 mm (0.28 in), it is considered that the finger cannot be inserted in the opening. If two parts can move to create an opening that vary its dimensions, but never smaller than 18 mm, it is considered that such moving parts cannot create shear points for the fingers.

3.20 **SINGLE SEATING** – A unit with one seating position.

3.21 **SWIVEL MOTION** – To turn freely and horizontally in a circle.

3.22 **TANDEM SEATING** – Multiple seating with individual seats structurally supported by a common or shared support member. Tandem seating also include one or more tables between seats.

3.23 **TEST PLATFORM** – The horizontal hard work surface, (concrete or other unyielding surface) on which the chair to be tested is placed during testing.

3.24 **TILT MOTION** – Motion chair can move back & forth in addition to swivel or no swivel.

3.25 **TIP OVER** – The condition where the unrestricted unit will not return to its normal upright position.

3.26 WORST-CASE CONDITION – The product and/or condition (i.e. size and construction of a given unit type) most likely to be adversely affected by an individual test or testing sequence.

CONSTRUCTION

4 General

4.1 Furniture for outdoor use shall be constructed of materials and fasteners suitable for the purpose.

4.2 Iron and steel units and components shall be protected against corrosion as specified in Protection against Corrosion, Section 5.

4.3 Glass components shall meet the requirements of the Standard Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings, ANSI Z97.1, Class A or shall not break when tested according to EN 14072:2003, or shall break as specified in EN 14072:2003, Clause 7, (c)(2) or (c)(3) or fulfils the requirements in EN 12150-1:2015, Clause 8, "Fragmentation test". If compliance to these standards is not met then Horizontal Glass Impact Test, Section 8 and Vertical Glass Impact Test, Section 9 tests shall be conducted.

4.4 Holes for umbrella in glass table top shall be protected to prevent metal to glass contact.

4.5 Plastics components that are deemed safety critical need to meet the outdoor requirements as defined by a F1 rating, per Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

4.6 In order to avoid physical injury when the product is in its intended position of use, all edges and corners shall be rounded, chamfered or otherwise protected. This applies to:

- a) Seating: Edges of the seat, backrest and arm rests and any part of the bottom surface of the seat at a distance less than 120 mm (4.7 in) from any edge, where the probe, see Figure 4.1 can commonly access;
- b) Tables: Table tops, any part of the underside of the top surface at a distance less than 500 mm (19.7 in) from any edge below the table, where a knee and/or an arm can commonly access.

4.7 All other parts shall be free from burrs, sharp edges and sharp points and shall comply with Standard for Tests for Sharpness of Edges on Equipment, UL 1439.

4.8 Movable and adjustable parts shall be designed so that injuries and inadvertent operation are avoided.

4.9 It shall not be possible for any load bearing part of the furniture to come loose unintentionally.

4.10 All parts which are lubricated to assist sliding shall be designed to protect users from lubricant stains when in normal use.

4.11 There shall be no accessible holes in the ends of tubular components with a diameter between 7 mm (0.28 in) to 12 mm (0.47 in) with a depth more or equal to 10 mm (0.39 in). The bottom of tubular legs in contact with the floor shall be closed or capped, however, holes in them are allowed as long as they are not between 7 and 12 mm as this poses a potential finger entrapment issue.

5 Protection Against Corrosion

5.1 Patio furniture made of the following materials shall be considered to comply with corrosion requirements and corrosion testing is not required, all other materials shall be tested:

- a) Copper, aluminum, or stainless steel; and
- b) Bronze or brass containing at least 80 percent copper; and
- c) Brass inserts containing at least 60 percent copper.

5.2 Patio furniture made of ferrous materials and provided with one of the coatings in Table 5.1 shall be considered to comply with corrosion requirements and corrosion testing is not required, all other materials shall be tested.

Table 5.1
Sheet steel coatings

Type of coating	mm	(in)	Type or thickness ^a description
(A) Hot-dipped mill galvanized steel	G90 ^b G60 ^b A60 ^b		— with 1 coat of outdoor paint ^c with 1 coat of outdoor paint ^c
(B) Zinc coating other than Type (A)	(0.0155) ^d (0.0104) ^d	0.00061 0.00041	— with 1 coat of outdoor paint ^c
(C) Cadmium coating	(0.0254) (0.01905) (0.0127)	0.0010 0.00075 0.0005	— with 1 coat of outdoor paint ^c with 1 coat of outdoor paint ^c
(D) Vitreous enamel ^e	—		—
^a As determined by ASTM B555, Standard Guide for Measurement of Electrodeposited Metallic Coating Thicknesses by the Dropping Test. ^b Conforming with the coating designation G90, G60, or A60 in Table 1 of ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, with no less than 40 percent of the zinc on any side based on the minimum single spot test requirement in this ASTM standard. ^c Identified as outdoor paint by paint manufacturer. ^d Average thickness with a spot minus tolerance of 0.00178 mm (0.00007 in). ^e Acceptable on sheet steel at least 0.66 mm (0.026 in) thick.			

5.3 Patio furniture shall not be constructed of metals in any combination such as to cause galvanic action that will adversely affect any part of the equipment exposed to moisture as shown in the Table 5.2.

Table 5.2
Galvanic corrosion

Item No.	Material	1	2	3	4	5
1	Aluminum		X			
2	Brasses, Copper, Bronzes	X		X	X	X
3	Cast Iron		X		X	X
4	Steel		X	X		X
5	Zinc		X	X	X	

5.4 If corrosion testing is needed a Salt spray test shall be performed using ASTM Testing from Standard Practice for Operating Salt Spray (Fog) Apparatus, ASTM B117, with 5% concentration neutral salt spray condition, test for 72 hours.

5.5 In reference to Salt spray test, 5.4 there shall be no less than rating 9 after 72 hours test on any component that will affect the performance of the furnishing, the rating standard shall follow Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces, ASTM D610-08.

PERFORMANCE

6 Welding

6.1 The welding process, materials and any special properties; joint configurations and preparation; and welding procedure specifications shall be suitable for the application.

6.2 The weld joint specification shall have a min tolerance of 0 – 0.5 mm for any bevel or root gap and a min trim tolerance of ± 0.5 mm. The parts shall be fitted as intended before welding and compliance with the tolerance requirement shall be determined via a rod gauge. Verification of the adequacy of the specified tolerance (minimum or other) shall be determined at the most adverse tolerance.

6.3 A fillet weld specification shall account for any curvature of the mounting surface. See Figure 6.1 (A to F).

Figure 6.1
Fillet weld specification

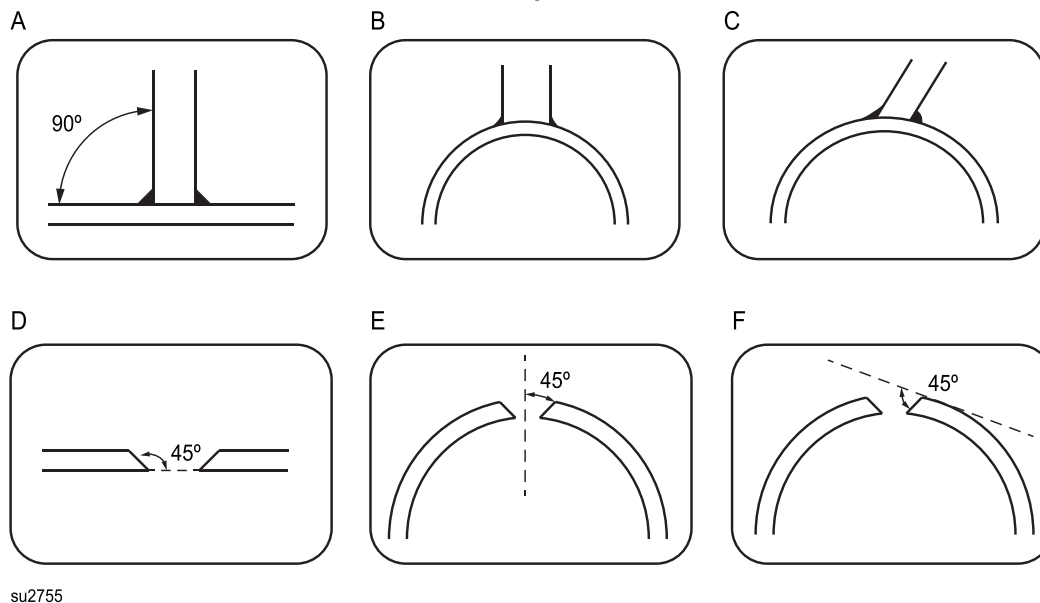


Fig 10.1 (A to F): Courtesy of the National Board of Boiler and Pressure Vessel Inspectors.

6.4 The specification for a beveled opening that accepts a separate part to be welded shall indicate the point of reference to which the bevel is to be measured.

6.5 All welding joints shall be positioned for welding in either the flat or horizontal position unless made using a production jig. The horizontal or vertical plane of the flat and horizontal joint vary up to a maximum of 10 degrees.

6.6 A beveled opening shall be made using a production jig or other aid that enables consistency of shape and dimensions with the specification. The production jig / aid shall provide visual indication that the welded part has the specified penetration.

6.7 The minimum overlap of parts in stress-carrying lap joints shall be five times the thickness of the thinner part.

6.8 Weld start/stops of intermittent welds shall be placed away from high stress areas (e.g. corners).

6.9 Qualifications and training records for staff performing welding must be maintained and available for review.

6.10 360° welding is required on all tube-to-tube, tube-to-plate, and tube-to-assembly welds. Strap-to-tube welds may have the strap connected with short beads.

7 General

7.1 Table 7.1 identifies the tests in this outline and the applicable tests for each product type.

Table 7.1
Applicable tests

Test	Section/ Paragraph	Products				
		Chairs	Benches	Tables	Chaise Lounge Chair	Hanging chairs or swings
Salt spray test	5.4	X	X	X	X	X
Horizontal Glass Impact Test	8			X		
Vertical Glass Impact Test	9			X		
Shear and Pinch Point Test	10	X	X	X	X	X
Stability Test	11			X		
Top Load Ease Cycle Test	12			X		
Concentrated Load Test	13			X		
Distributed Load Test	14			X		
Table Unit Drop Test	15			X		
Leg Strength Test	16			X		
Test for Tables with Casters	17			X		
Stability Tests	18	X	X			
Backrest Strength Test – Static – Type I and II	19	X	X			
Backrest Strength Test – Static – Type III	20	X	X			X
Drop Test – Dynamic	21	X	X			
Swivel Test – Cyclic	22	X				
Seating Durability Tests – Cyclic	23	X	X			
Arm Strength Test – Vertical – Static	24	X	X			X
Arm Strength Test – Horizontal – Static	25	X	X			X
Backrest Durability Test – Cyclic – Type I	26	X	X			

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Table 7.1 Continued

Test	Section/ Paragraph	Products				
		Chairs	Benches	Tables	Chaise Lounge Chair	Hanging chairs or swings
Backrest Durability Test – Cyclic – Type II and III	27	X	X			X
Caster/Chair Base Durability Test for Pedestal Base Chairs	28	X				
Caster/Chair Frame Durability Test for Chairs with Legs	29	X				
Leg Strength Test – Front and Side Application	30	X	X			
Footrest Static Load Test – Vertical	31	X	X			
Footrest Durability Test – Vertical – Cyclic	32	X	X			
Chaise lounge chair	33				X	
Stability	33.1				X	
Backrest Strength Test – Static	33.2				X	
Drop Test – Dynamic	33.3				X	
Seating Durability Tests – Cyclic	34				X	
Arm Strength Test – Vertical – Static	35				X	
Arm Strength Test – Horizontal – Static	36				X	
Backrest Durability Test – Cyclic	37				X	
Leg Strength Test – Front and Side Application	38				X	
Lifting Test for Mobile Chaise Lounge Chair	39				X	
Front and Rear Stability Test for Hanging Chairs	A1					X

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Table 7.1 Continued on Next Page



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Table 7.1 Continued

Test	Section/ Paragraph	Products				
		Chairs	Benches	Tables	Chaise Lounge Chair	Hanging chairs or swings
Static Load Test of Seat (Alternative Method to: Drop Test – Dynamic)	A2					X
Durability Load Test of Seat (Alternative Method to: Seating Durability Tests – Cyclic)	A3					X
Structural Strength Test of the Swing (Alternative Method to: Leg Strength Test – Front and Side Application)	A4					X
Oscillation Fatigue Test (Additional Test for Seating with Oscillation Motion)	A5	X	X			X

7.2 Table 7.2 identifies the safety cycles and additional levels of test cycles for specific tests.

Table 7.2
Test cycle for specific tests

Test	Section	Test Level		
		Safety		Performance*
		Stage 1	Stage 2	Stage 3
Seating Durability Tests – Cyclic	23	See 23.3 and 23.4	See 23.3 and 23.4	See 23.3 and 23.4
Impact Test	23.3	10,000	10,000	30,000
Front corner load-ease test – Cyclic – Off- center	23.4	8,000 Left: 4,000 Right: 4,000	2,000 Left: 1,000 Right: 1,000	10,000 Left: 5,000 Right: 5,000
Backrest Durability Test – Cyclic – Type I	26	Center: 15,000 Left: 5,000 Right: 5,000	Center: 10,000 – –	Center: 15,000 Left: 5,000 Right: 5,000
Backrest Durability Test – Cyclic – Type II and III	27	Center: 15,000 Left: 5,000 Right: 5,000	Center: 10,000 – –	Center: 15,000 Left: 5,000 Right: 5,000

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Table 7.2 Continued on Next Page



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Table 7.2 Continued

Test	Section	Test Level		
		Safety		Performance*
		Stage 1	Stage 2	Stage 3
Seating Durability Tests – Cyclic	34	10,000	10,000	30,000
Backrest Durability Test – Cyclic	37	Center: 15,000 Left: 5,000 Right: 5,000	Center: 10,000 – –	Center: 15,000 Left: 5,000 Right: 5,000
Durability Load Test of Seat (Alternative Method to: Seating Durability Tests – Cyclic)	A3	10,000	10,000	30,000
* At the manufacturer's option, the test cycles can be increased to these values for additional performance information.				

8 Horizontal Glass Impact Test

8.1 Applicability

8.1.1 This test applies to all tables that have horizontal glass surfaces that do not comply with 4.3.

8.2 Purpose of test

8.2.1 The purpose of this test is to determine the strength of the glass.

8.3 Test setup

8.3.1 The sample is to be supported as normally supported by the frame.

8.4 Test procedure

8.4.1 A solid steel sphere, 51 mm (2 in) in diameter and weighing 0.54 kg (1.18 lb), is to fall through the distance required to result in an impact of 6.8 J (5 ft-lbf).

8.5 Compliance criteria

8.5.1 The glass surface shall not crack or break.

9 Vertical Glass Impact Test

9.1 Applicability

9.1.1 This test applies to all tables that have vertical glass surfaces that do not comply with 4.3.

9.2 Purpose of test

9.2.1 The purpose of this test is to determine the glass stays in the frame.

9.3 Test setup

9.3.1 The sample is to be supported as normally supported by the frame.

9.4 Test procedure

9.4.1 The glass surface is to be mounted in the intended manner. A sand-filled bag having a 760 ± 13 mm (30 ± 0.5 in) circumference and a weight of 9.1 kg (20 lb) is to fall as a pendulum through the distance that produces an impact of 18.4 J (13.6 ft-lbf) on any point on the panel.

9.5 Compliance criteria

9.5.1 The glass shall not become dislodged or displaced from its mounting means.

10 Shear and Pinch Point Test

10.1 Applicability

10.1.1 This test is applicable to all furniture that may have an entrapment hazard.

10.2 Purpose of test

10.2.1 The purpose of this test is to determine if there are any pinch points or other personal injury hazards.

10.3 Test setup

10.3.1 The furnishing should be set up as intended based on its instructions. The test shall be performed with and without a load.

10.4 Test procedure

10.4.1 The furnishing shall be used in accordance with its instructions and shall be manipulated through all of its adjustments.

10.5 Compliance criteria

10.5.1 When a product is being folded or unfolded, shear and pinch points are acceptable if the user is in control of their movement and is able to stop movement if pain is experienced.

10.5.2 Shear and pinch points created by loads applied during normal use are not acceptable as there is a risk of injury created by the weight of the user. For example shear and pinch points created during an attempt to adjust the angle of the backrest of a chaise lounge chair while sitting.

10.5.3 Shear and pinch points created by energized components like mechanical springs and gas lifts are not acceptable as the user is not in control of his/her movement.

TABLE TESTING

11 Stability Test

11.1 General

11.1.1 Applicability

11.1.1.1 This test is applicable to all tables.

11.1.2 Purpose of test

11.1.2.1 The purpose of this test is to evaluate the stability of all tables.

11.1.3 Test setup

11.1.3.1 The test shall be conducted with all of the following:

- a) The legs, wheels, casters, or similar means of support, arranged in the position most likely to result in tip-over and blocked so that the table does not move. The thickness of the mechanism employed to block casters or wheels shall be a maximum of 1/8th the diameter of the caster or wheel.
- b) All table leaves and other movable or adjustable parts shall be positioned in the worst case position for stability, if the worst case is not obvious multiple tests need to be conducted.

11.1.4 Test procedure

11.1.4.1 A 305 mm (12 in) disk loaded with 57 Kg (125 pounds) shall be centered 178 mm (7 in) in from the edge of the table at the least stable position.

11.1.5 Compliance criteria

11.1.5.1 The table shall not tip over.

11.2 Table stability – Tables designed to support an umbrella

11.2.1 Applicability

11.2.1.1 This test is applicable for tables that are intended to support an umbrella. This test does not apply to tables that are not intended to support an umbrella even if the table is provided with an opening for an umbrella to pass through.

11.2.2 Purpose of test

11.2.2.1 The purpose of this test is to evaluate the stability of all tables that are intended to support umbrellas.

11.2.3 Test setup

11.2.3.1 Unless otherwise specified, the tests shall be carried out in the configuration most likely to cause overturning. Where the table top can be extended, and the smallest dimension of the unextended table top is less than 300 mm, then the extended configuration shall be considered most likely to cause failure. In this case, the extended configuration is considered as the main surface.

11.2.3.2 Levelling devices shall be set as near as possible to 5 mm (0.20 in) from the fully open position whilst ensuring the table top is parallel to the floor.

11.2.3.3 Tables supplied with storage features shall be tested with no load in the storage item.

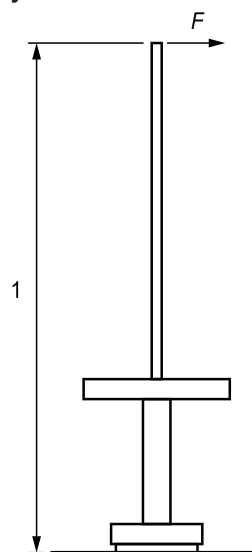
11.2.4 Test procedure

11.2.4.1 A metal pipe that is 2210 mm (87 in) in length with a diameter of 38 mm $\pm$ 4.1 mm (1.5 $\pm$ 0.16 in) and a wall thickness of 1.0 $\pm$ 0.02 mm (0.04 $\pm$ 0.0079 in) shall be fixed firmly in the opening for a table umbrella. A horizontal force of 30 N (6.7 lbf) is to be applied at the top end of the metal pipe. See Figure 11.1.

11.2.5 Compliance criteria

11.2.5.1 The table shall not tip over as a result of the application of the load.

Figure 11.1
Stability of table with an umbrella



su2798

1 = Length of the metal pipe.

12 Top Load Ease Cycle Test

12.1 Applicability

12.1.1 This test is applicable for all tables.

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12.2 Purpose of test

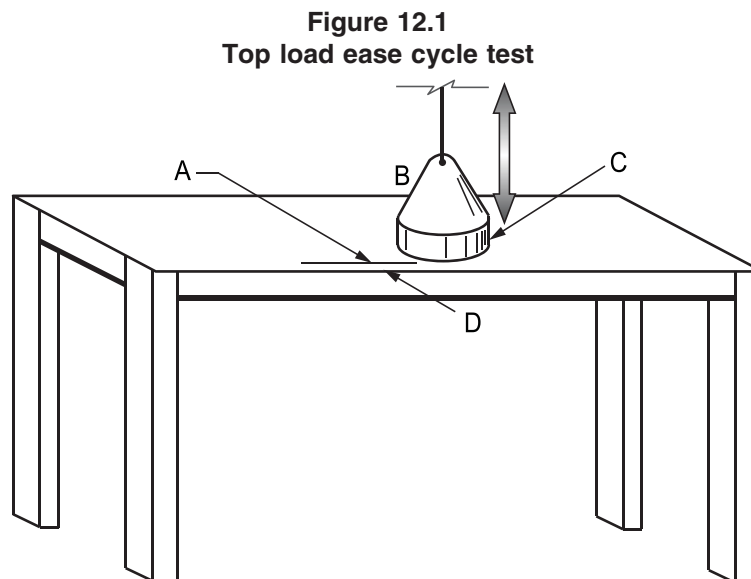
12.2.1 The purpose of this test is to evaluate the durability of the unit to withstand cyclic loading of the primary surface(s) resulting from a person sitting on the unit.

12.3 Test setup

12.3.1 For units with a primary surface with a depth greater than or equal to 457 mm (18 in) deep, a 91 kg (200 lb) weight applied by means of a 406 mm $\pm$ 13 mm (16 in $\pm$ 0.5 in) diameter bag (See Figure 12.1) or force applied through a 406 mm $\pm$ 13 mm (16 in $\pm$ 0.5 in) disk shall be positioned with the edge of the bag/disk within 25 mm (1 in) from the edge of the surface at the center of the largest unsupported span. For primary surfaces with a depth less than 457 mm (18 in), center the bag on the available surface depth as shown in Figure 12.1.

12.4 Test procedure

12.4.1 The cycling device shall be set to cycle at a rate of 14 $\pm$ 6 cycles per minute.



su2857

A – 25 mm (1 in)

C – 406 mm (16 in) Diameter loading device

B – 91 Kg (200 lb)

D – 25 mm (1 in)

12.4.2 The loading device shall be raised until the entire weight is off the surface and then eased (without impact) onto the surface, so that it takes the entire weight without any support from the cycling device. Repeat for a total of 5,000 cycles.

12.5 Compliance criteria

12.5.1 There shall be no loss of serviceability to the unit.

13 Concentrated Load Test

13.1 Normal (Functional) load test

13.1.1 Applicability

13.1.1.1 This test is applicable for all tables.

13.1.2 Purpose of test

13.1.2.1 The purpose of this test is to evaluate the ability of the unit to withstand static loads when loaded to its full capacity.

13.1.3 Test setup

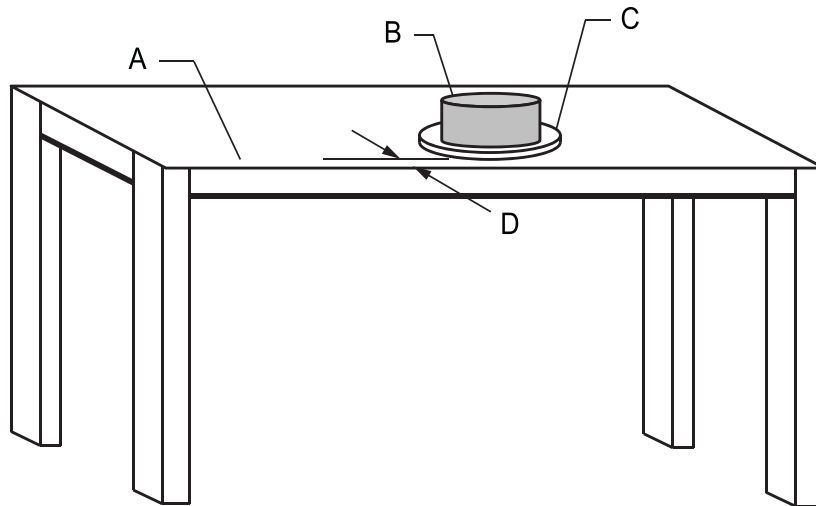
13.1.3.1 The test shall be conducted with all of the following:

- a) The legs, wheels, casters, or similar means of support shall be blocked so that the table does not move. The table legs shall be restrained to prevent the table from tipping as a result of the load.
- b) All table leaves and other movable or adjustable parts shall be positioned in the worst case position. If the worst case is not obvious multiple tests need to be conducted.

13.1.4 Test procedure

13.1.4.1 Apply the specified 90.7 Kg (200 lb) Concentrated load to the primary surface through a 305 mm (12 in) diameter disk so that its center is 178 mm (7 in) from the unit's edge at its apparent weakest point. If at the apparent weakest point the top has a depth less than 356 mm (14 in), center the loading disk across the depth at that position as shown in Figure 13.1

Figure 13.1
Normal (Functional) load test



su2856

A – Extendible elements loaded and extended
C – 305 mm (12 in) disk

B – Concentrated load
D – 25 mm (1 in)

13.1.4.2 When the weakest point is not obvious, several load applications be necessary to properly test the product. The following are some typical weakest points:

- a) Center point of longest unsupported span.
- b) Longest distance from cantilevered support to work surface edge.
- c) Each side of ganged surface edges.

13.1.4.3 When testing units with lengths (or diameters) greater than 1829 mm (72 in), two 90.7 Kg (200 lb) loads are required. The loads are applied through 305 mm (12 in) diameter disks. The centers of these disks shall be placed 915 mm $\pm$ 25 mm (36 in $\pm$ 1.0 in) apart and 178 mm (7 in) in from the edge of the primary surface at the apparent weakest point. Test time is 60 minutes.

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13.1.5 Compliance criteria

13.1.5.1 There shall be no loss of serviceability.

13.2 Concentrated abnormal (Proof) load test

13.2.1 Applicability

13.2.1.1 This test is applicable for all tables.

13.2.2 Purpose of test

13.2.2.1 The purpose of this test is to evaluate the ability of the unit to withstand static loads when loaded to its full capacity.

13.2.3 Test setup

13.2.3.1 For tables with an area greater than 0.46 m² (5 ft.²), unless stated otherwise, the setup shall be performed per Section 13 but with the appropriate 136.1 Kg (300 lb) concentrated load(s).

13.2.3.2 For tables with an area equal to or less than 0.46 m² (5 ft.²), the setup shall be performed per Section 13, except the 136.1 Kg (300 lb) concentrated load shall be placed in the center of the table.

13.2.4 Test procedure

13.2.4.1 Test to be performed for 15 minutes.

13.2.5 Compliance criteria

13.2.5.1 There shall be no sudden and major change in the structural integrity of the product. Loss of serviceability is acceptable.

14 Distributed Load Test

14.1 Normal (Functional) load test

14.1.1 Applicability

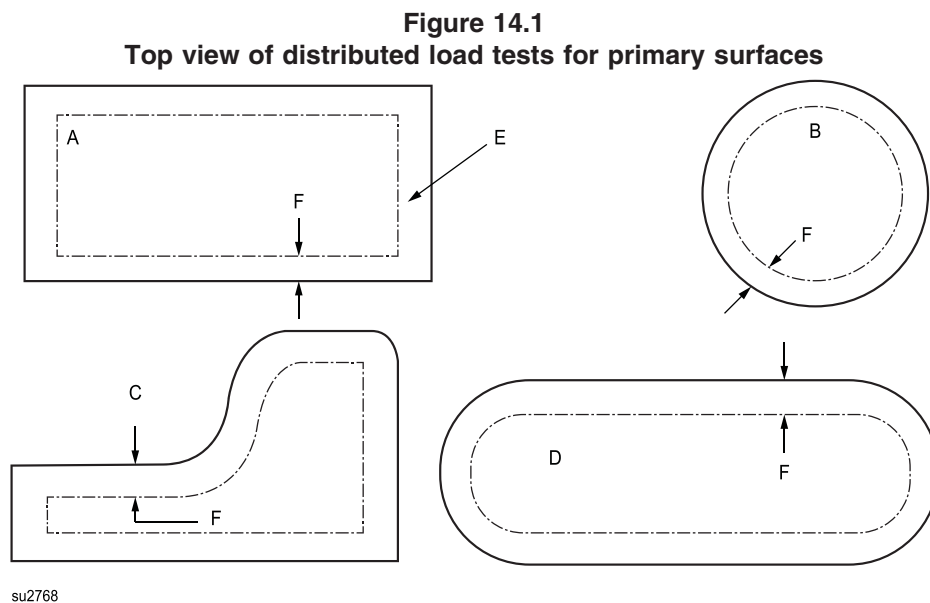
14.1.1.1 This test is applicable for all tables.

14.1.2 Purpose of test

14.1.2.1 The purpose of these tests is to evaluate the ability of the unit to withstand static loads when loaded to its full capacity.

14.1.3 Test setup

14.1.3.1 A load of 1.5 lb/in of perimeter shall be evenly distributed and centered over a line 203 mm (8 in) in from the edge along the entire perimeter as shown in Figure 14.1. For surfaces that are less than 406 mm (16 in) deep, evenly distribute the load across the surface. The loads are secured to the surface if necessary to perform this test.



A = Rectangular table
C = Irregularly shaped table
E = Centerline of distributed loads

B = Round table
D = Conference table
F = 203 mm (8 in)

14.1.4 Test procedure

14.1.4.1 Test to be performed for 60 minutes.

14.1.5 Compliance criteria

14.1.5.1 There shall be no loss of serviceability.

14.2 Distributed abnormal (Proof) load test

14.2.1 Applicability

14.2.1.1 This test is applicable for all tables.

14.2.2 Purpose of test

14.2.2.1 The purpose of these tests is to evaluate the ability of the unit to withstand static loads when loaded to its full capacity.

14.2.3 Test setup

14.2.3.1 Perform the setup per 14.1, Normal (Functional) load test, using a 2.3 lb/in of perimeter distributed abnormal (proof) loads.

14.2.4 Test procedure

14.2.4.1 Test to be performed for 15 minutes.

14.2.5 Compliance criteria

14.2.5.1 There shall be no sudden and major change in the structural integrity of the product that results in a personal injury. Loss of serviceability is acceptable.

15 Table Unit Drop Test

15.1 Applicability

15.1.1 This test is applicable only to tables with a weight of less than 136.1 Kg (300 lb).

15.2 Purpose of test

15.2.1 The purpose of this test is to determine the ability of a table unit to withstand an impact force on the legs, column or base.

15.3 Test setup

15.3.1 The unit shall be placed on a test platform.

15.4 Test procedure

15.4.1 Raise one end of the long axis of the unloaded unit so that the bottom of the base is 180 mm (7.1 in) above the test platform or at the balance point, whichever is lower. The end of the unit being tested shall be released and allowed a free fall to the test platform. Repeat for the other end of the table unit.

15.5 Compliance criteria

15.5.1 There shall be no loss of serviceability.

16 Leg Strength Test

16.1 Applicability

16.1.1 This test is applicable for all tables.

16.2 Purpose of test

16.2.1 The purpose of the test is to evaluate the strength of the leg of the table.

16.3 Test setup

16.3.1 All tests must be performed on a single leg structure. It is not necessary to repeat tests on legs or support elements of identical construction.

16.3.2 Test setup instructions steps are below (See Figure 16.1):

a) The unloaded unit shall be positioned on its top, on a test platform, and secured in place. If the unit has glides, they shall be set at the midpoint of their adjustment range but not greater than 13 mm (0.5 in). For units with top design features that do not allow the product to be placed on its top, it is acceptable to lift the product (either one or both ends) so that the legs do not contact the floor, and then apply the loads at the end of the leg(s).

b) Based on the table type, calculate the Normal (Functional) Force "A" as follows [not to exceed 445 N (100 lbf)]:

1) Tables with a total surface area greater than 0.46 m² (5 ft.²) and 610 mm (24 in) in height:

$$"A" = 0.5 \times (\text{unit weight, kg}) \times 9.8 + 222 \text{ N}$$

$$["A" = 0.5 \times (\text{unit weight, lb.}) + 50 \text{ lbf}]$$

2) All other types:

$${}^{\prime\prime}A^{\prime\prime} = 0.5 \times (\text{unit weight, kg}) \times 9.8 + 44 \text{ N}$$

$$[{}^{\prime\prime}A^{\prime\prime} = 0.5 \times (\text{unit weight, lb}) + 10 \text{ lbf}]$$

c) Calculate the Normal (Functional) Force ${}^{\prime\prime}B^{\prime\prime}$ as $(0.5 \times {}^{\prime\prime}A^{\prime\prime})$.

d) Calculate the Abnormal (Proof) Forces ${}^{\prime\prime}A^{\prime\prime}$ [not to exceed 668 N (150 lbf)] and ${}^{\prime\prime}B^{\prime\prime}$ as follows:

$$\text{Abnormal (Proof) Force } {}^{\prime\prime}A^{\prime\prime} = 1.5 \times (\text{Normal (Functional) Force } {}^{\prime\prime}A^{\prime\prime}).$$

$$\text{Abnormal (Proof) Force } {}^{\prime\prime}B^{\prime\prime} = 1.5 \times (\text{Normal (Functional) Force } {}^{\prime\prime}B^{\prime\prime}).$$

16.4 Normal (Functional) test

16.4.1 Test procedure

16.4.1.1 Attach a loading device to the support member to be loaded. The placement of the loading device shall be within 25 mm (1 in) of the end of the support member/glide assembly that makes contact with the floor. The placement of the loading device shall be as close to the glide end as possible (may be on the glide stem, but not on the glide foot itself). For tables with casters, apply the load as close as possible to the end of the support member but not to the caster assembly.

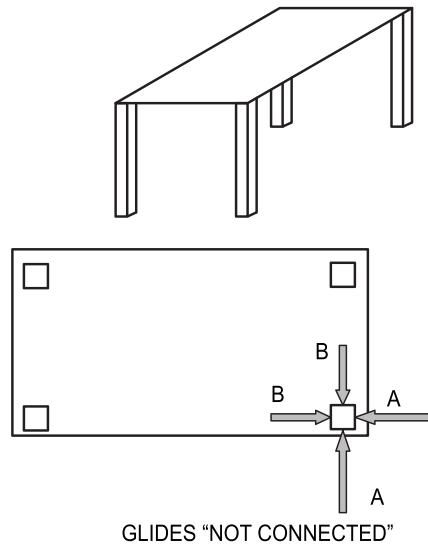
16.4.1.2 Individually and separately apply the Normal (Functional) horizontal forces (${}^{\prime\prime}A^{\prime\prime}$ and ${}^{\prime\prime}B^{\prime\prime}$) as shown in Figure 16.1.

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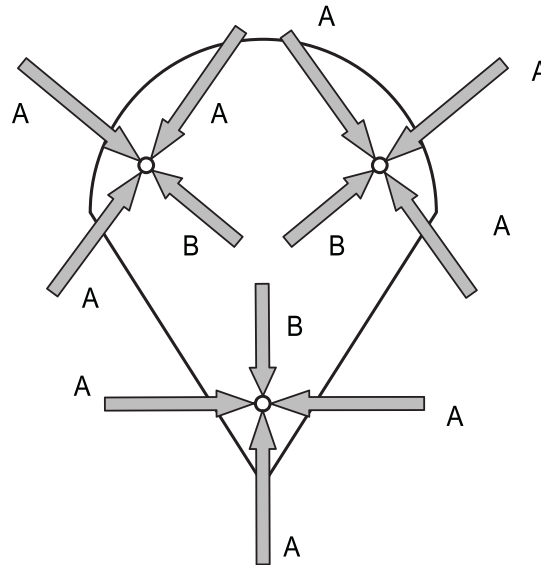
Figure 16.1
Leg strength test – Typical configurations



su2871

Figure 16.1 cont'd

Tables with legs tested as if glides are not connected



su2872

Figure 16.1 cont'd

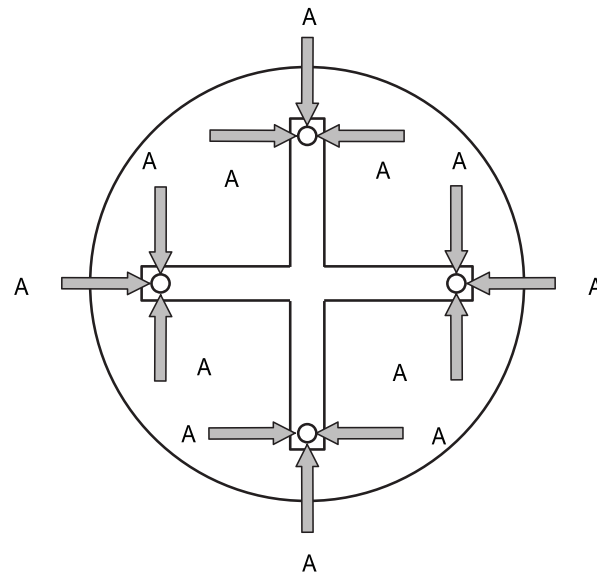
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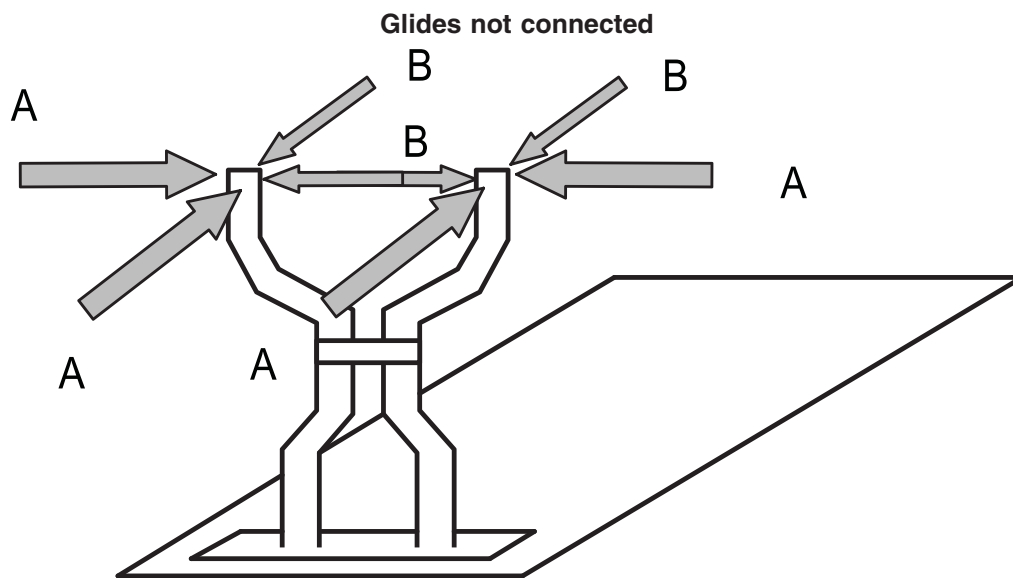
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Cross slab legs tested as shown above



su2873

Figure 16.1 cont'd



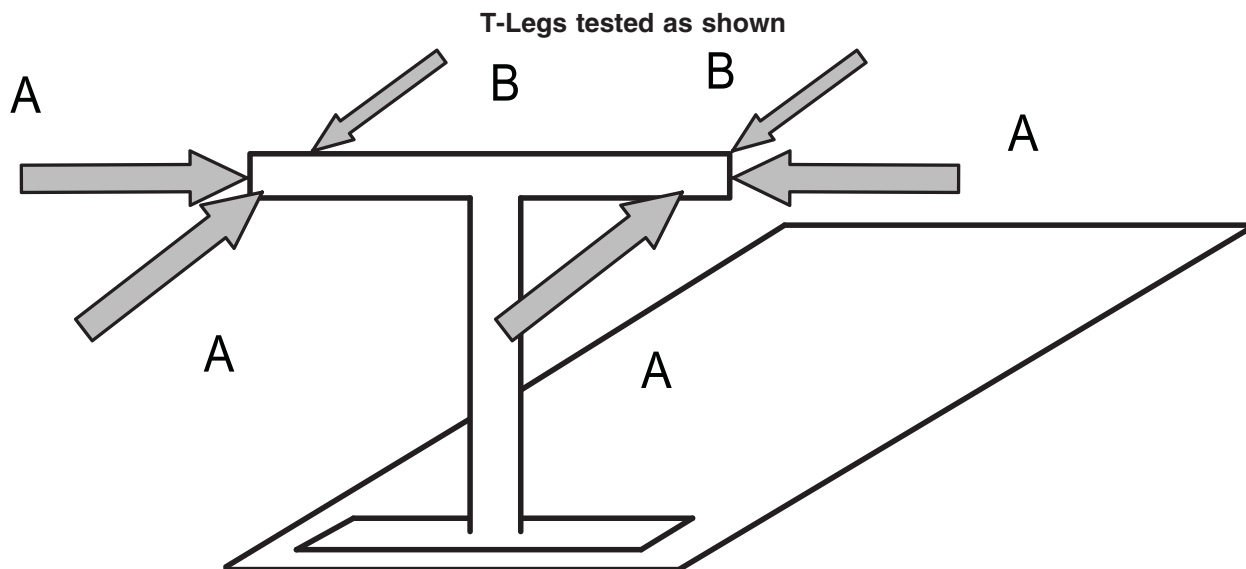
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Figure 16.1 cont'd

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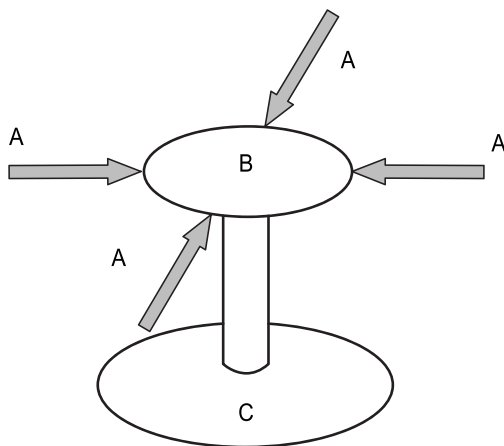
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su2875

Figure 16.1 cont'd

Column tables tested as shown above



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B = Base

C = Top

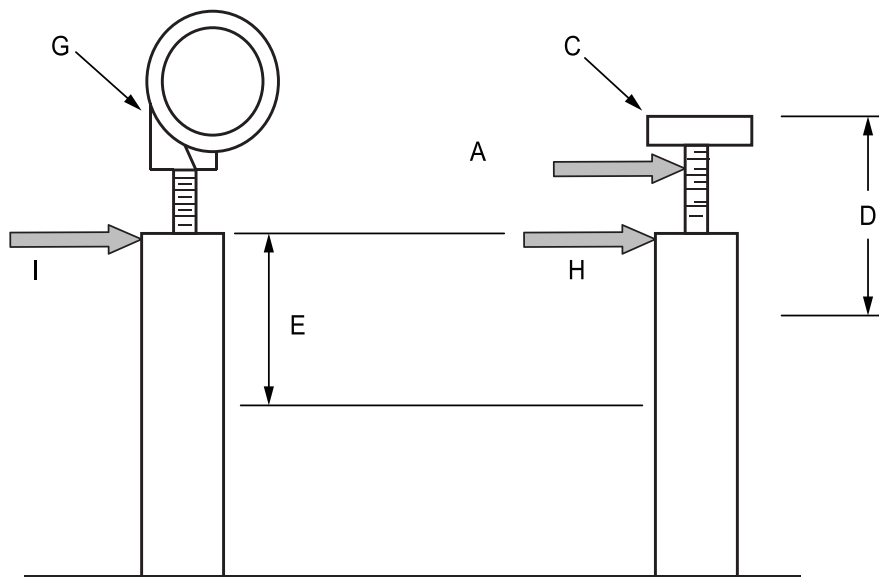
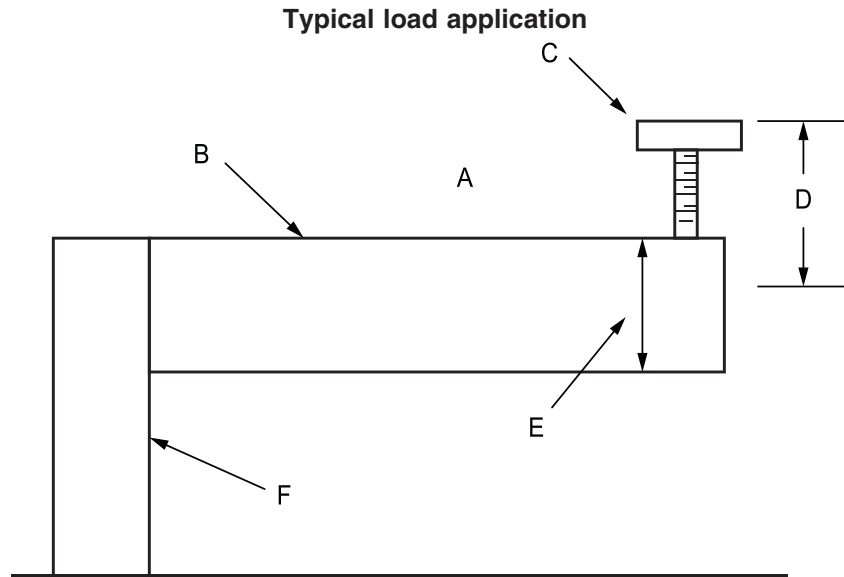
Figure 16.1 cont'd

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A – Normal (Functional) (Reference 16.4.1.1)

C – Glide assembly

E – 25 mm (1.0 in) Zone for proof force application

G – Caster assembly

I – Normal (functional) and Abnormal loadings

B – Horizontal leg

D – 25 mm (1.0 in) Zone for functional force application

F – Vertical center column

H – Abnormal loading

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16.4.1.3 Repeat for each unique type or non-symmetrically placed supporting member on the table product.

16.4.2 Compliance criteria

16.4.2.1 No loss of serviceability shall occur as a result of the application of the Normal (Functional) loads.

16.5 Abnormal (Proof) test

16.5.1 Test procedure

16.5.1.1 Repeat the testing as shown in the Normal (Functional) Test Procedure, but with the Abnormal (Proof) loads.

16.5.2 Compliance criteria

16.5.2.1 Application of the Abnormal (Proof) loads shall cause no sudden and major change in the structural integrity of the product. Loss of function is acceptable.

17 Test for Tables with Casters

17.1 Applicability

17.1.1 This test applies to all tables with casters.

17.2 Purpose of test

17.2.1 The purpose of this test is to evaluate the ability of tables with casters to withstand fatigue, stress, and wear caused by moving the product.

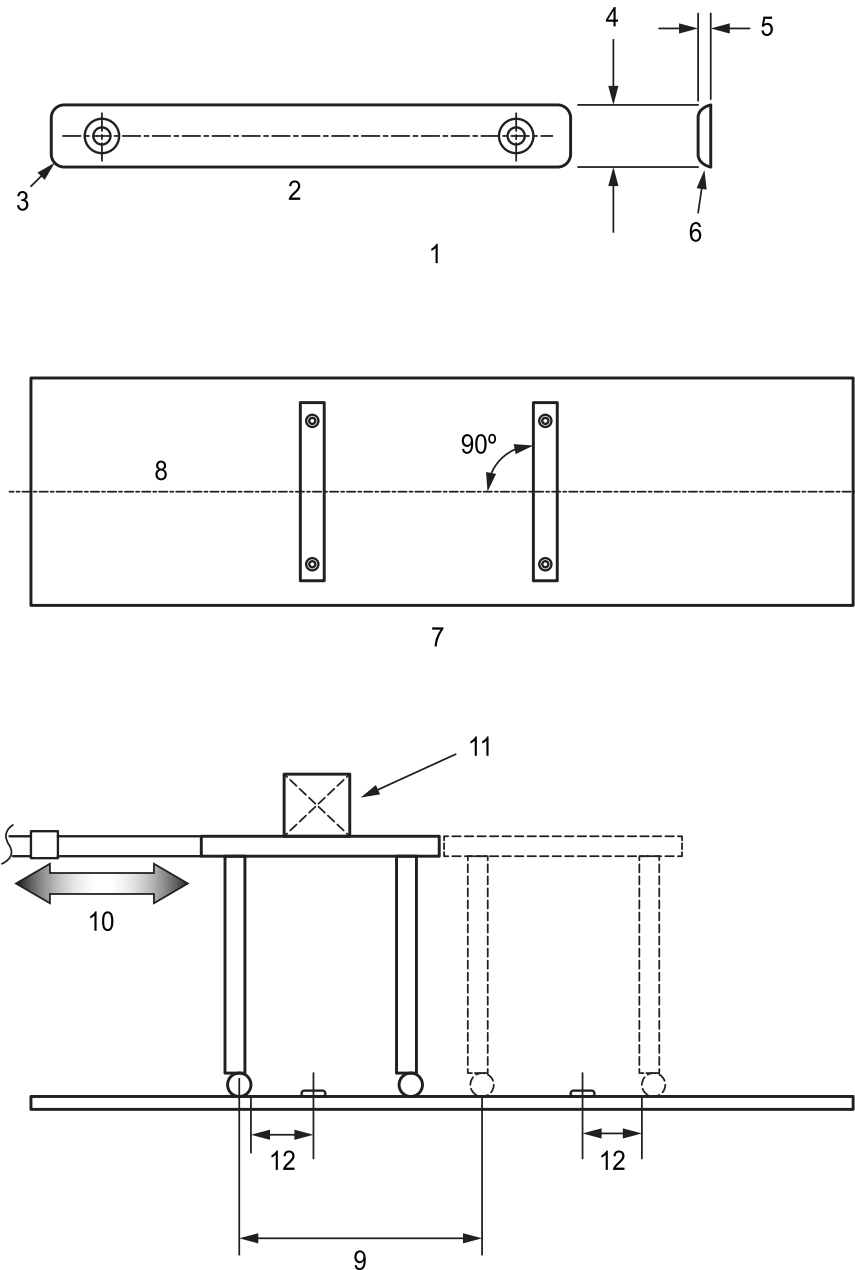
17.3 Test setup

17.3.1 Test setup and procedure steps are below (See Figure 17.1 for this test):

- a) Place the table on a smooth, hard surfaced test platform with obstacles. Obstacles shall be 51 mm (2 in) wide and 3.2 mm (0.125 in) thick steel with 3.2 mm (0.125 in) R edges and 8 mm (0.313 in) rounded corners. Obstacles shall be perpendicular to the travel of the table.
- b) Attach the cycling device no lower than 51 mm (2 in) from the top surface of the table, but not any higher than 965 mm (38 in). The method of attachment shall not support the unit during the test, except as noted in (h).
- c) Apply a 39 kg (85 lb) load to the primary surface. The load shall be applied through a 305 mm (12 in) diameter disk centered on the table.
- d) A weight equal to that of the force of the cycling device attachment on the unit shall be removed from the total weight in the unit.
- e) Adjust the length of stroke to 762 ± 51 mm (30 ± 2 in) and position the obstacles to ensure that all casters travel over an obstacle twice for each cycle.

- f) After changing direction at each end of the stroke, provide 200 mm to 400 mm (8 in to 15 in) of travel before encountering an obstacle. Only two casters will pass over an obstacle at one time.
- g) Set the cycling device to operate at a rate of 10 ± 2 cycles per minute. One cycle consists of a forward, then a backward stroke of the machine.
- h) For table units with caster and glide combinations, the legs without casters be raised a maximum of 51 mm (2 in) above the test platform (supported by the attachment device) during this test. The casters shall be free to rotate and swivel where applicable.

Figure 17.1
Durability test for tables with casters



su2776

1 – Obstacle detail – Typical all sides

3 – 8 mm R (0.313 in)

5 – 3.2 mm (0.125 in)

7 – Obstacle layout

9 – Stroke length: 762 mm $\pm$ 50 mm (30 in $\pm$ 2 in)

11 – Load per 17.3.1(c)

2 – Material steel

4 – 51 mm (2 in)

6 – 3.2 mm R $\pm$ 0.4 mm (0.125 in $\pm$ 0.016 in)

8 – Centerline of travel

10 – Cycling device

12 – 200 – 400 mm (8 – 15 in)

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17.4 Test procedure

17.4.1 Cycle the table unit for 2,500 cycles.

17.5 Compliance criteria

17.5.1 There shall be no loss of serviceability to a caster or the table.

CHAIR TESTING

18 Stability Tests

18.1 Applicability

18.1.1 The stability tests shall be performed on all types of chairs. For chaise lounge chair, see Section 33.

Note: Rearward stability tests apply only to chairs with backrests greater than 200 mm (7.9 in) in height as measured with the BIFMA CMD.

18.2 Purpose of test

18.2.1 The purpose of these tests is to evaluate the front and rear stability of chairs.

18.3 Stability disk

18.3.1 Stability Disk – Construction Details:

a) The disks shall weigh $10 \text{ kg} \pm 0.05 \text{ kg}$ ($22 \text{ lb} \pm 0.11 \text{ lb}$) each, having a diameter of 350 mm (13.8 in) and a thickness of 48 mm (1.9 in). The center of gravity shall be in the center of the disk. The surface friction of the disk (disk to disk) shall be such that the static sliding force shall be $31 \text{ N} \pm 9 \text{ N}$ ($7 \text{ lbf} \pm 2 \text{ lbf}$).

b) One acceptable construction of the disk is a sandwich construction consisting of two medium density fiberboards (mdf) outer plates with steel plates sandwiched in between them. The steel plates have through holes drilled out for the screws and additional holes symmetrically drilled to achieve the total weight required. The entire construction is held together with counter-sink screws into threaded inserts. See Figure 18.1.