

LABORATORY FURNITURE

CASEWORK, SHELVING AND TABLES

RECOMMENDED PRACTICES

SEFA 8 — 1999

SEFATM



SCIENTIFIC EQUIPMENT &
FURNITURE ASSOCIATION

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FOREWORD

SEFA Profile

The Scientific Equipment and Furniture Association (SEFA) is a voluntary international trade association representing members of the laboratory furniture, casework, fume hood and related equipment industry. The Association was founded to promote this rapidly expanding industry and to improve the quality, safety and timely completion of laboratory facilities in accordance with customer requirements.

SEFA Glossary of Terms

SEFA has developed a glossary of terms for the purpose of promoting a greater understanding between designers, architects, manufacturers, purchasers and end users. The terms defined by SEFA are frequently used in contracts and other documents which attempt to define the products to be furnished or the work involved. The association has approved this glossary in an effort to provide uniformity among those who use these terms.

SEFA encourages all interested parties to submit additional terms or to suggest any changes to those terms already defined by the association. The glossary should be used to help resolve any disputes that may arise or to incorporate the applicable terms in any contract or related documents.

SEFA Recommended Practices

SEFA and its committees are active in the development and promotion of recommended practices having domestic and international applications. Recommended practices are developed by the association taking into account the work of other national standard-writing organizations. Liaison is also maintained with government agencies in the development of their specifications.

SEFA's recommended practices are developed in and for the public interest. These Practices are designed to promote better understanding between designers, architects, manufacturers, purchasers, and end users to assist the purchaser in selecting and specifying the proper product to meet the user's particular needs. The existence of a SEFA recommended practice does not preclude any member or non-member from providing products or services that do not conform to these recommended practices. SEFA welcomes any proposed changes or additions to these recommended practices and encourages all interested parties to participate in this important endeavor.

SEFA's recommended practices and the glossary of terms are not copyrighted and may be disseminated for their widest possible use by quoting or photocopying whenever necessary.

Laboratory Furniture, Casework, Shelving and Tables

1.0 Scope

SEFA recommended practices are intended to provide manufactures, specifiers, and users tools for evaluating the safety, durability, and structural integrity of laboratory *casework* and complementary items.² The scope of this document is inclusive of casework (base units, wall mounted units, counter mounted units, tall units), *shelving* and table systems. There is no material bias in this document. Typical materials include, but are not limited to, *cold rolled steel*, *stainless steel*, wood, and high pressure *laminates on composition core*. Casework, shelving, and *tables*, manufactured for laboratory use should be subjected to the following tests and proce-

dures. Great care should be exercised when heavy loads are applied to the cabinet and appropriate safety precautions taken to insure safety to testing personnel. All tests should be performed by properly trained personnel. SEFA assumes no liability for damage or injury as a result of conducting these tests.

The *acceptance levels* are based on the cumulative experience of actual field testing and laboratory results of SEFA (Scientific Equipment and Furniture Association) members.

2.0 Purpose

The purpose of this document is to describe the means of evaluating the function and safety of laboratory *casework* and complementary items.

Cabinets shall be of a type specifically designed and manufactured for installation and use in a laboratory. Cabinet *hardware* and materials shall be of appropriate quality and type for the purpose intended. Construction shall conform to the *best practices* of the scientific *casework* industry. Joints and corners shall be well fitted, eliminating unsightly openings and seams. Edges or corners that may, in normal use, come into contact with laboratory personnel shall be free of burrs, splinters, sharp or rough edges. Product finish shall be resistant to chemical spills and splashes common to a typical laboratory operation. Structural strength shall be adequate to support heavy laboratory *apparatus*,

high-density shielding, or containers and heavy instruments.

Although aggregate test results may vary from manufacturer to manufacturer, procedures for testing performance criteria shall be as outlined in this document and results made available upon request. It is assumed that the test model reflects the performance criteria for all product regardless of construction, material, size, or style used. A test unit has been identified in this document with the sole purpose of obtaining continuity of procedures and results in a scientific format. Different styles, materials, and construction methods used may yield different results and therefore should be tested as a different test model.

3.0 Definitions

Acceptance Levels – The acceptance level for each performance criteria is based on the cumulative experience of actual field testing and laboratory results of SEFA members. Acceptance levels describe the expected outcome of each test procedure.

ANSI/BIFMA – ANSI is the American National Standards Institute. Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer. BIFMA is the Business and Institutional

Furniture Manufacturer's Association, an association of manufacturers of desk products and the like.³

Apparatus – A machine or group of machines and accessories.

Arithmetic Mean – A number obtained by dividing the sum of a set of quantities by the number of quantities in a set; average.⁴

ASTM – American Society for Testing and Materials.

Base Cabinets – A base cabinet is a storage device consisting of two ends, a back, and a face. The face may be open, to access the storage area, or may be outfitted with one or more drawers and/or door(s). The base cabinet may or may not include a top. A base cabinet is always mounted on the floor and normally supports a surface. The top surface is normally no more than 42" (1,066.8mm) off the floor surface.

Best Practices – When given a choice of grade, the "best practice" is to select one that offers a well defined degree of control over the quality of workmanship, materials, and installation of a project. SEFA-8 Recommended Practices are written from a view of high quality laboratory furniture.

Cabinet Depth (Deep) – Given a front, bottom, two sides, and a top, the cabinet depth is a measure of the side of the cabinet, in its normal upright position, from the back to the front.

Cabinet Height (High) – Given a front, bottom, two sides, and a top, the cabinet height is a measure of the side of the cabinet, in its normal upright position, from the bottom to the top, excluding any additional surface.

Cabinet Width (Wide) – Given a front, bottom, two sides, and a top, the cabinet width is a measure of the front of the cabinet in its normal upright position from one side to the other.

Casework – Base and wall cabinets, display fixtures, and storage shelves. The generic term for both "boxes" and special desks, reception counters, nurses stations and the like. Generally includes the tops and work surfaces.⁵

Chase (Plumbing Area) – Space located behind the back of the base cabinet used to house plumbing or electric lines.

Cold Rolled Steel – Sometimes referred to as Cold Drawn. Cold Drawn is the process of cold forming steel parts wherein plastic flow occurs over a curved axis.⁶

Composition Core – A core material using particleboard.

Counter Mounted Cabinet – A counter mounted cabinet is a wall cabinet (usually with a height of approximately 48" [1,219.2mm] and is typically mounted on the work surface or shelf, as in a reagent shelf).

Cupboard (Door Unit) – That portion of the cabinet with no drawer(s) and may be enclosed by door(s).

Combination Unit – A base unit of the type that has both door(s) and drawer(s).

Drawer – A sliding storage box or receptacle opened by pulling out and closed by pushing in.⁷

Free Standing – Requiring no support or fastening to other structures.

Hardware – Manufactured articles used in producing cabinets. Such articles include items such as screws, pulls, hinges, and drawer slides.

High Density Shielding – A barrier made of lead.

High Pressure Laminate – Laminated thermosetting decorative sheets for lamination to a selected core for panel, shelf and top constructions. (See NEMA LD-3, latest edition).

Joinery – The junction of two pieces intended to be permanently connected.

Laboratory Furniture – Furniture designed and manufactured for installation and use in a laboratory.

Laminate – A product made by bonding together two or more layers (laminations) of material or materials.⁸

Latch – A piece of hardware designed to hold a door closed.

Leveling Screws (Levelers) – Threaded components designed to allow adjustment of the cabinet vertically as needed for leveling.

Medium Density Fiberboard (MDF) – Wood particles reduced to fibers in a moderate pressure steam vessel combined with a resin, and bonded together under heat and pressure.⁹

Nominal Dimensions – Not all cabinet manufacturers produce product to the identical dimensions. All dimensions given in this document are accurate to within five percent, which is considered nominal.

Particleboard – A generic term for a panel manufactured from lignocellulosic materials - commonly wood - essentially in the form of particles (as distinct from fibers). These materials are bonded together with synthetic resin or other suitable binder, under heat and pressure, by a process wherein the interparticle bonds are created wholly by added binder.¹⁰

Permanent Damage – Destruction to material or joinery that would require repair in order to return to its original state.

Permanent Deformation – Deflection that has exceeded the plastic limit, thus changing the original shape of the product.

Permanent Deterioration – Erosion or corrosion of material such that the component will never return to its original shape.

Permanent Failure – See “permanent damage.”

Pulls - Articles used to grasp the door or drawer (see also hardware).

Rack Resistance – The ability of a desk product to resist stresses that tend to make the product distort and the drawers to become misaligned.¹¹

Rail – A bar extending from one side of the cabinet to the other.

Reagent – A substance used because of its chemical or biological activity.¹²

Removable Back – A panel located on the inside back of the base cabinet which is removable in order to gain access to the plumbing area.

Shelving – A flat surface fastened horizontally to a cabinet interior or a wall used to hold objects.

Stainless Steel – Iron based alloys containing more chromium than the 12% necessary to produce passivity (less reactive), but less than 30%.¹³

Submersion – Covered with water.

Tables – An article of furniture having a flat, horizontal surface supported by one or more support members (legs), and a frame (apron).

Tall Cabinet (Full Height Unit) – A tall cabinet is a storage device that is consisting of two ends, a back, and a face. The face may be open to access the storage area or may be outfitted with one or more drawers and/or door(s). A tall cabinet is always mounted on the floor and is nominally 84" (2,133.6mm) high.

Torsion – The state of being twisted.

Uniformly Distributed – The application of forces such that weight is evenly applied to the subject surface even as the surface deflects.

Unobstructed Entry – A cabinet is deemed to be unobstructed if access to the entire storage area is completely without obstacle.

Upright Position – A cabinet oriented in its intended position.

Wall Cabinet – A wall cabinet is a storage device consisting of two ends, a back, a top, bottom, and a face. The face may be open to access the storage area or may be outfitted with one or more door(s). The wall cabinet usually does not include a drawer. A wall cabinet is always mounted on a vertical surface such as a wall, a divider, panel or some other vertical structure. A wall cabinet is usually less than 48" (1,219.2mm) high.

Work Surface – A normally horizontal surface used to support apparatus at a convenient height off the floor. Work Surfaces are normally positioned atop a base cabinet or table structure.

3.1 Description of Testing Apparatus

Solid Steel Bar – A square solid steel bar 2 1/2" (63.5mm) square, 28 1/4" (717.55mm) long, weighing 50 pounds (22.68 Kg).

Sand or Shot Bag (10 pounds [4.54 Kg]) – A bag of plastic or cloth with the approximate dimensions 10 9/16" (2680mm) x 11" (2790mm) as in typical “gallon size reclosable storage bags.” Fill with enough sand or shot so that contents weigh 10 pounds (4.54 Kg).

Sand Bag (20 pounds [9.07 Kg]) - Two 10 pound (4.54 Kg) sand bags bound together.

Shot Bag (100 lbs. [45.36 Kg]) – A plastic or cloth bag of sufficient size to contain 100 pounds (45.36 Kg) of shot.

Cycling Mechanism – Per ANSI A156.9.

Steel Rod – A 2" (50.8mm) diameter by 12" (304.8mm) long rod, approximately 10 pounds (4.54 Kg) in weight.

Hot Water – To be considered “hot water,” the temperature of the water must be between 190° F to 205° 88° C to 96° C).

One Pound Ball – Solid steel sphere approximately 2" (50.8mm) in diameter.

Hardwood Corner Block – A block of hardwood 2" (50.8mm) square by 1" (25.4mm) high.

4.0 Base Cabinets

4.1 Description of Test Cabinet

The base cabinet shall be a combination of *cupboard* and *drawer* per Figure #1. The base cabinet shall have *nominal dimensions* of 48" (1,219.2mm) wide, 36" (914.4mm) high, and 22" (558.8mm) deep. The drawer shall be above the cupboard, full width and approximately one-fourth the height of the cabinet's face opening. Cupboard shall be double-door design and provide *unobstructed entry* into the cabinet interior with the doors open. The unit shall contain one adjustable shelf. The cabinet back shall be the removable type (per manufactures standard design as used for access to the plumbing or *chase area*) with the removable panel removed.

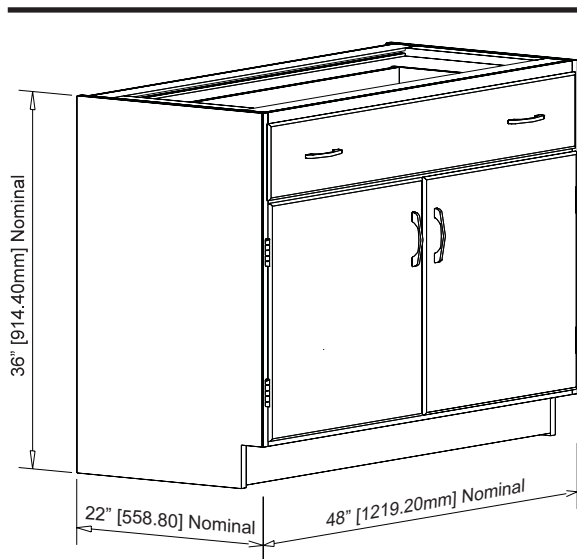


Figure 1. Description of Test Base Cabinet.

The cabinet shall be *free standing*, squared and leveled and sitting 1" (25.4mm) off the floor on all four *leveling screws*. When leveling screws are not required, the cabinet shall be squared and leveled and sitting 1" (25.4mm) off the floor atop four hardwood corner blocks 2" (50.8mm) square and 1" (25.4mm) high. A top of 1" (25.4mm) thick 37-50 pcf *medium density fiberboard* shall be positioned on the cabinet without glue or fasteners of any kind. The top dimensions will be such that it will overhang the cabinet perimeter by 1" (25.4mm). Its weight shall be included in the test as live load.

Before conducting the test, a visual examination shall be conducted to verify that the unit configuration and

setup conditions are appropriate. Operate doors and *drawer*. Doors should be free moving and *latch* properly. Inspect the unit for dimensions and note the fit of doors and drawers to the cabinet body. Open and close the drawer. The drawer should be free moving and function as specified by the manufacturer. Discontinue evaluation if unit is not in compliance or if malfunction is noted.

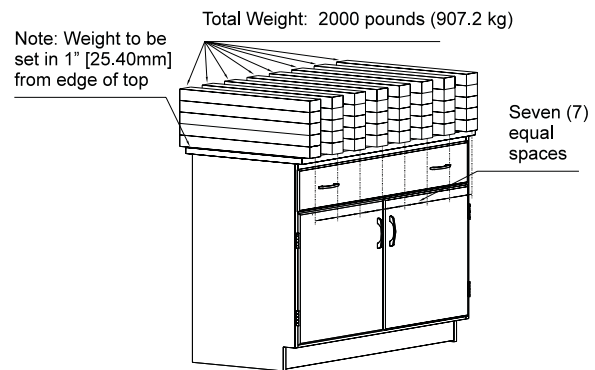


Figure 2. Cabinet Load Test Configuration.

4.2 Cabinet Load Test

4.2.1 Purpose of Test

The cabinet load test will challenge the structural integrity and load bearing capability of the cabinet construction. This test will demonstrate the ability of the cabinet to support heavy applied loads. This is not intended to test the functional characteristics of the cabinet under heavy loads.

4.2.2 Test Procedure

Verify that the cabinet is level. Load the cabinet top by using 2000 pounds (907.2 Kg) of solid steel bars (per Section #3.1) stacked five high and spaced per Figure #2. After ten minutes, unload the cabinet.

4.2.3 Acceptance Level

The cabinet will have no signs of *permanent failure*. After the load is removed, inspect the *levelers*. Any deformation shall not interfere with the function of the leveling system.

4.3 Cabinet Concentrated Load Test

4.3.1 Purpose of Test

The purpose of this test is to challenge the functional characteristics of the cabinet when subjected to a concentrated load on the center of the cabinet top.

4.3.2 Test Procedure

Using solid weights or 10 pound (4.54 Kg) sand bags (per Section #3.1), apply a total of 200 pounds (90.72 Kg) to the top of the cabinet along the cabinet centerline (See Figure #3). Operate doors and drawers.

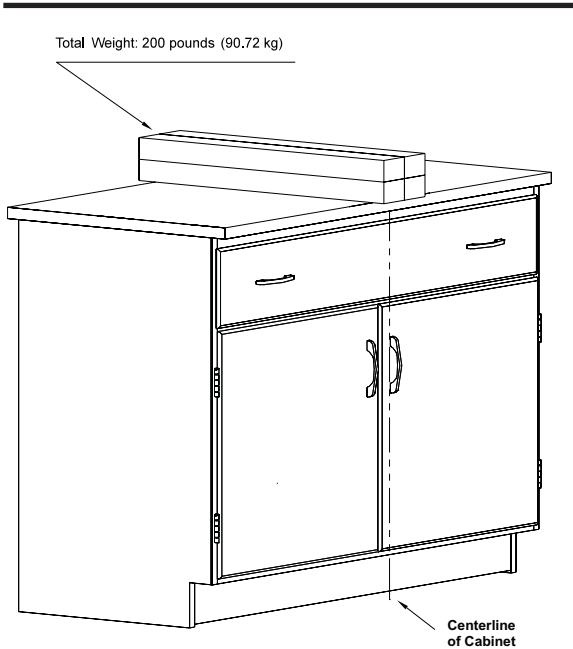


Figure 3. Base Cabinet Concentrated Load Test.

4.3.3 Acceptance Level

Door and drawer operation shall be normal under condition of test load. There shall be no signs of permanent distortion to front rail, cabinet joinery, doors, or drawers.

4.4 Cabinet Torsion

4.4.1 Purpose of Test

This test will evaluate the structural integrity of the cabinet construction when subjected to a *torsional* load.

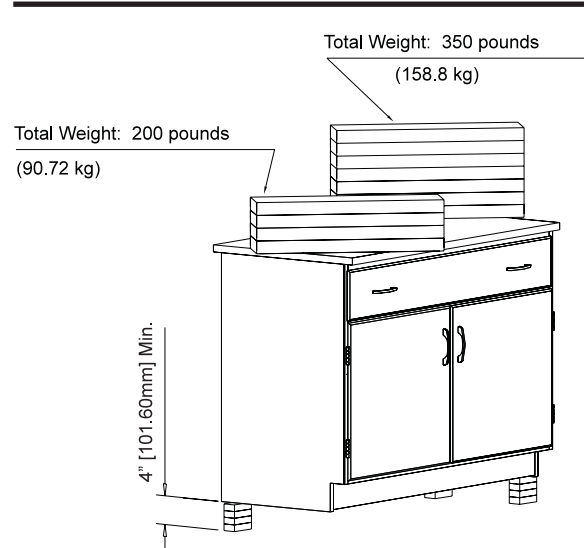


Figure 4. Base Cabinet Torsion Test Procedure.

4.4.2 Test Procedure

The cabinet shall be tested in its normal *upright position*, raised not less than four-inches off the floor and supported on rear and one front corner. The area of support under the cabinet shall be located not more than 6" (152.4mm) in from each supported corner. Secure the cabinet diagonally from the unsupported corner with seven solid steel bars per Section #3.1 (350 pounds (158.76 Kg) of weight), on the top of the cabinet to prevent overturning. Apply four solid steel bars (200 pounds [90.72 Kg] of weight) to the unsupported corner for a period of fifteen minutes (See Figure #4). Remove weight and place cabinet on the floor in its normal upright position. Observe cabinet *joinery*. Level the cabinet and measure the face and back of the cabinet across the diagonal corners.

4.4.3 Acceptance Level

When returned to normal position, the operation of the cabinet shall be normal, and there will be no signs of *permanent damage*. The difference between the two measurements taken from measuring the diagonal corners shall be no more than 1/8" (3.175mm).

4.5. Cabinet Submersion Test

4.5.1 Purpose of Test

This test will demonstrate the ability of a cabinet to resist standing water. Only units that rest on the floor or a unit where the base is within 2"

(50.8mm) of the floor should be subjected to this test.

4.5.2 Test Procedure

The material thickness along the perimeter of the cabinet shall be measured on 6" (152.4mm) increments. Record the thickness of the material to be submerged in water. Calculate the *arithmetic mean* of the data taken. Place the entire test cabinet in its *upright position* such that the cabinet is submerged in a pan filled with 2" (50.8mm) of water. After four hours, remove the unit from the wa-

ter and immediately measure the thickness of the material at the same points measured initially. Calculate the new arithmetic mean. After the unit has been allowed to dry, inspect for other damage.

4.5.3 Acceptance Level

The cabinet will show no signs of *permanent deformation* or deterioration. Increase in thickness shall not exceed four percent of the initial mean measurements.

5.0 Doors

5.1 Door Hinge Test

5.1.1 Purpose of Test

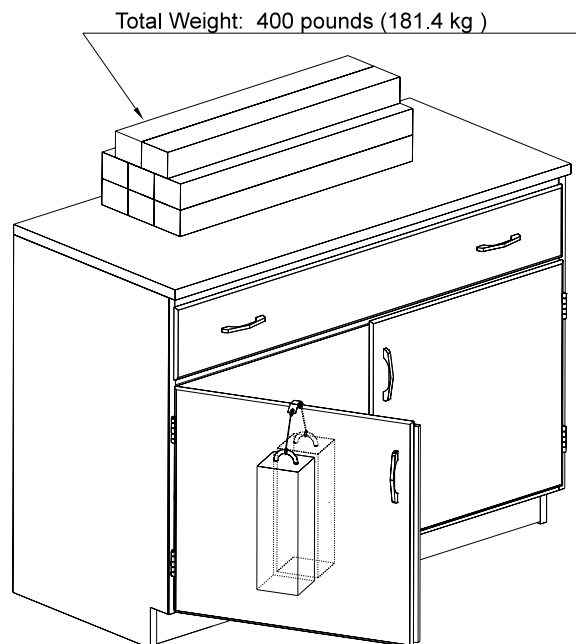
This test will demonstrate the durability of the door and its *hardware* (hinge leaf, screws, etc.) to an applied load of 200 pounds (90.72 Kg).

5.1.2 Test Procedure

Remove the shelf for this test. With unit and top set as described in Section # 4.1, add sufficient weight to the top in order to prevent overturning. With cabinet door opened 90-degrees, hang a sling made up of two 100 pound (45.36 Kg) weights (shot bags or solid weights) over top of the door at a point 12" (304.8mm) out from the hinge centerline (See Figures #5a and 5b). Slowly move door through the full cycle of the hinge, up to a 160-degree arc. Remove weight and swing door through its full intended range of motion and close door.

5.1.3 Acceptance Level

The open door shall withstand a load of 200 pounds (90.72 Kg) when applied at a point 12" (304.8mm) from the hinge centerline without sig-



Note: Load top sufficient to prevent tipping of base cabinet.

Figure #5a. Base Cabinet Door Load Test Configuration.

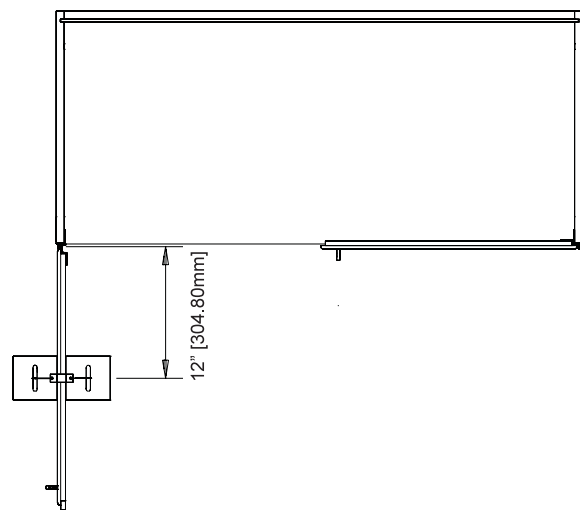


Figure 5b. Base Cabinet Door Load Test Configuration.

nificant permanent distortion. Operation of the door, after test, shall show no significant permanent distortion that will cause binding of the door or hinges or that will adversely affect operation of the catch*.

*** Certain unit configurations require hinge location to be such that load ratings are lower than the test model. See manufacturer for details.**

5.2 Door Impact Test

5.2.1 Purpose of Test

This test will demonstrate the resistance of a 240 inch-pound (27.1 N-m) impact to the door face. Only units that extend below the *work surface* should be subjected to this test. This test should not be inclusive of glass doors.

5.2.2 Test Procedure

With unit and top set as described in Section # 4.1, add sufficient weight to the top in order to prevent overturning. A 20 pound (9.07 Kg) sand bag (per Section #3.1) shall be suspended and dropped to provide an impact of 240 inch-pounds (27.1 N-m) at the center of the closed door. (See Figure #6.)

5.2.3 Acceptance Level

After the test, the door and catch shall operate normally and show no signs of *permanent damage*.

5.3 Door Cycle Test

5.3.1 Purpose of Test

This test will demonstrate the durability of the door hinge *hardware* to withstand 100,000 cycles as a reliable measure for longevity).

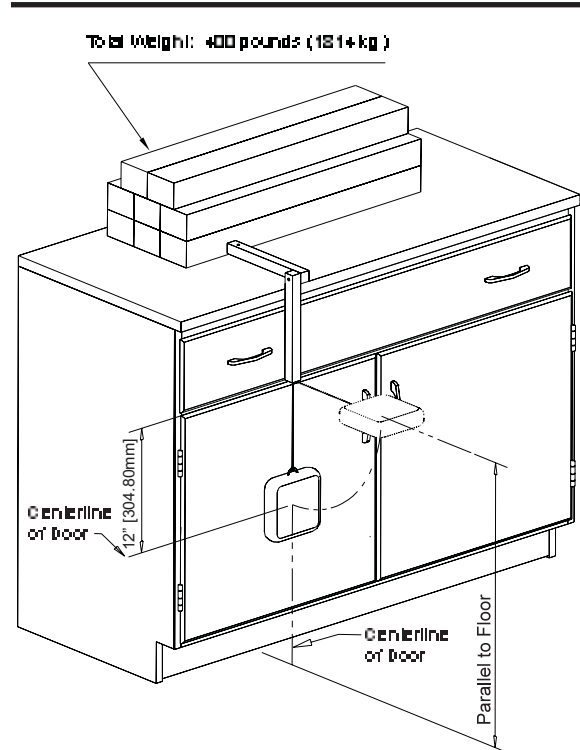


Figure 6. Base Cabinet Door Impact Test Configuration.

5.3.2 Test Procedure

This test shall be in conformance to the ANSI test procedure A156.9, Grade 1, requirements for cycle testing of doors. A cycling mechanism shall swing door 90-degrees. Door shall operate for 100,000 cycles with a speed not greater than 15 cycles per minute.

5.3.3 Acceptance Level

Door shall operate for the full cycle period without deterioration that will significantly affect the function of the door. The door shall operate freely without binding.

6.0 Drawers

6.1 Drawer Static Test

6.1.1 Purpose of Test

This test will demonstrate the ability to support a point load given to the front of the *drawer* and will challenge the attachment of the drawer head to the drawer.

6.1.2 Test Procedure

With unit and top set as described in Section # 4.1, add sufficient weight to the top in order to prevent overturning. Open the drawer to 13" (330.2mm) of travel and hang 150 pounds (68.04 Kg) from the drawer head at the centerline of the drawer for five minutes. (See Figure #7) Remove

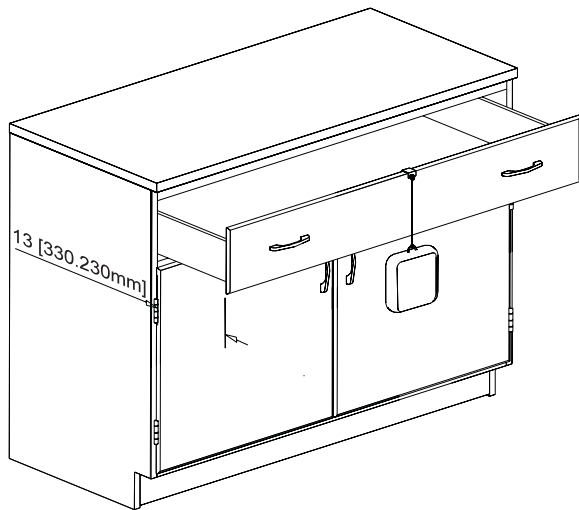


Figure 7. Base Cabinet Drawer Static Load Test Configuration

the weight and operate the drawer through the full cycle.

6.1.3 Acceptance Level

There shall be no interference with the normal operation of the drawer.

6.2 Drawer and Door Pull Test

6.2.1 Purpose of Test

This test will evaluate the strength of the pull and pull hardware.

6.2.2 Test Procedure

Pulls are to be installed in accordance with manufacturer's practice using specified attaching hardware and method. Block door and drawer closed. Using a cable, pulley and weight assembly (See Figure #8), apply a force of 50 pounds (22.68 Kg) perpendicular to each pull. Revise setup to hang weight from each pull. (See Figure #9) Remove weight.

6.2.3 Acceptance Level

Pulls shall resist force and support weight without breakage. After completion of test and removal of weight, there shall be no significant permanent distortion. Some pull designs will require variations to set up apparatus. These pulls shall be tested in conformance to the applied pull forces.

6.3 Drawer Impact Test

6.3.1 Purpose of Test

This test will demonstrate the resistance to impact of the drawer bottom and slide mechanism.

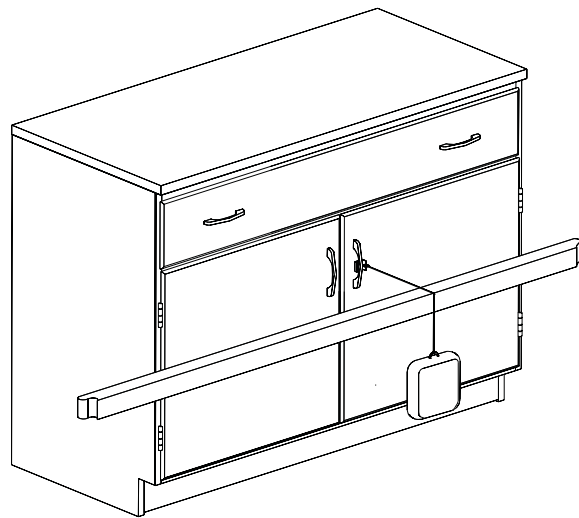


Figure 8. Base Cabinet Door And Drawer Pull Horizontal Load Test Configuration.

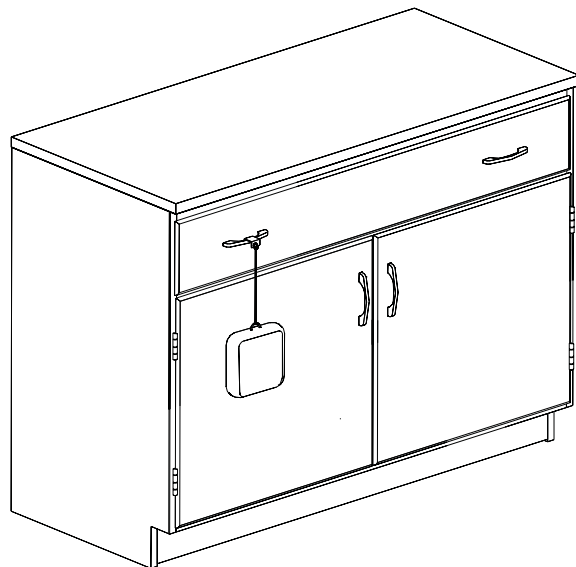


Figure 9. Base Cabinet Door And Drawer Pull Vertical Load Test Configuration.

6.3.2 Test Procedure

Open *drawer* to 13" (330.2mm) of travel. Drop a 10 pound (4.54 Kg) sand or shot bag from a height of 24" (609.6mm) into the bottom of a drawer at the center of the width of the drawer and 6" (152.4mm) back from the inside face of the drawer. Remove the sand or shot bag.

6.3.3 Acceptance Level

Operate *drawer* through full cycle. Drawer shall operate normally. Any deformation will not cause binding or interfere with the operation of the drawer.

6.4 Drawer Internal Rolling Impact

6.4.1 Purpose of Test

This test will evaluate the strength of the *drawer* head, bottom, and back as a result of opening and closing the drawer with a rolling load.

6.4.2 Test Procedure

Position the *drawer* on a table at a 45-degree angle per Figure #10. Place a 2" (50.8mm) diameter by 12" (304.8mm) long steel rod (approximately 10 pounds [4.54 Kg]) 13" (330.2mm) from the target impact

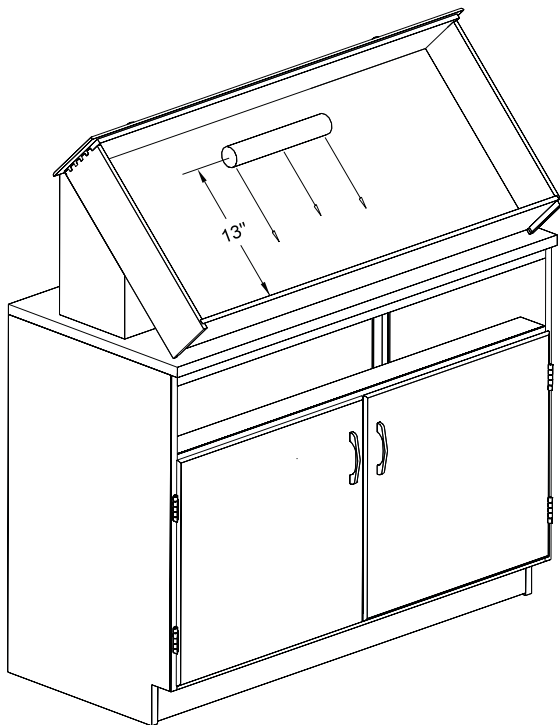


Figure 10. Base Cabinet Drawer Internal Rolling Impact Test Configuration.

area such that the rod will roll freely to impact the back of the drawer. Subject the back to three impacts and reverse the drawer to subject the front to three additional impacts.

6.4.3 Acceptance Level

The *drawer* shall show no signs (other than minor scratches and dents) of permanent damage. All *joinery* shall be intact and the drawer, when replaced in the unit, shall operate normally. Minor scratches and dents are acceptable.

6.5 Drawer Cycle Test

6.5.1 Purpose of Test

This test is intended to replicate years of operation of a drawer under full load.

6.5.2 Test Procedure

Laboratory Load (100 pounds [45.36 Kg]) - A static load of 100 pounds (45.36 Kg) (using ten 10 pound [4.54 Kg] sand bags per Section #3.1) shall be *uniformly distributed* in the *drawer*. Measure force required to activate the drawer. Operate from a closed position to within 1/4" (6.35mm) of full extension for 50,000 cycles at a rate not to exceed 10 cycles per minute.

Heavy Duty Laboratory Load (150 pounds [68.04 Kg]) - A static load of 150 pounds (68.04 Kg) (using fifteen 10 pound [4.54 Kg] sand bags per Section #3.1) shall be *uniformly distributed* in the *drawer*. Measure force required to activate the drawer. Operate from a closed position to within 1/4" (6.35mm) of full extension for 50,000 cycles at a rate not to exceed 10 cycles per minute.

6.5.3 Acceptance Level

The *drawer* shall operate freely without evidence of dragging rubbing or binding. The force required to open and close loaded drawer shall not be more than a 20% increase of that required prior to test and shall not be greater than 8 pounds (3.63 Kg) to activate hardware.*

**The American's with Disabilities Act (ADA) requires a force no greater than five pounds to activate hardware. The load rating in this document is intended only for testing conditions where loads challenge the durability of the hardware. Under actual conditions, drawer loading should be reduced to levels that result in compliance with ADA as applicable.*

7.0 Shelving

Shelves, regardless of material or application, shall be tested using the following procedure. This is inclusive of shelves in *wall cabinets*, *counter mounted cabinets*, *full height cabinets*, wall mounted shelves and *free standing shelves*. Typical shelving materials include cold rolled painted steel, stainless steel, plywood, high pressure laminate on composition core and high pressure laminate as a solid composite panel. Typical thicknesses are 3/4" (19.05mm) or 1" (25.4mm) for most applications. Values given are based on laboratory tests and fall within a normal range of properties for typical materials. Actual results may vary. Use this data as a guideline only. Other factors that should be evaluated when selecting shelving include chemical resistance, impact resistance, color and appearance, abrasion resistance, cost, and support requirements. Consult with the manufacturer for assistance with these other criteria.

7.1 Shelf Load Test

7.1.1 Purpose of Test

This test will demonstrate the ability of a shelf and its mounting hardware to support normal laboratory loads.

7.1.2 Test Procedure

A shelf shall be mounted in the manner in which it is designed. Measure the distance from the underside of the shelf to a reference point perpendicular to the center of the shelf. Use shot or sand bags weighing 10 pounds (4.54 Kg) each. Unless otherwise specified, load the shelf uniformly to 40 pounds (18.14 Kg) per square foot shelf area to a maximum of 200 pounds (90.72 Kg). Measure the deflection on the shelf by measuring the distance to the reference point and calculating the differ-

ence between the two measurements. Record data and remove load from the shelf.

7.1.3 Acceptance Level

Different materials will perform differently to the loads applied based on the Modulus of Elasticity for the material and the cross section moment of inertia for the shape of the material. Longer shelves will support less loads than shorter shelves. The allowable maximum deflection of a shelf is 1/180 of the span and not in excess of .25" (6.35mm). The following formula may be used to calculate the approximate deflection expected from a uniformly distributed load:

$$D(\text{max.}) = 5W L^3 / 384 E I$$

WHERE:

D = Deflection in inches (Maximum 1/180 span, not to exceed .25" (6.35mm).

W = (Design Load) x (Shelf Depth in Inches) x (Shelf Span in Inches)

(Design Load = 40 pounds (18.14 Kg) / square foot

divided by 144)

"W" shall not exceed 200 pounds (90.72 Kg).

L = Span between supports in inches

E = Modulus of Elasticity

Steel = $29 * 10^6$ psi 1-M-2

Particleboard, w/Hardwood Veneer 2s = 640,000 psi

D. Fir Veneer Core Plywood = 950,000 psi

1-M-2 Particleboard w/High pressure plastic laminate 1/32" two sides w/rigid glue line = 950,000 psi

Epoxy = $4.46 * 10^6$ psi

Solid Composite Panel = $1.7 * 10^6$ psi

I = Cross section moment of inertia.

8.0 Cabinet Surface Finish Tests

8.1 Chemical Spot Test

8.1.1 Purpose of Test

The purpose of the chemical spot test is to evaluate the resistance a finish has to chemical spills.

Note: Many organic solvents are suspected carcinogens, toxic and/or flammable. Great care should be exercised to protect personnel and the

environment from exposure to harmful levels of these materials.

8.1.2 Test Procedure

Obtain one sample panel measuring 14" x 24" (355.6mm x 609.6mm). The received sample to be tested for chemical resistance as described herein.

Place panel on a flat surface, clean with soap and water and blot dry. Condition the panel for 48-hours at 73± 3F (23± 2(C) and 50± 5% relative humidity. Test the panel for chemical resistance using forty-nine different chemical *reagents* by one of the following methods.

Method A - Test volatile chemicals by placing a cotton ball saturated with *reagent* in the mouth of a 1-oz. (29.574cc) bottle and inverting the bottle on the surface of the panel.

Method B – Test non-volatile chemicals by placing five drops of the *reagent* on the surface of the panel and covering with a 24mm watch glass, convex side down.

For both of the above methods, leave the *reagents* on the panel for a period of **one hour**. Wash off the panel with water, clean with detergent and naphtha, and rinse with deionized water. Dry with a towel and evaluate after 24-hours at 73± 3°F (23± 2°C) and 50± 5% relative humidity using the following rating system.

- Level 0** - No detectable change.
- Level 1** - Slight change in color or gloss.
- Level 2** - Slight surface etching or severe staining.
- Level 3** - Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	A
2.	Acetate, Ethyl	A
3.	Acetic Acid, 98%	B
4.	Acetone	A
5.	Acid Dichromate, 5%	B
6.	Alcohol, Butyl	A
7.	Alcohol, Ethyl	A
8.	Alcohol, Methyl	A
9.	Ammonium Hydroxide, 28%	B
10.	Benzene	A
11.	Carbon Tetrachloride	A
12.	Chloroform	A
13.	Chromic Acid, 60%	B
14.	Cresol	A
15.	Dichlor Acetic Acid	A
16.	Dimethylformamide	A
17.	Dioxane	A
18.	Ethyl Ether	A
19.	Formaldehyde, 37%	A
20.	Formic Acid, 90%	B
21.	Furfural	A
22.	Gasoline	A

Test No.	Chemical Reagent	Test Method
23.	Hydrochloric Acid, 37%	B
24.	Hydrofluoric Acid, 48%	B
25.	Hydrogen Peroxide, 3%	B
26.	Iodine, Tincture of	B
27.	Methyl Ethyl Ketone	A
28.	Methylene Chloride	A
29.	Mono Chlorobenzene	A
30.	Naphthalene	A
31.	Nitric Acid, 20%	B
32.	Nitric Acid, 30%	B
33.	Nitric Acid, 70%	B
34.	Phenol, 90%	A
35.	Phosphoric Acid, 85%	B
36.	Silver Nitrate, Saturated	B
37.	Sodium Hydroxide, 10%	B
38.	Sodium Hydroxide, 20%	B
39.	Sodium Hydroxide, 40%	B
40.	Sodium Hydroxide, Flake	B
41.	Sodium Sulfide, Saturated	B
42.	Sulfuric Acid, 33%	B
43.	Sulfuric Acid, 77%	B
44.	Sulfuric Acid 96%	B
45.	Sulfuric Acid (77%) and Nitric Acid (70%), equal parts	B
46.	Toluene	A
47.	Trichloroethylene	A
48.	Xylene	A
49.	Zinc Chloride, Saturated	B

8.1.3 Acceptance Level

Results will vary from manufacturer to manufacturer. Laboratory grade finishes should result in no more than four Level 3 conditions. Suitability for a given application is dependent upon the chemicals used in a given laboratory.

8.2 Hot Water Test

8.2.1 Purpose of Test

The purpose of this test is to insure the coating is resistant to hot water.

8.2.2 Test Procedure

Hot water (190°F. to 205°F. [88°C to 96°C]) shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces [177.44cc] per minute) on the finished surface, which shall be set

at an angle of 45-degrees, for a period of five minutes.

8.2.3 Acceptance Level

After cooling and wiping dry, the finish shall show no visible effect from the hot water.

8.3 Impact Test

8.3.1 Purpose of Test

The purpose of this test is to evaluate the ductility of the coating.

8.3.2 Test Procedure

A one-pound ball (approximately 2" [50.8mm] in diameter) shall be dropped from a distance of 12" (304.8mm) onto a flat horizontal surface, coated to manufacturers standard manufacturing method.

8.3.3 Acceptance Level

There shall be no visual evidence to the naked eye of cracks or checks in the finish due to impact.

8.4 Paint Adhesion on Steel

8.4.1 Purpose of Test

The paint adhesion test is used to determine the bond of the coating to steel. This does not apply to non-steel products.

8.4.2 Test Procedure

This test is based on *ASTM D2197-86* "Standard Method of Test for Adhesion of Organic Coating." Two sets of eleven parallel lines 1/16" (1.587mm) apart shall be cut with a razor blade to intersect at right angles thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush for one minute. Examine under 100-foot candles of illumination.

8.4.3 Acceptance Level

Ninety or more of the squares shall show finish intact.

8.5 Paint Hardness on Steel

8.5.1 Purpose of Test

The paint hardness test is used to determine the resistance of the coatings to scratches.

8.5.2 Test Procedure

Pencils, regardless of their brand, are valued in this way: 8-H is the hardest, and next11 order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which are softest).

The pencils shall be sharpened on emery paper to a wide sharp edge. (See Figure #11) Pencils of increasing hardness shall be pushed across the paint film in a chisel like manner until one is found that

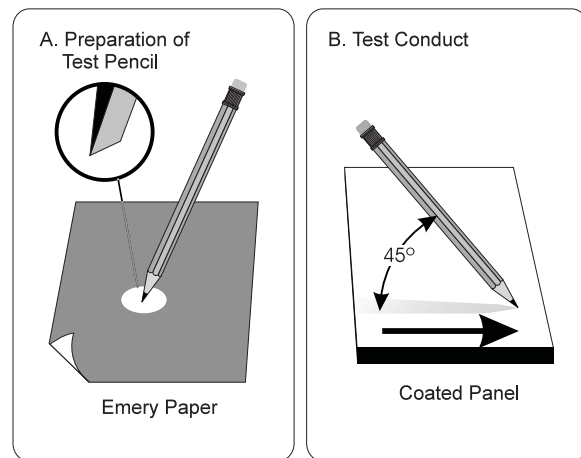


Figure 11. Cabinet Body Surface Hardness Test

will cut or scratch the film. The pencil used before that one, that is the hardest pencil that will not rupture the film, is then used to express or designate the hardness.

8.5.3 Acceptance Level

The paint shall have a hardness of 4-H minimum.

9.0 Wall, Counter Mounted, and Tall Cabinets

9.1 Description of Test

Unit Evaluation shall be conducted on a wall mounted cabinet with *nominal dimensions* as follows: 48" (1,219.2mm) wide, 30" (762mm) high, and 12" (304.8mm) deep. The *wall cabinet* shall be manufactured to manufacturers' standard construction and practices. The wall cabinet shall have two swinging doors, designed in such a way that when the doors are open, access to cabinet is unobstructed (See Figure #12). Door loading procedures are outlined under Section 5.0 (Doors). The wall cabinet will be provided with the manufacturer's standard number of shelves. Shelves shall be evaluated per Section 7.0 (Shelves). The unit and shelves shall be mounted in a manner recommended by the manufacturer. A visual examination shall be conducted to verify that the configuration and installation comply with these conditions. Discontinue evaluation if unit is not in compliance or if malfunction is noted.

9.2 Load Test

9.2.1 Purpose of Test

The wall mounted load test will demonstrate the strength of the back of the *wall cabinet* as well as the *joinery* of the cabinet and function of doors when the unit is subjected to loads normally expected for *laboratory furniture*.

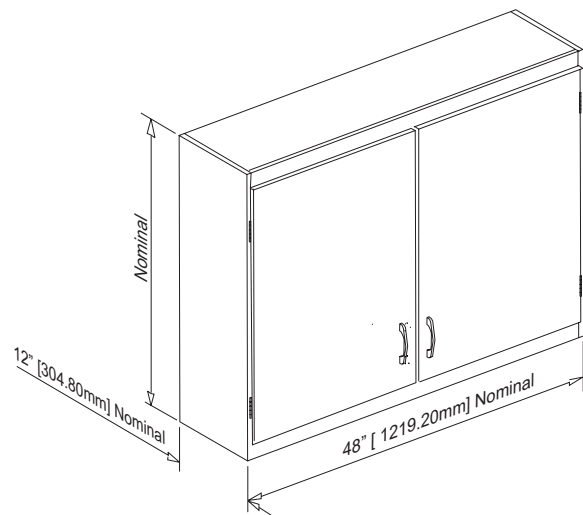
9.2.2 Test Procedure

Using sand or shot bags weighing 10 pounds (4.54 Kg) each, load cabinet bottom, each shelf, and top uniformly with 40 pounds (18.14 Kg) per square foot to a maximum of 200 pounds (90.72 Kg) each. Maximum load to any cabinet shall not exceed 600 pounds (272.16 Kg) (a maximum of 200 pounds [90.72 Kg] loaded to each bottom, a mini-

num of one shelf loaded per Section 7.0, and the top) regardless of the number of shelves

9.2.3 Acceptance Level

With weights in place, operate doors through full travel to verify normal operation of doors. Remove weights and operate doors to verify normal operation. Verify that there is no significant permanent deflection of cabinet top, cabinet back, cabinet bottom, or shelves. After weights are removed, the cabinet shall show no *permanent damage* to the cabinet, cabinet bottom, or shelves.



**Figure 12. Wall Mounted Cabinet
Description of Test Cabinet.**

10.0 Tables

10.1 Description of Test Unit

The table for evaluation shall be a standing height, four legged, free standing table. The table shall be nominally 60" (1,524mm) long, 24" (609.6mm) deep, and 36" (914.4mm) high (See Figure #13). Leg and apron size and construction shall be to manufacturer's specification. A top of 1" (25.4mm) thick 37 - 50 pcf *medium density fiberboard* shall be positioned on the table in a manner recommended by the manufacturer. The top dimensions will be such that it will overhang the cabi-

net perimeter by 1". Its weight shall be included in the test as live load. *Tables* can be represented by a very large range of styles and designs. Products inclusive in this section of testing are: *Free Standing Tables*, Desks, Aprons mounted between two fixed areas such as a wall or *Casework*, Mobile Tables (Free Standing Tables on wheels or casters), Mobile Under Counter Units, Mobile Workstations, Adjustable Tables, Modular Tables, C-Frame Tables, L-Frame Tables, J-Frame Tables, and Tables for systems furniture. These table systems

can all be classified as one of three types of tables; Fixed, Free Standing, and Mobile.

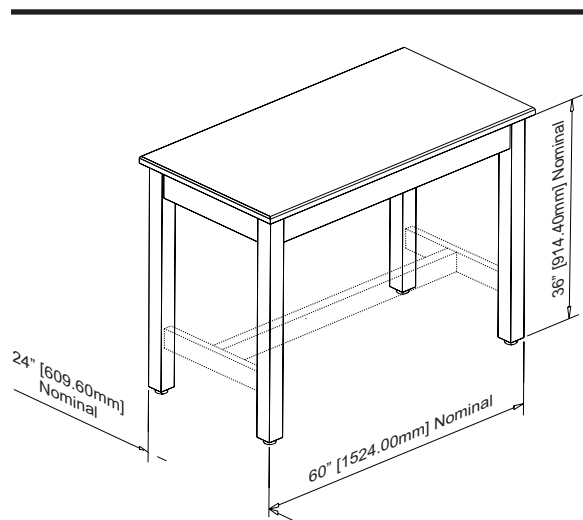


Figure 13. Description of Test Table.

10.2 Table Static Load

10.2.1 Test Purpose of Test

This test will challenge the *table* components to loads that are normal for use in a laboratory.

10.2.2 Test Procedure

Load the table top by using solid steel bars (per Section #3.1), each weighing 50 pounds (22.68 Kg), stacked evenly and spaced per Figure #14. Load the table to the manufacturer's recommended live load*. These evenly distributed loads should be no less than 300 pounds (136.08 Kg) for mobile, 600 pounds (272.16 Kg) for free standing and 2000 pounds (907.20 Kg) for fixed. Include the weight of the working surface as live load.

**Table load will vary considerably. Factors impacting live load capability include the size of the table, material, amount of drawers and book compartments, glide or caster load rating. Contact manufacturer for live load specifications.*

10.2.3 Acceptance Level

No structural breakage shall result from application of the load. With the full load, the apron rails shall not deflect more than 1/360 of the span of the table and not to exceed 1/8" (3.175mm). In

the case of a table with a *drawer*, the deflection of the rail shall not interfere with the function of the drawer. After the load is removed, inspect the table for structural damage.

10.3 Table Racking

10.3.1 Purpose of Test

This test will demonstrate the structural integrity of the table construction when subjected to a racking load. Most racking failures occur upon dragging an unloaded table across a floor. The ability of a table to resist a racking load will indicate less damage to the structure. The following tests were based on and adapted from *ANSI/BIFMA X5.5-1989 American National Standard for Office Furnishings "Desk Products-Tests."* Adjustments have been made to better accommodate the specific applications of tables used in laboratories.

10.3.2 Test Procedure

The table shall be tested in its normal *upright position*, with floor glides or casters fully retracted and blocked to prevent the table from sliding. The table shall then be positioned at 45°, with one pair of legs on the floor and the other raised and supported (See Figure #15). The unit shall remain in this position for thirty minutes. The unit shall be lowered without shock to the leveled surface and

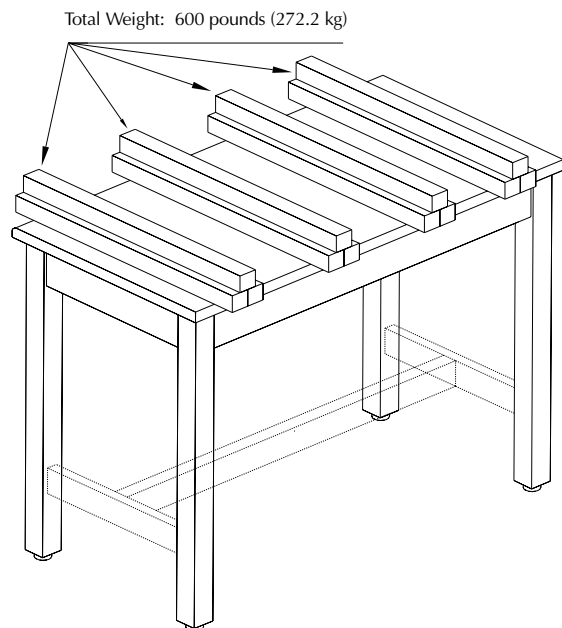


Figure 14. Table Static Load Test Configuration.

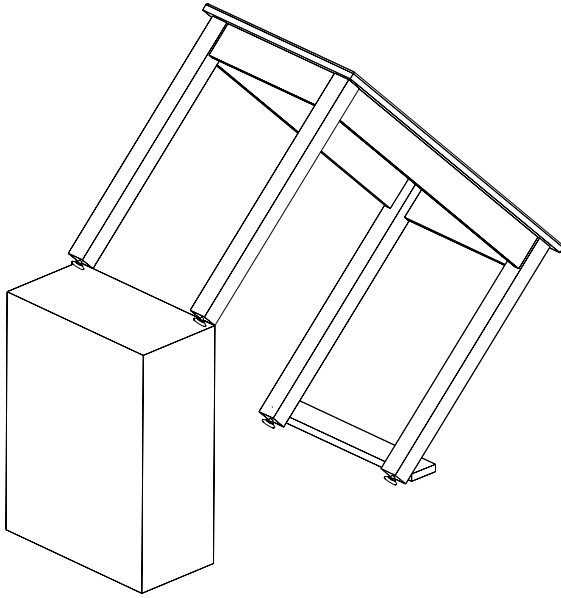


Figure 15. Table Racking Test Configuration.

the general operation of the drawers shall be evaluated. The procedure shall be repeated on the opposite end.

10.3.3 Acceptance Level

When returned to normal position, the operation of the table shall be normal, and there will be no signs of permanent damage.

Footnotes

¹This format has been adapted from the BIFMA American National Standard format, X5.5 - 1989.

²Ibid. p 8.

³Ibid. pp 10-26.

⁴*The Concise American Heritage Dictionary*, (Boston: Houghton Mifflin Company, 1969), p. 38.

⁵Architectural Woodwork Institute, *Architectural Woodwork Quality Standards Illustrated*, 7th Edition Version 1.0, 1997, p A-563.

⁶E. Paul DeGarmo, *Materials and Process in Manufacturing*, 5th Edition, (New York: MacMillan Publishing Co., Inc.1979), p 423.

⁷A. Merriam-Webster, *Webster's Ninth New Collegiate Dictionary*, (Massachusetts: Merriam-Webster Inc. 1988), p 381.

⁸U.S. Forest Products Laboratory, *Wood Engineering Handbook*, (New Jersey: Prentice-Hall, Inc. 1974), p 23-6.

⁹*Architectural Woodwork Quality Standards Illustrated*, 7th Edition Version 1.0, p 38.

¹⁰*Wood Engineering Handbook*, p 23-7.

¹¹BIFMA, *American National Standard for Office Furnishings*, (ANSI/BIFMA X5.5-1983), p 8-9.

¹²*Webster's Ninth New Collegiate Dictionary*, 1988, p 980.

¹³Metals Handbook Committee, *Metals Handbook*, 8th Edition, Vol.1 "Properties and Selection of Metals" (Ohio: American Society for Metals, 1969), p 408.

FORMS

**The following pages
contain supporting forms
to be used for certification
and to report
suggested
changes/corrections
to SEFA-8.**

LABORATORY FURNITURE CERTIFICATE OF PERFORMANCE TO SEFA-8 SPECIFICATIONS



_____ Certifies that its laboratory furniture identified
COMPANY
 _____ as has been tested in conformance with the full requirements of
TEST UNIT
 the SEFA-8 Recommended Practice with results noted below.

TEST	TEST RESULTS PASS/FAIL	TEST	TEST RESULTS PASS / FAIL	TEST	TEST RESULTS PASS / FAIL
4.2		6.1		8.1	See Attached Form
4.3		6.2		8.2	
4.4		6.3		8.3	
4.5		6.4		8.4	
5.1	@200 lbs.	6.5	@ 100 lbs.	8.5	
5.2		6.5	@ 150 lbs.	9.2	
5.3		7.1	Deflection Measured	10.2	

Full documentation of the test results is available upon request in a bound report that includes a detailed description of the test unit and procedures, witnessed results, and appropriate drawings or photographs of the test unit and procedures.

COMPANY INFORMATION	TEST SUPERVISOR INFORMATION
Name:	Name:
Address:	Title:
	Signature:
Telephone:	COMPANY OFFICER INFORMATION
Fax:	Name:
	Title:
Date:	Signature:

CHEMICAL RESISTANCE TESTING – 8.1



Date of Test:	Sample Description:	Type of Material Coated:	Coating Type:
----------------------	----------------------------	---------------------------------	----------------------

Rating Scale: Level 0 – No Detectable Change
 Level 1 – Slight Change in Color or Gloss
 Level 2 – Slight Surface Etching or Severe Staining
 Level 3 – Pitting, Cratering, Swelling, Erosion of Coating. Obvious & Significant Deterioration.

#	CHEMICAL	RATING	COMMENTS
1	Amyl Acetate		
2	Ethyl Acetate		
3	Acetic Acid 98%		
4	Acetone		
5	Acid Dichromate 5%		
6	Butyl Alcohol		
7	Ethyl Alcohol		
8	Methyl Alcohol		
9	Ammonium Hydroxide 28%		
10	Benzene		
11	Carbon Tetrachloride		
12	Chloroform		
13	Chromic Acid 60%		
14	Cresol		
15	Dichlor Acetic Acid		
16	Dimethylformamide		
17	Dioxane		
18	Ethyl Ether		
19	Formaldehyde 37%		
20	Formic Acid 90%		
21	Furfural		
22	Gasoline		
23	Hydrochloric Acid 37%		
24	Hydroflouric Acid 48%		
25	Hydogen Peroxide 28%		
26	Tincture of Iodine		

CHEMICAL RESISTANCE TESTING – 8.1 Page 2 of 2

Rating Scale: Level 0 – No Detectable Change
 Level 1 – Slight Change in Color or Gloss
 Level 2 – Slight Surface Etching or Severe Staining
 Level 3 – Pitting, Cratering, Swelling, Erosion of Coating, Obvious & Significant Deterioration.

#	CHEMICAL	RATING	COMMENTS
27	Methyl Ethyl Ketone		
28	Methylene Chloride		
29	Mono Chlorobenzene		
30	Napthalene		
31	Nitric Acid 20%		
32	Nitric Acid 30%		
33	Nitric Acid 70%		
34	Phenol 90%		
35	Phosphoric Acid 85%		
36	Silver Nitrate, Saturated		
37	Sodium Hydroxide 10%		
38	Sodium Hydroxide 20%		
39	Sodium Hydroxide 40%		
40	Sodium Hydroxide, Flake		
41	Sodium Sulfide, Saturated		
42	Sulfuric Acid 25%		
43	Sulfuric Acid 85%		
44	Sulfuric Acid 96%		
45	Sulfuric Acid 85%, and Nitric Acid 70%, equal parts		
46	Toulene		
47	Trichlorethylene		
48	Xylene		
49	Zinc Chloride, Saturated		

TEST PERFORMED BY:

DATE:

SUGGESTIONS FOR IMPROVEMENT

SEFA-8 Laboratory Furniture Recommended Practices Specifications (Casework, Shelving & Tables)
TABLE OF RESOLUTIONS SUBMITTAL



The following suggestion will improve the
SEFA-8 Laboratory Furniture Recommended Practices Specifications.

Please turn to Section: _____
WRITE IN SECTION NUMBER

Look at Page: _____ Look at Section Heading: _____

Add, after this heading, a new heading and the following words:
Revise the wording of this heading as follows:
Delete this heading:
Revise the illustration as follows:
Add a new illustration as follows:
Comments [add extras sheet(s) as required]:

For clarification, you can contact _____ at:
Company Name: _____
Your Name: _____
Street Address: _____
City, State, & Zip: _____
Telephone with Area Code first: (_____) _____ Fax: (_____) _____

