

ANSI/BIFMA X5.1-2002



The Industry Voice for Workplace Solutions

General-Purpose Office Chairs - Tests
American National Standard for Office Furniture

American National Standard

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**American National Standard
for Office Furniture**

General-Purpose Office Chairs - Tests

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ANSI/BIFMA X5.1-2002

Foreword

The material presented in this standard was developed as a result of the efforts of the members of BIFMA International and reviewed by a broad representation of interested parties, government organizations and commercial testing and procurement and interior design organizations.

This standard defines specific tests, laboratory equipment, conditions of test, and recommended minimum levels to be used in the test and evaluation of the performance, durability, and structural adequacy of general-purpose office chairs.

The original work on this standard was completed in May 1974 by the BIFMA Engineering Committee and, particularly by its Subcommittee on Chair Standards. During the periods from February 1983 through January 1984, March 1990 through April 1993, and again from September 1997 to October 2002, the Subcommittee on Chair Standards conducted reviews of the standard to ensure that the tests accurately describe the proper means of evaluating the safety, durability, and structural adequacy of general-purpose office chairs. The reviews produced revisions and/or additions to the various test procedures that improve the procedures and provide consistency. The revisions were submitted to the membership of BIFMA International and approved in December 2001. A canvass of interested parties and stakeholders was conducted in accordance with the requirements of an ANSI accredited standards developer. After completion of the canvass process, the standard was subsequently submitted to the American National Standards Institute for approval as an American National Standard. Approval by ANSI was given on December 31, 2002.

Suggestions for the improvement of this standard are welcome. The suggestions should be sent to BIFMA, International, 2680 Horizon SE, Suite A1, Grand Rapids, MI 49546.

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American National Standard
for Office Furnishings

General-Purpose Office Chairs - Tests

1 Scope

This standard is intended to provide manufacturers, specifiers, and users with a common basis for evaluating the safety, durability, and structural adequacy of general-purpose office chairs. General-purpose office chairs are normally used in an office environment and may include, but are not limited to those seating styles typically referred to as: executive/management, task/secretarial, side/guest chairs, stacking chairs, tablet arm chairs and stools.

This standard describes the means of evaluating general-purpose office chairs, independent of construction materials, manufacturing processes, mechanical designs or aesthetic designs. This standard does not address lounge seating, flammability, surface material durability, cushioning materials, product emissions, or ergonomic considerations.

The standard defines specific tests, the laboratory equipment that may be used, the conditions of tests, and the minimum acceptance levels to be used in evaluating general-purpose office chairs. The acceptance levels given in this standard are based on the actual field use and test experience of BIFMA International members.

The tests in this standard are intended to assess the performance of new products only. They are not intended to assess a product that has been in use.

2 Definitions

Note: Refer to BIFMA PD-1 Industry Product Definitions for related terms not included in this standard. Otherwise, the common dictionary definition shall be used for terms not defined in this section or in BIFMA PD-1.

- 2.1 **acceptance level:** The performance level required to pass the test.
- 2.2 **appropriate rate:** Any rate that avoids resonant frequencies or excessive heating.
- 2.3 **back stop position:** The position of the unit when the unit's tilt mechanism first contacts its rearward mechanical stop, regardless of the force on the backrest.
- 2.4 **CMD:** The BIFMA Chair Measuring Device used for the measurement of seating products.
- 2.5 **CMD-1 Chair Measurement Procedure:** A universal procedure for the BIFMA Chair Measuring Device.
- 2.6 **cpm:** Abbreviation for cycles per minute.
- 2.7 **counterbalancing force:** A force or influence that offsets an opposing force.
- 2.8 **cycle:** A complete operation of loading and unloading or of stress reversal; to open and close; one complete revolution; to operate in a cyclic manner.
- 2.9 **force:** A vector quantity, expressed in newtons (N) or pounds force (lbf.) that may produce an acceleration of a body in the direction of its application.
- 2.10 **form-fitting device:** A device that distributes a force over a 305 ± 13 mm x 89 ± 13 mm (12 ± 0.5 in. x 3.5 ± 0.5 in.) area of a backrest. The device will be shaped to approximate the contours of the chair backrest.
- 2.11 **front stop position:** The position of the unit when the unit's tilt mechanism first contacts its forward mechanical stop.
- 2.12 **functional load:** The level of loading or force considered typical of hard use.
- 2.13 **IFD:** Indentation Force Deflection. See Method B1, Indentation Load Deflection Test, in Methods of testing flexible cellular materials - Slab, bonded, and molded urethane foams, ASTM D 3574-01.
- 2.14 **lbf.:** Abbreviation for pounds-force. The corresponding unit in the SI (Système International) system is the newton (N).
- 2.15 **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.
- 2.16 **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.
- 2.17 **loss of serviceability:** The failure of any component to carry its intended load or to perform its normal function or adjustments.
- 2.18 **lounge seating:** Free standing seating that is intended for use in public spaces such as waiting, reception, or lounge areas. It is generally not adjustable for personal use.

- 2.19 manufacturer's instructions:** Instructions for assembly, operation, and/or maintenance supplied by the manufacturer to the customer.
- 2.21 N (newton):** a unit of force in the SI (Système International) System, also known as the Metric system.
- 2.22 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.
- 2.23 pedestal base:** A base that supports a chair by a single central structural member such as a spindle.
- 2.24 pivoting backrest:** A backrest that rotates on a horizontal axis above the height of the seat.
- 2.25 proof load:** The level of loading or force in excess of hard use.
- 2.26 spindle:** A vertical axis or shaft supporting a chair.
- 2.27 stool:** A chair with a seat height greater than 584 mm (23 in.), intended to allow the user to sit at standing-height work surfaces such that the user's feet are not supported by the floor.
- 2.28 tablet arm:** A surface attached to a chair which has the primary function to support tasks such as writing and short-term reference material handling. These surfaces typically do not have independent support legs and are not intended to support a person's weight.
- 2.29 test platform:** The horizontal hard work surface, (concrete or other unyielding surface) on which the chair to be tested is placed during testing.
- 2.30 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.

3 General

3.1 Types of Tests

3.1.1 The testing and evaluation of a product against this standard may require the use of materials and/or equipment that could be hazardous. This document does not purport to address all the safety aspects associated with its use. Anyone using this standard has the responsibility to consult the appropriate authorities and to establish health and safety practices in conjunction with any applicable regulatory requirements prior to its use.

3.1.2 The types of tests to be employed fall into the following general categories:

- a) Static load applications;
- b) Dynamic load applications;
- c) Durability and/or life cycle testing.

3.1.3 The tests described in this standard, other than the specifically identified component tests (i.e., base loading) are intended to evaluate the entire chair assembly, including the base, tilt mechanism, height adjustment device, locking/adjustment mechanisms, seat/backrest attachment, etc.

3.1.4 Each manufacturer's model or unit type in any configuration shall comply with applicable requirements when tested in accordance with this standard. Only worst-case models need to be tested for a specific unit type. A worst-case condition shall be representative of all models or units of the type tested. If "worst-case condition" is not readily evident, a case-by-case product line analysis by the manufacturer in consultation with the designated testing facility may be necessary, taking into consideration any special attributes, methods of construction, materials, and/or design features, etc.

3.1.5 The test methods included in this standard require the use of fixtures and/or load adapters to perform the tests. Some products and/or constructions may need special test fixtures, load adapters, etc., to perform these tests in a manner that meets the intent of the standard. This is especially true of products with complex articulation of joints, unique motions or adjustments, or non-traditional use of materials. The users of this standard are encouraged to develop appropriate fixtures and/or test variations that more accurately simulate application of loads, etc., for given unique products in a manner that reflects actual use. Fixtures, load adapters, etc., shall not add structure or provide support to the product being tested. Any deviations from the test methods/fixtures or special testing considerations shall be noted in the test report (see Section 3.7). Independent/consumer testing facilities may need to consult with product manufacturers to assure any special conditions are considered during testing.

3.1.6 It is not intended that all of the tests in this standard be conducted on a single unit. The tests may be performed on a series of units at the discretion of the manufacturer. When a test requires a functional load and a proof load be applied as part of the test criteria, the functional and proof loads shall be applied to the same component or unit.

3.1.7 Table 1 indicates the tests that shall be performed on each type of chair, as defined in Section 4.

3.1.8 The tests may be conducted in any sequence.

3.2 Manufacturer's Instructions

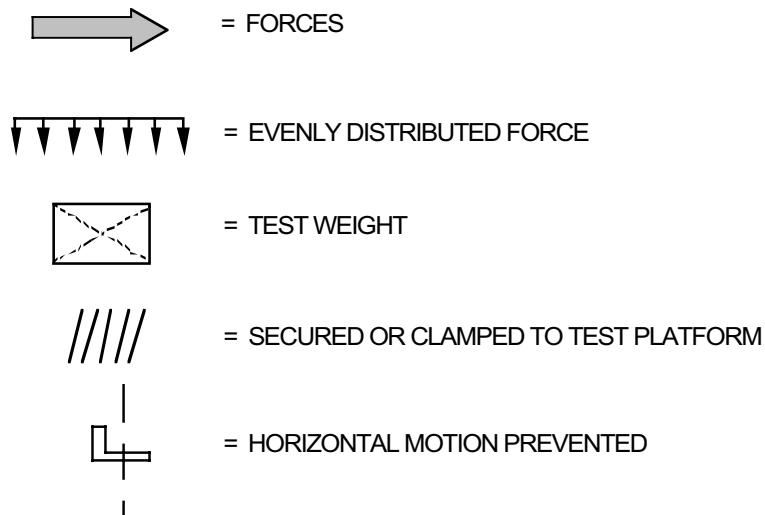
Where supplied, manufacturer's assembly instructions shall be followed during the initial assembly or set up of the chair. When a manufacturer recommends specific instructions or maintenance adjustments that may be required in order to keep the product in good operating condition, unless otherwise specified by these test procedures, the manufacturer's assembly, operating and maintenance instructions shall be followed.

3.3 Figures

Figures provided in this standard are intended as guidelines only and may not be representative of all possible test configurations.

(Continued)

3.4 Figure Symbols



3.5 Measurements

The BIFMA Chair Measurement Device (CMD) is recommended for use in determining applicable setup measurements. In order for measurements to be "universally" acceptable, only Chair Measuring Devices (CMD) built to BIFMA specifications may be used. The specifications and CMD are available from BIFMA International.

3.6 Tolerances

Unless otherwise specified, tolerances on test equipment, measuring equipment and loading devices, shall be:

- Test Weights, Forces, Velocities, and Time, $\pm 5\%$
- Linear measurements, ± 1.5 mm (1/16 in.),
- Angles, ± 5 degrees
- Level, within 5 mm per meter (1/16 in. per linear foot)
- Cycle requirements are minimums.

Test weights, forces, dimensions, angles, times, rates and velocities shall be targeted at the nominal values specified.

3.7 Recommended Test Report Format

When a test report is required, the following information should be included:

1. A title: (i.e., "Test Report");
2. Name and address of the laboratory, and the location where the tests were carried out, if different from the address of the laboratory;
3. Unique identification of the report (such as serial number) and on each page an identification in order to insure that the page is recognized as part of the test report and a clear identification of the end of the test report;
4. Name and address of the client (where applicable);
5. Description and unambiguous identification of the item tested (i.e., model number, manufacturing date, etc.);
6. Characterization and condition of the test item;
7. Date of receipt of the test item;
8. Date(s) of the performance of test;
9. Identification of the test method used;
10. Any additions to, deviations from, or exclusions from the test method (such as environmental conditions);
11. The name(s), function(s) and signature(s) , or equivalent identification of the person(s) authorizing the test report;
12. Where relevant, a statement to the effect that the results relate only to the items tested;
13. Date of issue of the report;
14. Test results with, where appropriate, the units of measurement and a statement of compliance/non-compliance with requirements and/or specifications;
15. A statement that the report shall not be reproduced, except in full, without the written approval of the laboratory.

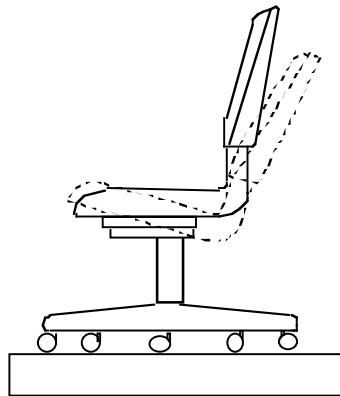


Figure 4a - Type I – Tilting Chair

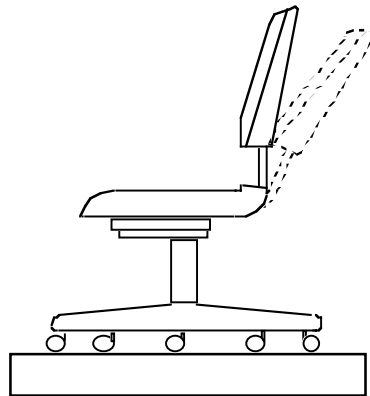


Figure 4b - Type II - Fixed seat angle, tilting backrest

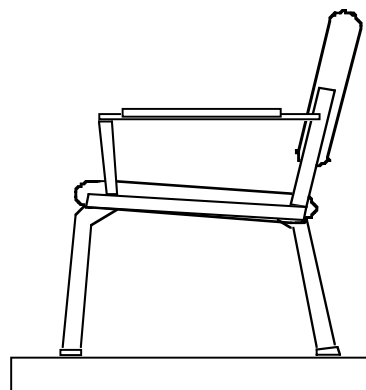


Figure 4c - Type III - Fixed seat angle, fixed backrest

4 Types of Chairs

To accommodate a wide variation in chair designs, it may be necessary to apply the tests to various types of chairs.

If a product can be classified as more than one chair type, it shall be tested under all applicable classifications. For example, a chair with a locking tilt mechanism would be classified as both a Type I (when the seat is unlocked) and Type III chair (when the seat is locked).

The following classification of types and features of chairs provides standard product identification:

Chair Type:

Type I. Tilting chair:

A chair with a seat that tilts with a counterbalancing force. Chairs of this type are typically referred to as synchro-tilt, center-tilt, knee-tilt, etc.

(See Figure 4a)

Type II. Fixed seat angle, tilting backrest:

A chair that provides a fixed seat angle with a tilting backrest.

(See Figure 4b)

Type III. Fixed seat angle, fixed backrest:

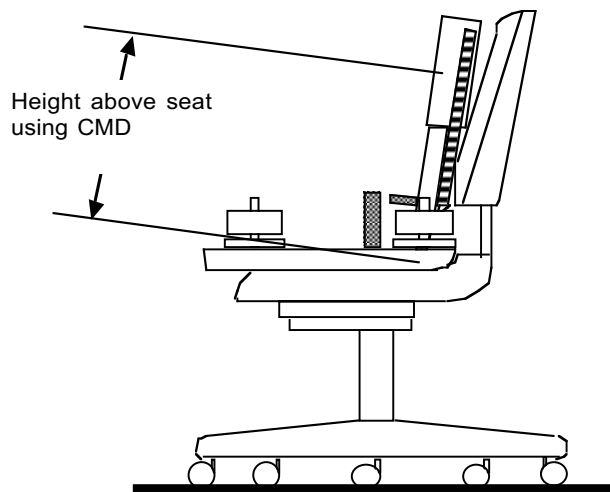
A chair that provides a fixed seat angle with a fixed backrest.

This may include chairs with legs, including sled base chairs.

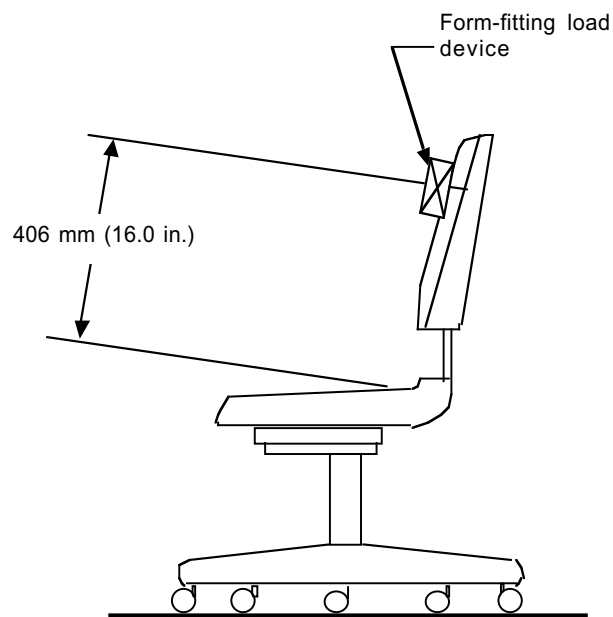
(See Figure 4c)

TABLE 1 – Test Guide by Chair Type

Section Number	Description	Type I	Type II	Type III
5	Backrest Strength Test - Static - Type I	X		
6	Backrest Strength Test - Static - Type II & III		X	X
7	Base Test - Static	X	X	X
8	Drop Test - Dynamic	X	X	X
9	Swivel Test - Cyclic	X	X	X
10	Tilt Mechanism Test - Cyclic	X	X	
11	Seating Durability Test - Cyclic	X	X	X
12	Stability Tests	X	X	X
13	Arm Strength Test - Vertical - Static	X	X	X
14	Arm Strength Test - Horizontal - Static	X	X	X
15	Backrest Durability Test - Cyclic - Type I	X		
16	Backrest Durability Test - Cyclic - Type II and Type III		X	X
17	Caster/Chair Base Durability Test - Cyclic	X	X	X
18	Leg Strength Test - Front and Side Application	X	X	X
19	Footrest Durability Test - Vertical - Cyclic	X	X	X
20	Arm Durability Test - Cyclic	X	X	X
21	Out Stop Tests for Chairs with Manually Adjustable Seat Depth	X	X	X
22	Tablet Arm Static Load Test	X	X	X
23	Tablet Arm Load Ease Test - Cyclic	X	X	X



**Figure 5a - Height Determination
Backrest Strength Test - Static – Type I**



**Figure 5b - Positioning of Form-Fitting Device for Backrests Higher than 452 mm
(17.8 in.) Backrest Strength Test - Static - Type I**

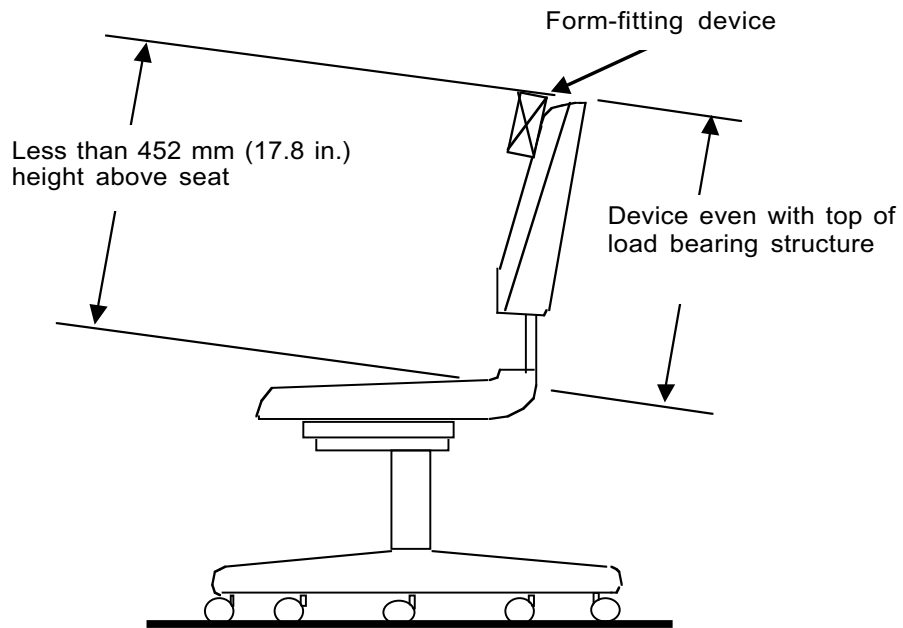


Figure 5c - Positioning of Form-Fitting Device for Backrests Lower than 452 mm (17.8 in.) Backrest Strength Test - Static - Type I

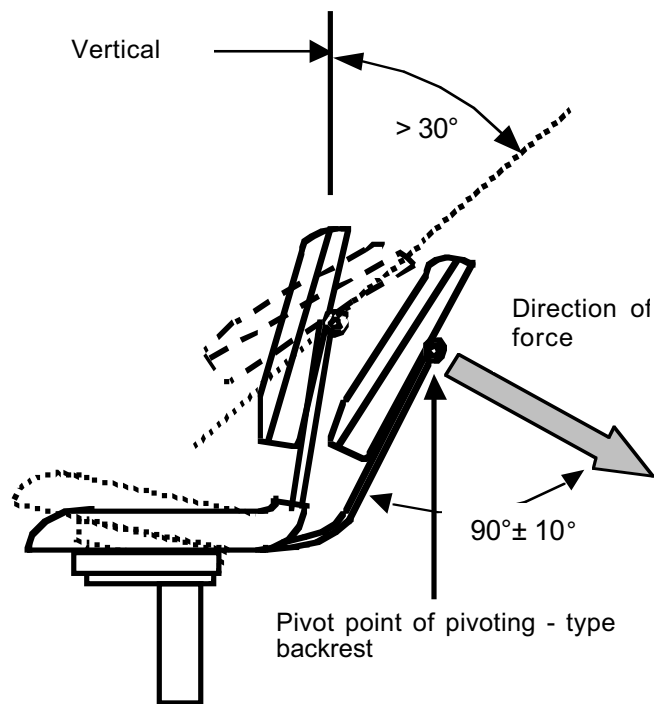
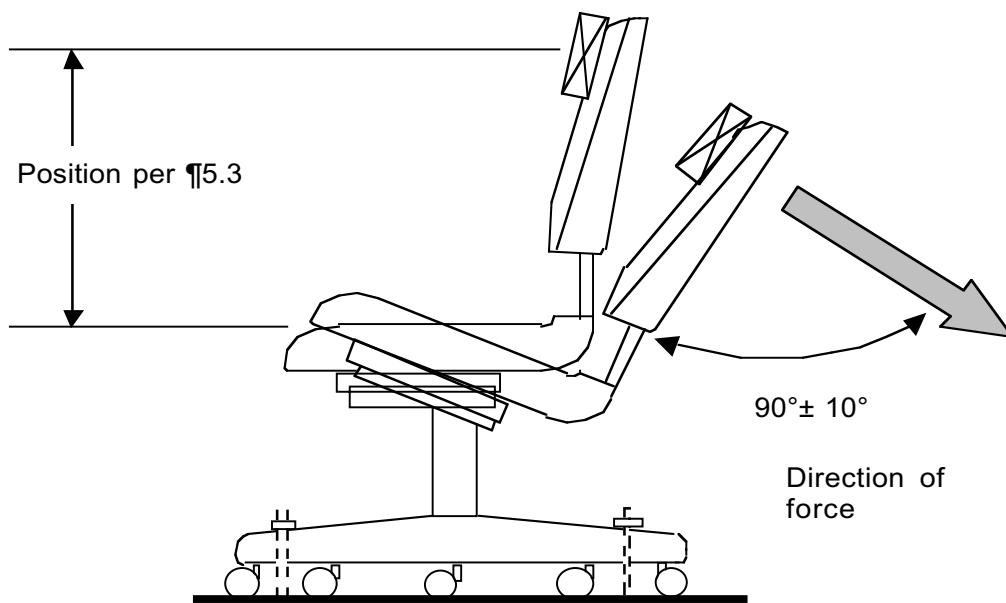


Figure 5d - Force Application for Backrests that Pivot Greater than 30° Backrest Strength Test - Static - Type I



**Figure 5e - Force Application for All Other Backrests
Backrest Strength Test - Static - Type I**

5 Backrest Strength Test - Static - Type I (See Figures 5a through 5e)

5.1 Applicability

This backrest strength test shall be performed on Type I chairs. For chairs with tilt locks, locking the chair changes the chair type (See Section 4) and must also be tested according to Section 6 in the upright locked position. An additional chair may be used for the Section 6 testing.

5.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chair to withstand stresses such as those caused by the user exerting a rearward force on the backrest of the chair.

5.3 Test Setup

5.3.1 The chair shall be placed on a test platform in an upright position and the base shall be restrained from movement, but shall not restrict movement of the backrest or arms of the chair. Figure 5e shows one acceptable method of restraining the chair.

5.3.2 If adjustable features are available, all adjustments shall be set at normal use conditions, except for height-adjustable pivoting backrests which shall have the pivot point set at its maximum height or 406 mm (16.0 in.) whichever is less.

5.3.3 After making the above adjustments, determine points 406 mm (16 in.) and 452 mm (17.8 in.) above the seat. (See Figure 5a). Mark these points on the vertical centerline of the backrest.

- a) If the top of the load-bearing structure/surface of the backrest is greater than or equal to 452 mm (17.8 in.) above the seat, position the center of the form-fitting device (See Definition 2.10) 406 mm (16 in.) above the seat. (See Figure 5b).
- b) If the top of the load-bearing structure/surface of the backrest is less than 452 mm (17.8 in.) above the seat, position the top of the form-fitting device even with the top of the load-bearing structure/surface. (See Figure 5c).
- c) If the unit has a pivoting backrest rest that stops at a position less than or equal to 30 degrees rearward of vertical (with the support structure in its most upright position), position the form-fitting device as directed in a) or b). If the unit has a pivoting backrest that stops at a position greater than 30 degrees rearward of vertical (with the support structure in its most upright position), position the center of the form-fitting device at the height of the pivoting point. (See Figure 5d).

5.3.4 Attach a loading device (front push or back pull) to the horizontal center of the backrest as determined above. The force shall be applied $90^\circ \pm 10^\circ$ to the plane of the backrest(s) when at the back stop position. (See Figure 5e). If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley. Note: Where the design of the chair does not allow the transfer of force(s) from the loading device to the load-bearing structure/surface, a bridging device not exceeding $89 \pm 13\text{mm}$ (3.5 ± 0.5 in.) in height may be used to span the width of the load-bearing structure/surface. The plane of the backrest may be defined by the front of the CMD upright.

5.4 Test Procedures

5.4.1 Functional Load

- a) A force of 890 N (200 lbf.) shall be applied to the backrest at the backstop position for one (1) minute. If the backrest/tilt lock mechanism will not accept the load due to gradual slipping of the adjustment mechanism during the load application, set the backrest to its most rearward (stopped) position, then apply the specified load(s).
- b) Remove the load and evaluate the product in accordance with the acceptance level in 5.5.1.

5.4.2 Proof Load

- a) A force of 1334 N (300 lbf.) shall be applied to the backrest at the backstop position for one (1) minute. If the backrest/tilt lock mechanism will not accept the load due to gradual slipping of the adjustment mechanism during the load application, set the backrest to its most rearward (stopped) position, then apply the specified load(s).
- b) Remove the load and evaluate the product in accordance with the acceptance level in 5.5.2.

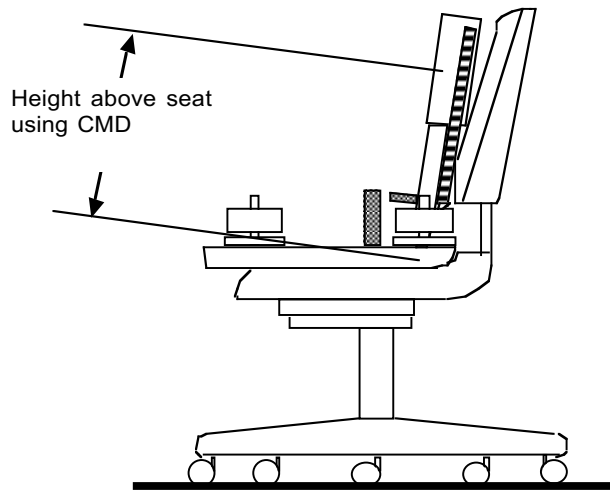
5.5 Acceptance Level

5.5.1 Functional Load

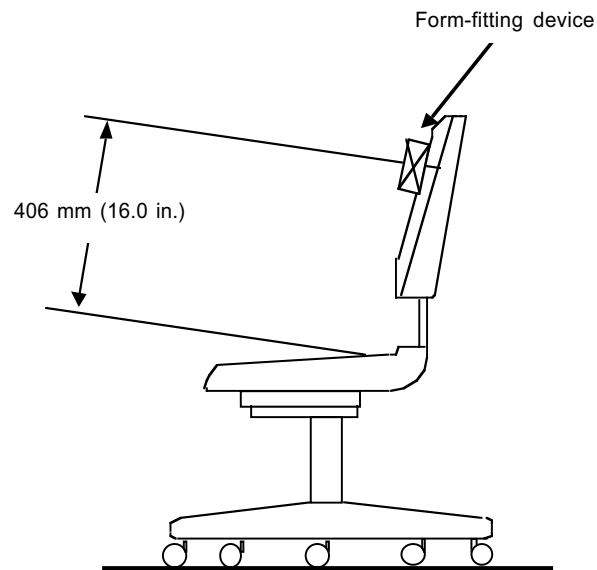
There shall be no loss of serviceability to the chair.

5.5.2 Proof Load

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



**Figure 6a - Height Determination
Backrest Strength Test - Static – Type II and III**



**Figure 6b - Positioning of Form-Fitting Device for Backrests Higher than 452 mm
(17.8 in.) Backrest Strength Test - Static – Type II and III**

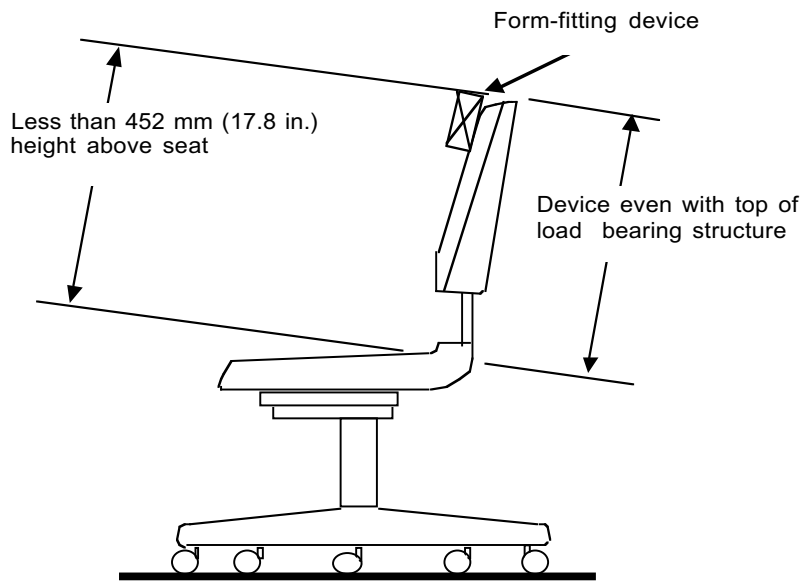


Figure 6c - Positioning of Form-Fitting Device for Backrests Lower than 452 mm (17.8 in.) Backrest Strength Test - Type II and III

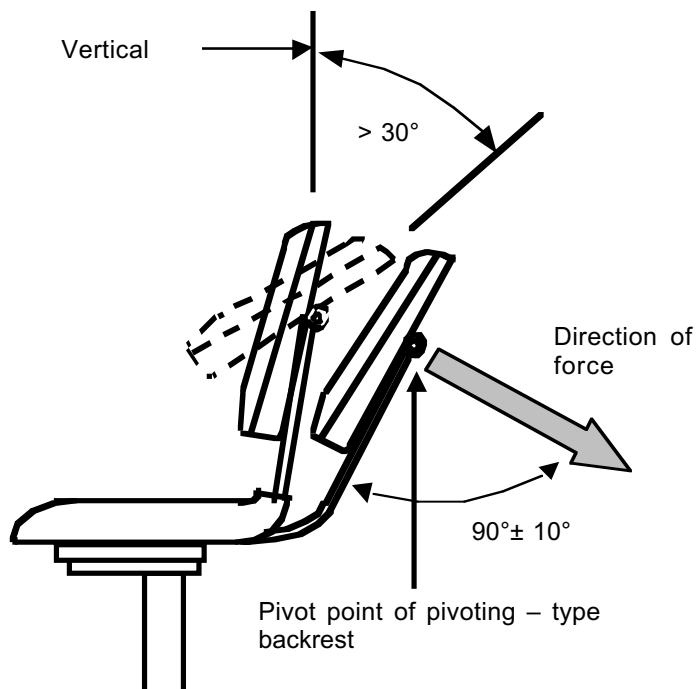
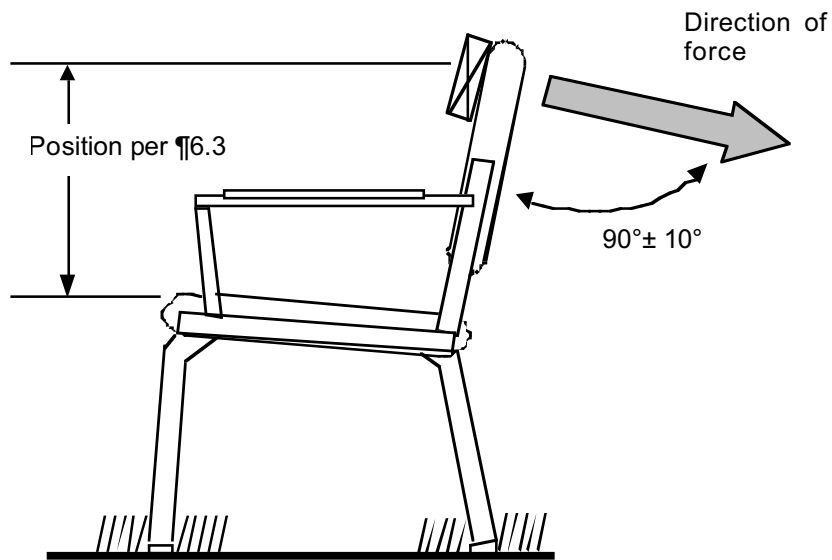
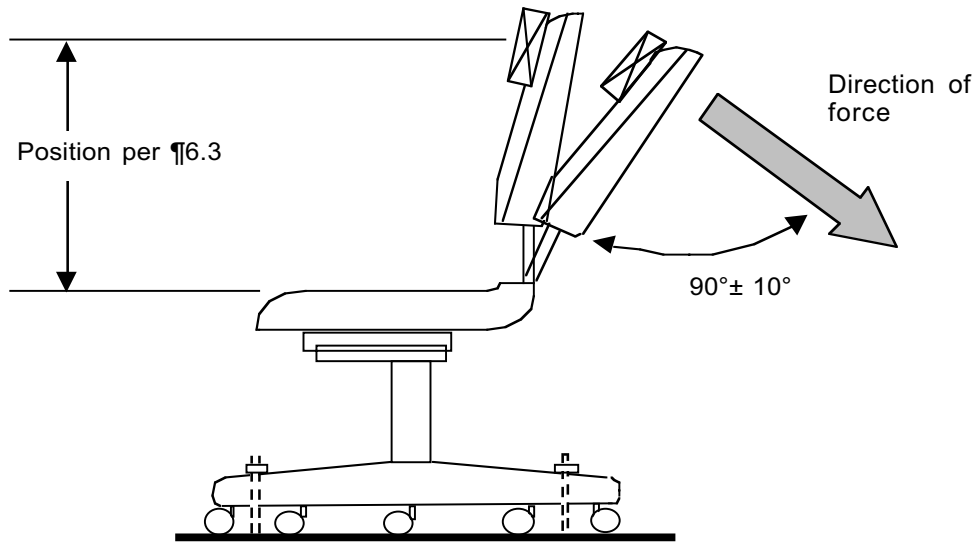


Figure 6d - Force Application for Backrests that Pivot Greater than 30° Backrest Strength Test - Static - Type II and III



**Figure 6e Force Application for All Other Backrests
Backrest Strength Test - Static – Types II and III**

6 Backrest Strength Test - Static - Type II & III (See Figures 6a through 6e)

6.1 Applicability

This backrest strength test shall be performed on Type II and III chairs.

6.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chair to withstand stresses such as those caused by the user exerting a rearward force on the backrest of the chair.

6.3 Test Setup

6.3.1 The chair shall be placed on a test platform in an upright position and the base shall be restrained from movement, but shall not restrict movement of the backrest or arms of the chair. Figure 6e shows one acceptable method of restraining the chair.

6.3.2 If adjustable features are available, all adjustments shall be set at normal use conditions, except for height-adjustable pivoting backrests which shall have the pivot point set at its maximum height or 406 mm (16.0 in.) whichever is less.

6.3.3 After making the above adjustments, determine points 406 mm (16 in.) and 452 mm (17.8 in.) above the seat. (See Figure 6a). Mark these points on the vertical centerline of the backrest.

- a) If the top of the load-bearing structure/surface of the backrest is greater than or equal to 452 mm (17.8 in.) above the seat, position the center of the form-fitting device (See Definition 2.10) 406 mm (16 in.) above the seat. (See Figure 6b).
- b) If the top of the load-bearing structure/surface of the backrest is less than 452 mm (17.8 in.) above the seat, position the top of the form-fitting device even with the top of the load-bearing structure/surface. (See Figure 6c).
- c) If the unit has a pivoting backrest that stops at a position less than or equal to 30 degrees rearward of vertical (with the support structure in its most upright position), position the form-fitting device as directed in a) or b). If the unit has a pivoting backrest that stops at a position greater than 30 degrees rearward of vertical (with the support structure in its most upright position), position the center of the form-fitting device at the height of the pivoting point. (See Figure 6d).

(Continued)

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6 Backrest Strength Test - Static - Type II & III (Continued)

6.3.4 Attach a loading device (front push or back pull) to the horizontal center of the backrest as determined above. The force shall be applied $90^\circ \pm 10^\circ$ to the plane of the backrest when at the back stop position. (See Figure 6e). If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley. For backrests with complex or varying contours, the plane of the backrest may be defined by the front of the CMD upright. Note: Where the design of the chair does not allow the transfer of force from the loading device to the load-bearing structure/surface, a bridging device not exceeding 89 ± 13 mm (3.5 ± 0.5 in.) in height may be used to span the width of the load-bearing structure/surface.

6.4 Test Procedures

6.4.1 Functional Load

- a) A force of 667 N (150 lbf.) shall be applied to the backrest at the backstop position for one (1) minute. If the backrest/tilt lock mechanism will not accept the load due to gradual slipping of the adjustment mechanism during the load application, set the backrest to its most rearward (stopped) position, then apply the specified load(s).
- b) Remove the load and evaluate the product in accordance with the acceptance level in 6.5.1.

6.4.2 Proof Load

- a) A force of 1112 N (250 lbf.) shall be applied to the backrest at the backstop position for one (1) minute. If the backrest/tilt lock mechanism will not accept the load due to gradual slipping of the adjustment mechanism during the load application, set the backrest to its most rearward (stopped) position, then apply the specified load(s).
- b) Remove the load and evaluate the product in accordance with the acceptance level in 6.5.2.

6.5 Acceptance Level

6.5.1 Functional Load

A functional load applied once shall cause no loss of serviceability to the chair.

6.5.2 Proof Load

A proof load applied once shall cause no sudden and major change in the structural integrity of the chair. Loss of serviceability is acceptable.

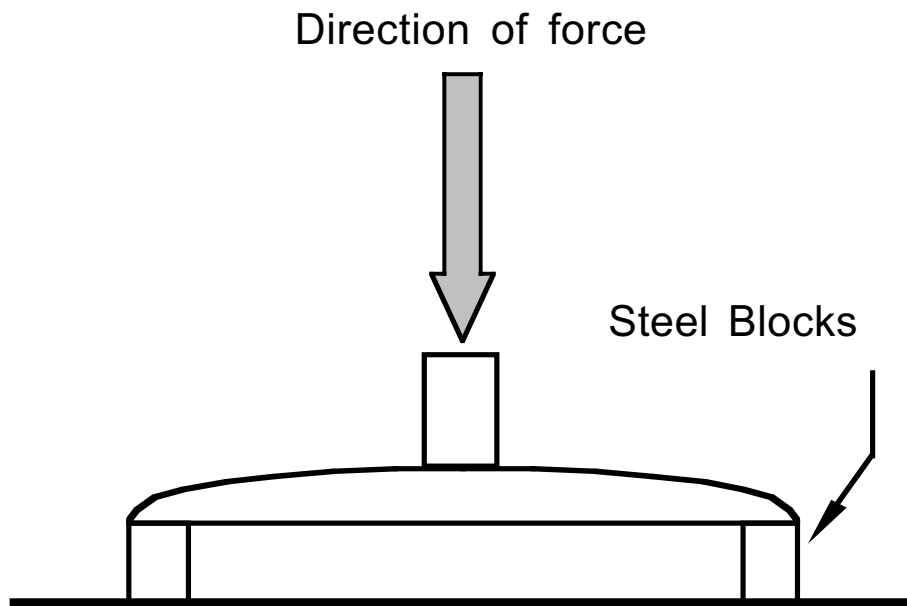


Figure 7 - Base Test - Static

7 Base Test - Static (See Figure 7)

7.1 Applicability

The test shall be performed on all pedestal bases.

7.2 Purpose of Test

The purpose of this test is to evaluate the ability of a pedestal base to withstand excessive vertical forces.

7.3 Test Setup

- a) Remove the glides or casters (caster sockets may remain in place), and replace with blocks or supports. Caster stems are recommended for support. The blocks or supports shall be of sufficient height to prevent the center column and/or legs from touching the test platform during the test. Remove the seat support mechanism(s) and height adjustment mechanism (if applicable) from the base. Apply the load to the vertical support column, or test fixture that simulates the taper/base interface. (See Figure 7).
- b) The base legs shall be allowed to move laterally and the center of the base to move vertically as the force is applied. The blocks or supports shall support the base in a manner and location similar to the original casters/glides and shall not impede the deflection and/or lateral motion during the test. Blocks or supports shall not lessen the severity of the test.

7.4 Test Procedures

- a) A force of 11,120 N (2,500 lbf.) shall be applied for one (1) minute.
- b) Remove the force.
- c) Apply a second force of 11,120 N (2,500 lbf.) for one (1) minute.
- d) Remove the load and evaluate the product in accordance with the acceptance level in Section 7.5.

7.5 Acceptance Level

There shall be no sudden and major change in the structural integrity of the base. The center column may not touch the test platform during the load applications.

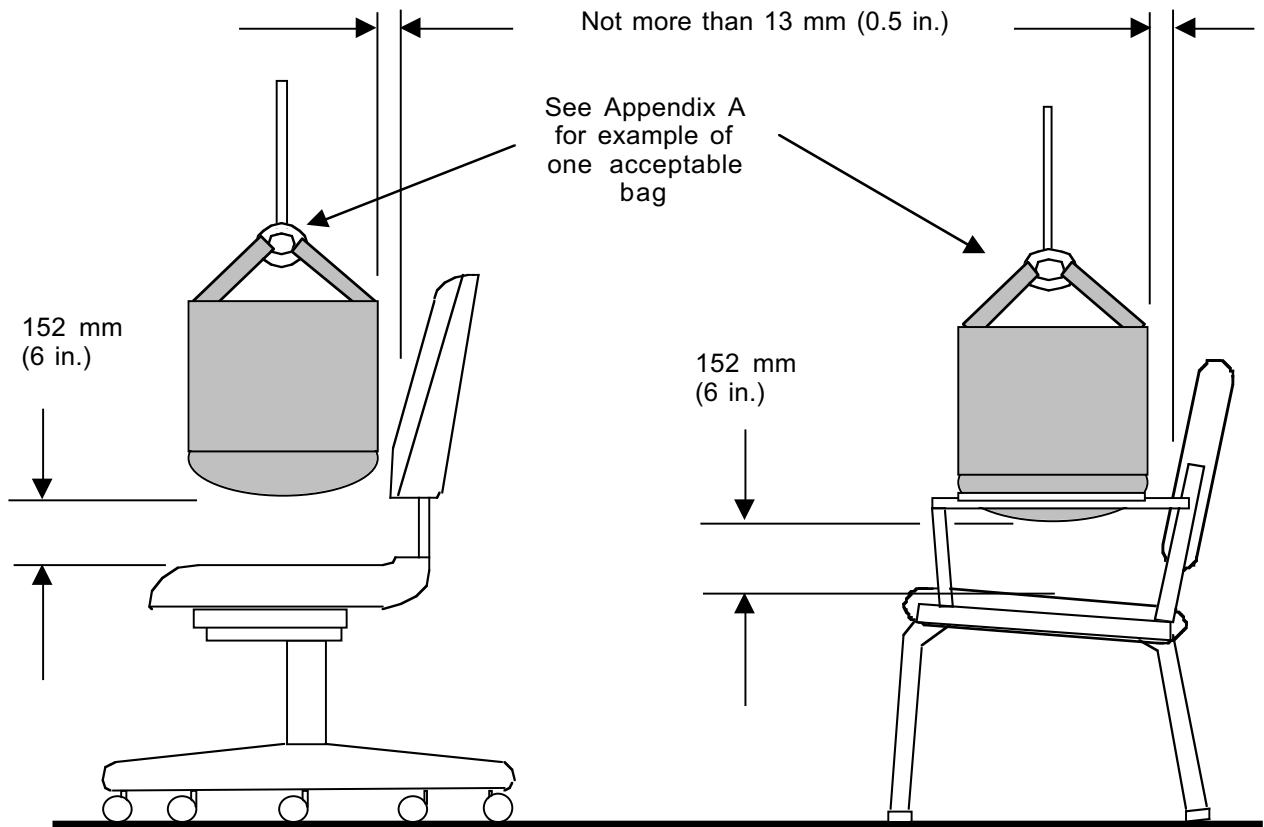


Figure 8 - Drop Test - Dynamic

8 Drop Test - Dynamic (See Figure 8)

8.1 Applicability

This test applies to all chair types.

8.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chair to withstand heavy and abusive impact forces on the seat.

8.3 Test Setup

- a) The unit shall be placed on a test platform.
- b) For chairs with a seat height adjustment feature, set the adjustment to its highest position. If other adjustable features are available, set these adjustments at normal use conditions. Casters, if present, shall be initially placed at the apparent worst-case position (typically at a position 90° to the base leg).
- c) A test bag as shown in Appendix A or other fixture that gives an equivalent impact shall be attached to a device permitting a free fall to the seating position as shown in Figure 8.
- d) The bag shall be centered side-to-side on the seat and shall be positioned not more than 13 mm (0.5 in.) from the most forward surface of the backrest during free fall. The bag shall not contact the backrest during the free fall.

8.4 Test Procedures

8.4.1 Functional Load Test

- a) A test bag approximately 400 mm (16 in.) in diameter containing sand and/or shot weighing 102 kg (225 lb.) shall be raised 152 mm (6 in.) above the uncompressed seat and released one time. (See Figure 8).
- b) Remove the bag and evaluate the product in accordance with the acceptance level in Section 8.5.1.
- c) For chairs with seat height adjustment features, set height to its lowest position and repeat a) and b).

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8 Drop Test - Dynamic (Continued)

8.4.2 Proof Load Test

- a) Repeat setup in 8.3 and increase the weight of the test bag to a proof load of 136 kg (300 lb.).
- b) The test bag shall be raised 152 mm (6 in.) above the uncompressed seat and released one time. (See Figure 8)
- c) Remove the bag and evaluate the product in accordance with the acceptance level in Section 8.5.2.
- d) For chairs with height adjustments, set seat height to its lowest position and repeat a) through c). A second chair may be used for testing the chair in the lowest position. Note: if a second chair is used for the proof load test, it must also be subjected to the functional load impact per Section 8.4.1 while in its lowest position.

8.5 Acceptance Level

8.5.1 Functional Load

There shall be no loss of serviceability.

8.5.2 Proof Load

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

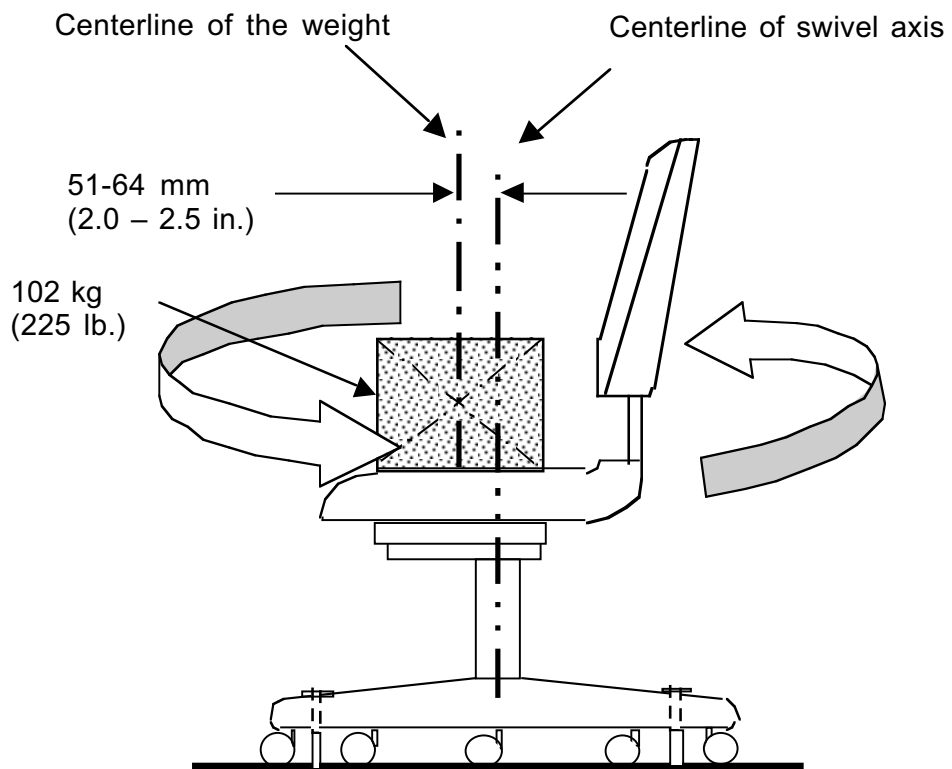


Figure 9 - Swivel Test – Cyclic

9 Swivel Test - Cyclic (See Figure 9)

9.1 Applicability

This test applies to all chair types with a swivel seat.

9.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chair to withstand stresses and wear of repeated swiveling.

9.3 Test Setup

- a) The chair shall be restrained on a platform. Either the seat or the platform shall be restrained from rotation. Figure 9 shows one acceptable method of restraint.
- b) If the seat height is adjustable, set it to the maximum seat height position. Set all other adjustable features to the normal use condition.
- c) A 102 kg (225 lb.) load shall be placed on the seat such that the center of gravity of the load is 51 to 64 mm (2 to 2.5 in.) forward of the centerline of the spindle as shown in Figure 9.
- d) The cycling device shall be adjusted to rotate the lesser of the following: the available range of rotation or $360^\circ \pm 10^\circ$. If the available range of rotation is less than 360° , the rotation of the test machine shall be adjusted such that the swivel mechanism touches but does not override the stops. The rotation may be either bi-directional (alternating) or unidirectional.
- e) For chairs that swivel 360° , a cycle is one full rotation. For chairs that swivel less than 360° , one cycle is rotating from one stop to the other stop.

9.4 Test Procedure

- a) The seat or platform shall rotate for 60,000 cycles at an appropriate rate between 5 and 15 rotations per minute.
- b) If the seat height is adjustable set the height to its lowest position.
- c) For all chairs, continue the test for an additional 60,000 cycles to a total of 120,000 cycles.
- d) Record findings.

9.5 Acceptance Level

There shall be no loss of serviceability.

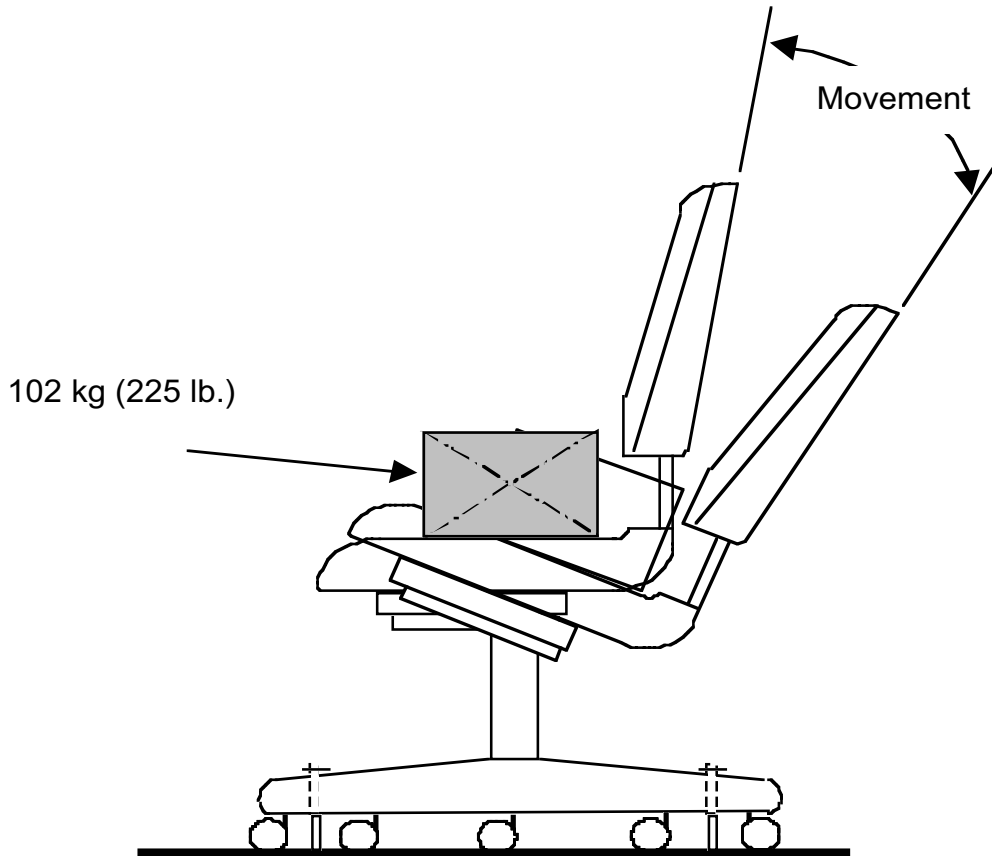


Figure 10 - Tilt Mechanism Test - Cyclic

10 Tilt Mechanism Test - Cyclic (See Figure 10)

10.1 Applicability

This test shall be performed on Type I and Type II chairs with tilting backrests.

10.2 Purpose of Test

The purpose of this test is to evaluate the ability of the tilt mechanism to withstand the fatigue stresses and wear caused by repeated tilting.

10.3 Test Setup

- a) The chair or fixture with attached tilt mechanism shall be restrained on a test platform. Figure 10 shows one acceptable method of restraint.
- b) If adjustable features are available, all adjustments shall be set at normal use conditions.
- c) A cycling device shall be attached to the chair or fixture at any location appropriate to apply a controlled (push and/or pull) motion.
- d) A test load of 102 kg (225 lb.) shall be secured on the center of the seat (or equivalent location on the fixture).
- e) Adjust the cycling device to move the mechanism between the front and back stops, without overriding or impacting either stop.

10.4 Test Procedure

The unit shall be cycled for 300,000 cycles at an appropriate rate between 10 and 30 cycles per minute. The tilt mechanism and/or cycling device should be checked and readjusted as needed to maintain the original conditions specified.

10.5 Acceptance Level

There shall be no loss of serviceability to the tilt mechanism.

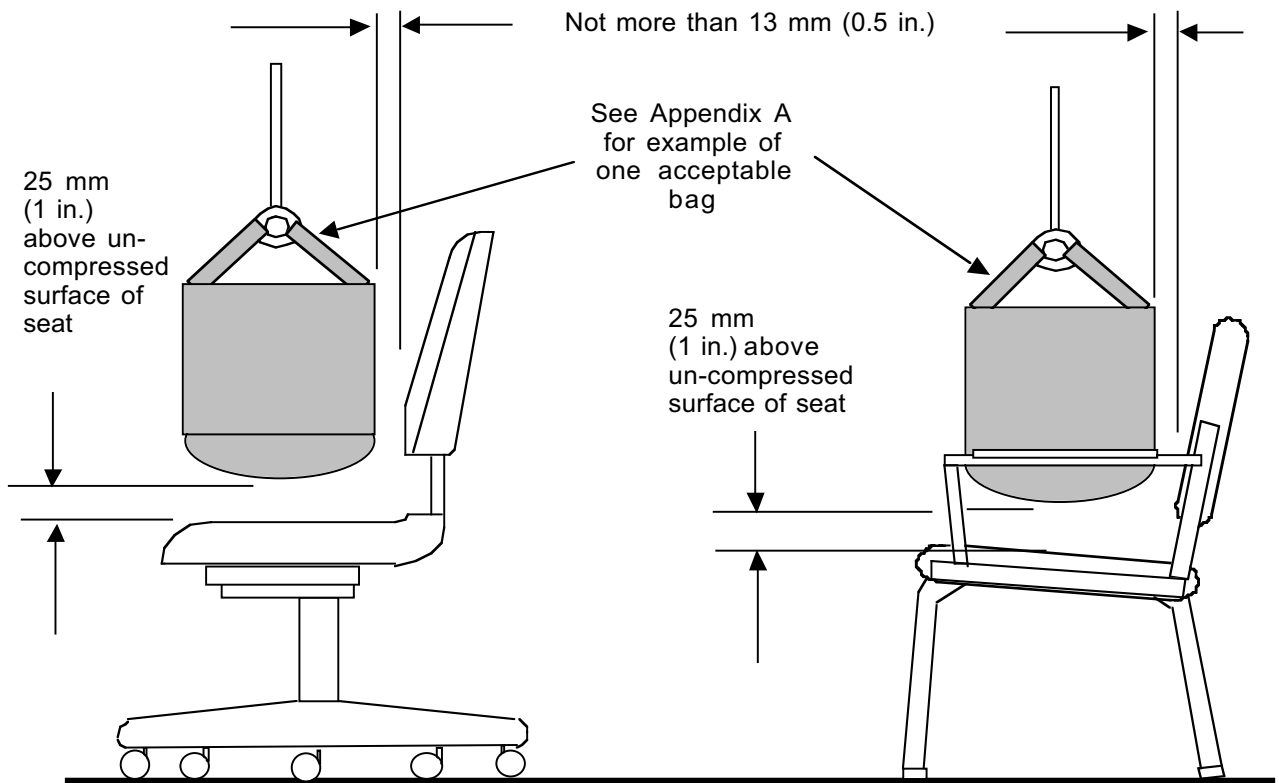


Figure 11a - Seating Impact Test – Cyclic

11 Seating Durability Tests – Cyclic (See Figure 11a and 11b)

Note: This is a two-part test. The impact test and front corner load-ease tests must be run sequentially for this evaluation.

11.1 Applicability

These tests apply to all chair types.

11.2 Purpose of Tests

The purpose of these tests is to evaluate the ability of chairs to withstand fatigue stresses and wear caused by downward vertical force(s) on the seat.

11.3 Impact Test**11.3.1 Test Setup**

- a) The unit shall be placed on a test platform and be restrained in a manner that will maintain the impact location on the seat. The method of restraint shall not add support or structure to the chair, or inhibit movement of the chair response to the impact. Casters, if present, shall be initially placed at the apparent worst-case position (typically at a position 90° to the base leg).
- b) If adjustable features are available, all adjustments shall be set at normal use conditions.
- c) Chairs with less than 44 mm (1.75 in.) of cushioning materials in the seat shall have foam added to bring total cushioning thickness to 50 mm ± 6 mm (2 in. ± .25 in.). Any additional foam added to the top of the seat shall have a 25% Indentation Force Deflection (IFD) of 200 N ± 22 N (45 lbf. ± 5 lbf.).¹
- d) A test bag approximately 400 mm (16 in.) in diameter containing sand and/or shot weighing 57 kg (125 lb.), shall be attached to a cycling device, permitting a free fall to the seat as shown in Figure 11a. The free fall shall begin after lifting the test bag 25 mm (1 in.) above the uncompressed surface on the seat, as measured at the center of the seat. Other methods of creating the impact are acceptable if the impact can be shown to be equivalent. The drop height and/or seat height shall be adjusted during the test if the drop height increases by more than 13 mm (0.5 in.). The cycling device shall be set at an appropriate rate between 10 and 30 cycles per minute.
- e) The bag shall be centered side-to-side on the seat and shall be positioned not more than 13 mm (0.5 in.) from the most forward surface of the backrest during free fall. The bag shall not contact the backrest during the free fall.

11.3.2 Test Procedure

The chair shall be tested to 100,000 cycles.

¹ Specimen thickness 102 mm (4 in.). See Method B₁, Indentation Force Deflection Test, in *Standard Test Methods for Flexible Cellular Materials — Slab, Bonded, and Molded Urethane Foams*, ASTM D 3574-01.

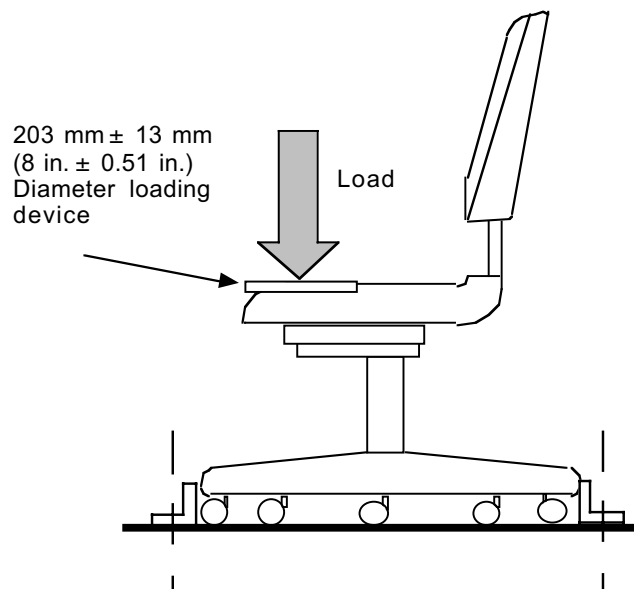
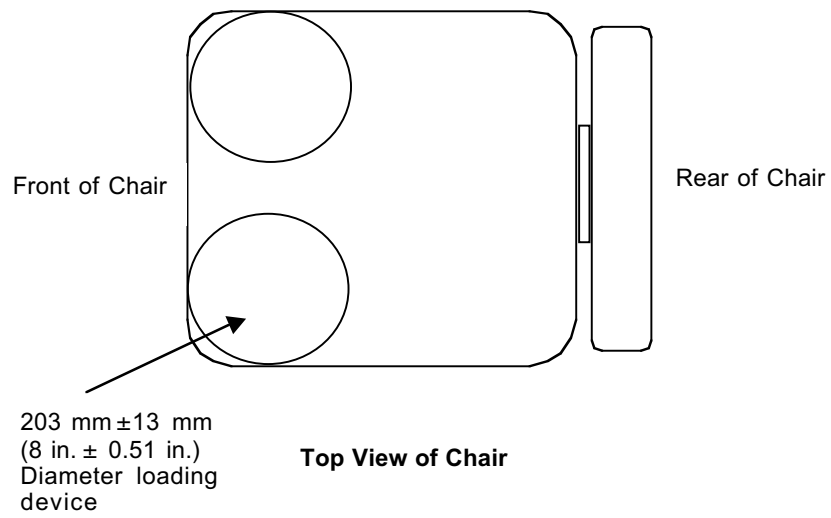


Figure 11b – Front Corner Load-Ease Test – Cyclic – Off-center

11 Seating Durability Tests – Cyclic (Continued)

11.4 Front Corner Load-Ease Test – Cyclic – Off-center

11.4.1 Test Setup

After completing the impact test in Sections 11.3, apply a load of 734 N (165 lbf.) through a 203mm \pm 13mm (8 in. \pm 0.51 in.) diameter loading device at one front corner flush to each structural edge. If arms interfere with the placement of the weights and are intended to be removable, they may be removed for this test. If arms interfere but are not removable (or adjustable) the load may be positioned to avoid interference.

11.4.2 Test Procedure

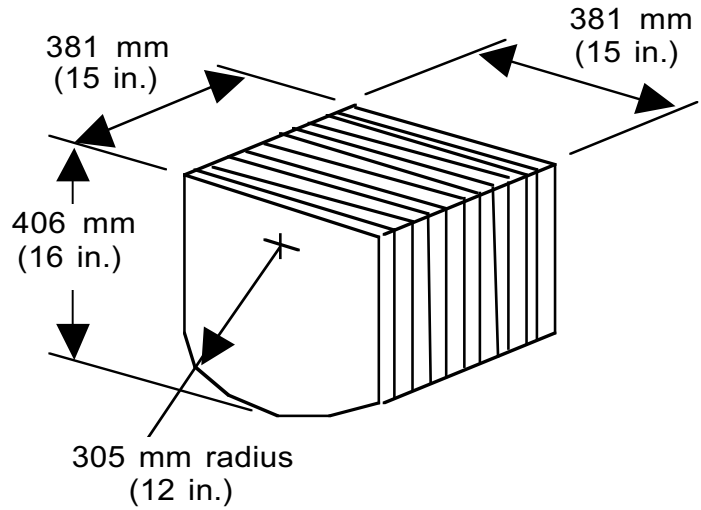
Raise the loading device from the seat and lower completely, without impact to the seat so that it takes the entire load without any support from the cycling device, at a rate of 10 to 30 cycles per minute. Test for 20,000 cycles. Reposition the load to the other front corner, and perform the test for an additional 20,000 cycles.

Note: Applying the loads in an alternating sequence to attain a total of 40,000 cycles is an acceptable method of performing this test.

11.5 Acceptance Level

There shall be no loss of serviceability to the chair after completion of both the impact and load-ease tests.

Note: The exact materials used to construct the weight are not important, but their mass shall be distributed equally throughout the weight.



79 kg (173 lb.) Weight for Rear Stability

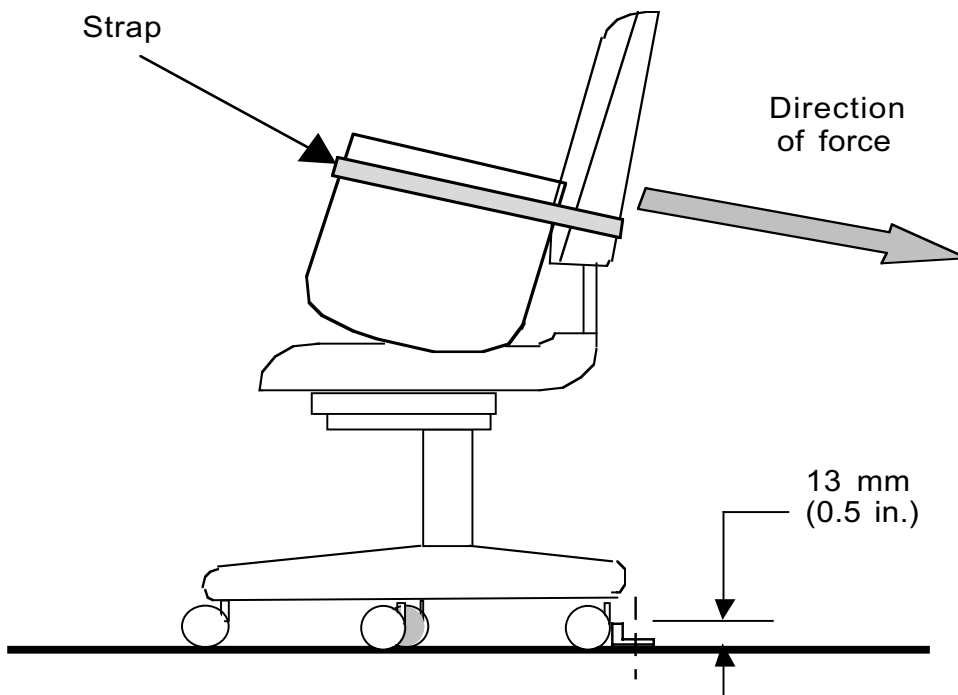


Figure 12a - Stability Tests

12 Stability Tests (See Figures 12a and 12b)

12.1 Applicability

The stability tests shall be performed on all types of chairs.

12.2 Purpose of Tests

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

12.3 Rear Stability (Figure 12a)

12.3.1 Test Setup

12.3.1.1 The chair shall be placed on a test platform.

12.3.1.2 On chairs with adjustable features, all adjustments shall be set at the apparent least stable condition for rearward stability, such as:

- a) maximum height of seat or backrest, or both,
- b) minimum tension of tilt mechanism,
- c) rearmost seat or backrest position, or both,
- d) the least stable condition of casters or glides.

Note: On chairs with tilt locks, locking the mechanism in the near upright position changes the chair type (See Section 4: Chair Type) and the chair shall be tested in the locked (near upright) and unlocked (reclined) conditions.

12.3.1.3 A 79 kg (173 lb.) weight shall be placed on the seat at the center of the unit or on the seating position nearest to the center of the chair. The weight shall be strapped as shown in Figure 12a.

12.3.1.4 A block, obstruction or other restraining device 13 mm (0.5 in.) in height shall be affixed to the test platform. The device shall prevent sliding but not restrict the unit from tipping. On chairs that rotate, the base and casters shall be positioned to offer the least resistance to rearward tipping of the chair.

12.3.2 Test Procedure

- a) A rearward force, either push or pull, shall be applied to the backrest of the chair, in the plane of the top of the weight as shown in Figure 12a, or the top of the backrest, whichever is lower.
- b) A force shall be applied until the total unit weight is transferred to the rear support members (This typically occurs when the front support members lift off the test platform.).
- c) Determine that the force required to achieve the condition described in 12.3.2b) exceeds the acceptance levels below.

12.3.3 Acceptance level

The force determined in 12.3.2 shall not be less than that shown for each type of chair:

Type I	89 N (20 lbf.)
Type II	89 N (20 lbf.)
Type III	156 N (35 lbf.)

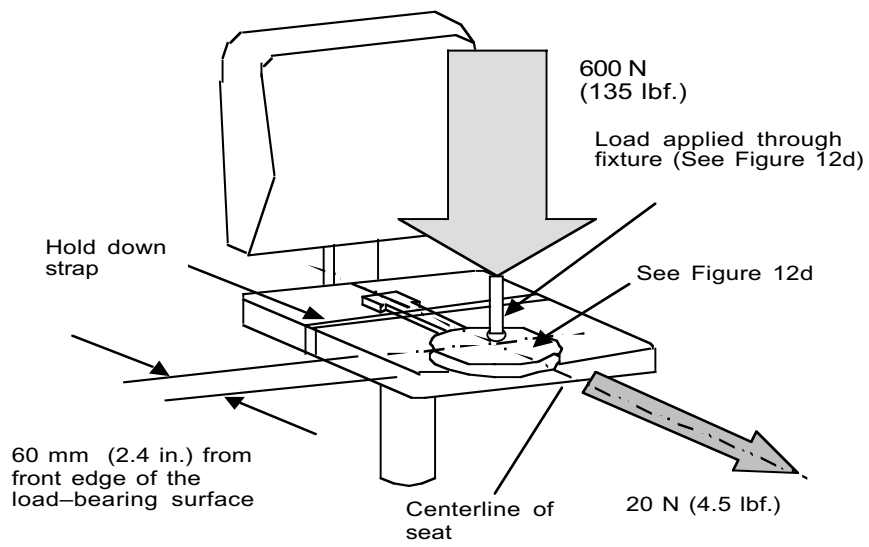


Figure 12b- Front Stability Test

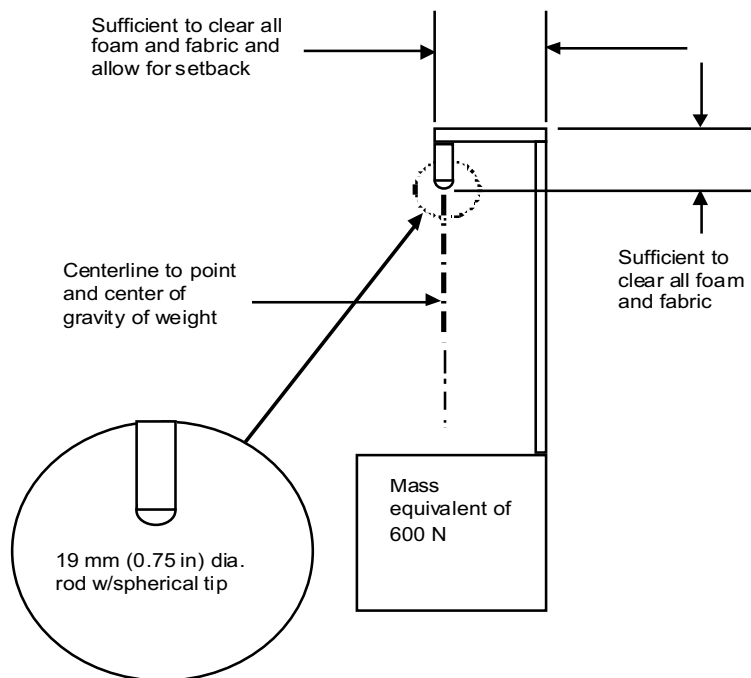


Figure 12c - Front Stability Loading Fixture

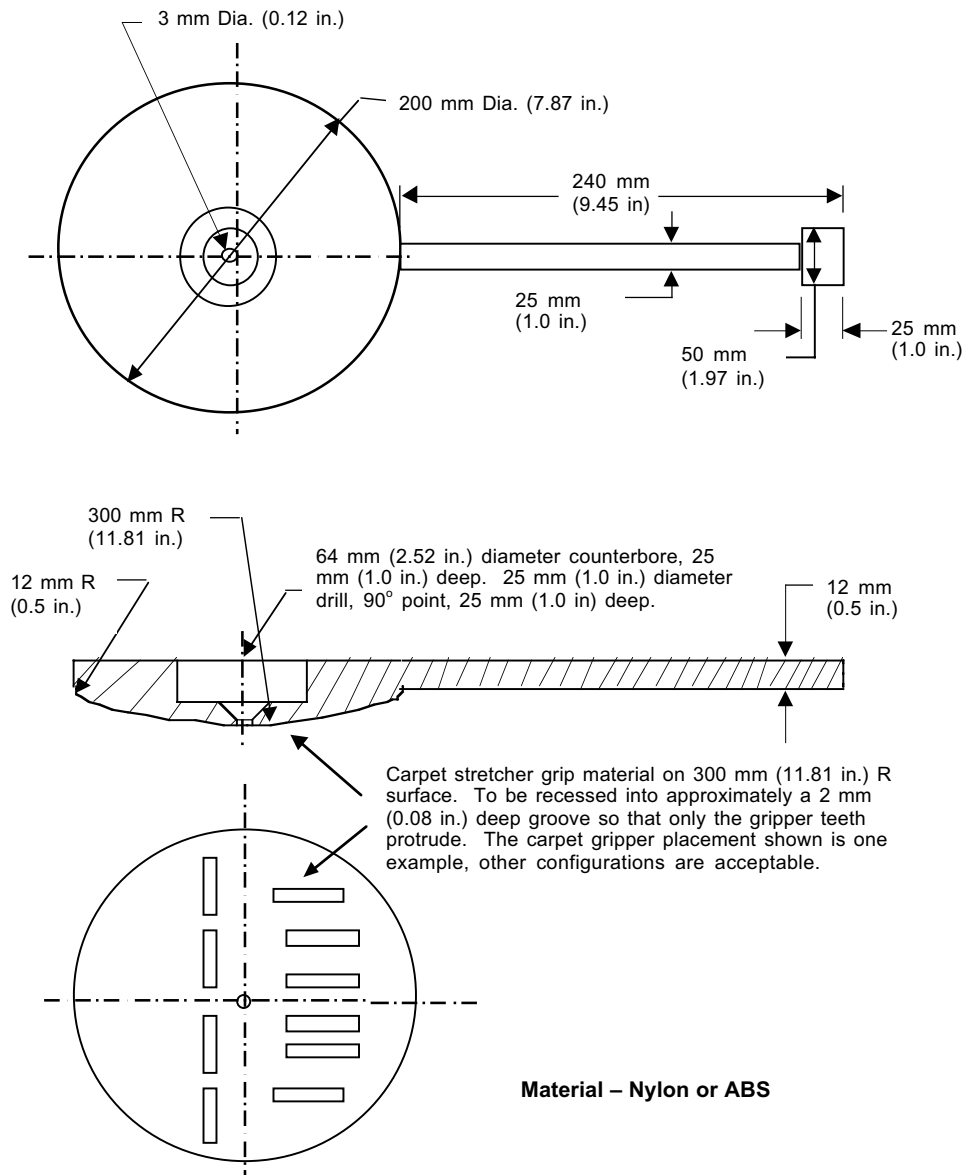


Figure 12d - Front Stability Loading Disk

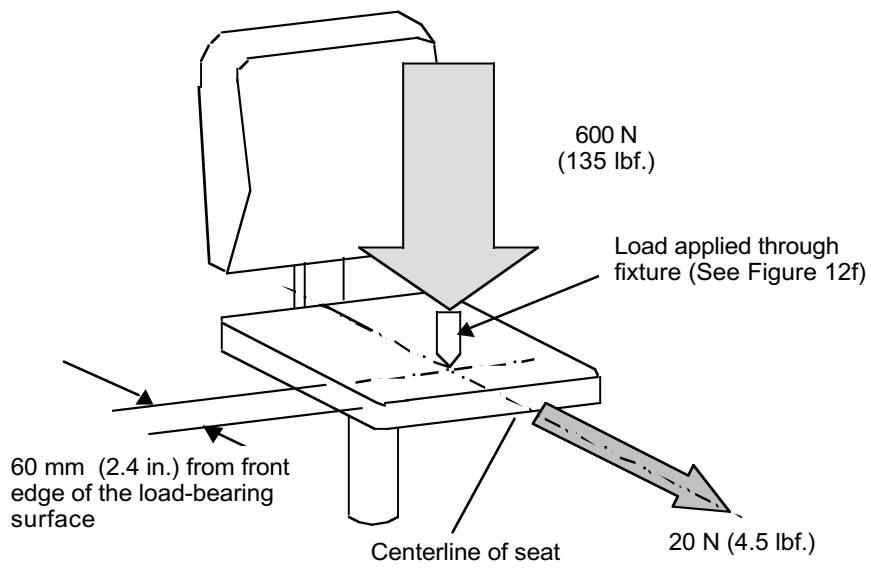


Figure 12e- Front Stability Test

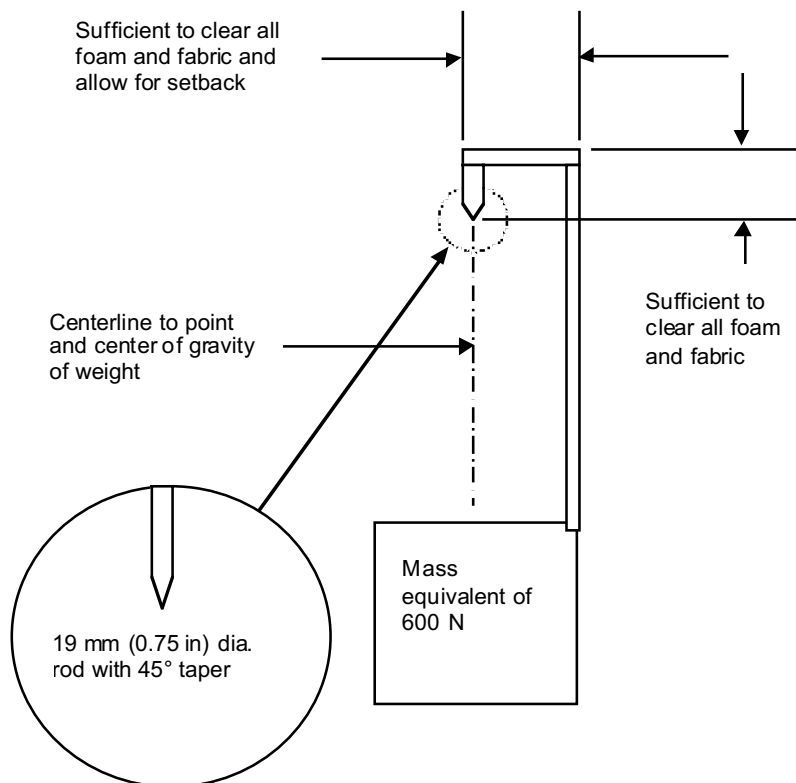


Figure 12f - Front Stability Loading Fixture

12 Stability Tests (Continued)

12.4 Front Stability

Front stability shall be determined by either the method described in Sections 12.4.1 and 12.4.2 or 12.4.1 and 12.4.3.

12.4.1 Test Setup

- a) The unit shall be placed on a test platform.
- b) On units with adjustable features, all adjustments shall be set at the apparent least stable condition for forward stability, such as, maximum height of seat or backrest, or both, most forward seat or backrest position or both, and at the least stable condition of casters, glides and tilt mechanism.
- c) For chairs with casters, a block or obstruction 13 mm (0.5 in.) in height shall be affixed to the test platform. The device shall prevent sliding but not restrict the unit from tipping. On units that rotate, the bases and casters, if any, shall be positioned to offer the least resistance to forward tipping of the unit.
- d) For chairs without casters, a block or obstruction 13 mm (0.5 in.) in height shall be affixed to the test platform. On units that rotate, the base shall be positioned to offer the least resistance to forward tipping of the unit.

12.4.2 Test Procedure - Alternative A (See Figures 12b and 12c)

- a) This alternative may only be used on chairs that do not have a resilient seat surface.
- b) Apply a vertical load of 600 N (135 lbf.), through a 200 mm (7.87 in) diameter disk, the center of which is 60 mm (2.4 in.) from the front center edge of the load-bearing surface of the seat. (See Figure 12d for details).
- c) Apply a horizontal force of 20N (4.5 lbf.) at the same level of the plane of the top of the seat. The force shall be coincident with the side-to-side centerline of the seat.

12.4.3 Test Procedure – Alternative B (See Figures 12e and 12f)

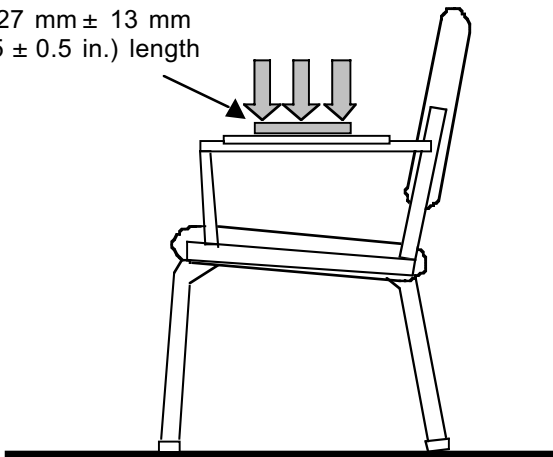
- a) Apply a vertical load of 600 N, (135 lbf.), by means of the front stability loading fixture shown in Figure 12f at a point 60 mm (2.4 in.) from the front center edge of the load-bearing surface of the chair.
- b) Apply a horizontal force of 20N (4.5 lbf.) at the same level of the plane of the top of the seat. The force shall be coincident with the side-to-side centerline of the seat.

12.4.4 Acceptance Level

The chair shall not tip over as the result of the force application.

DIRECTION OF FORCE: INITIALLY VERTICAL

127 mm ± 13 mm
(5 ± 0.5 in.) length



127 ± 13 mm
(5 ± 0.5 in.) length

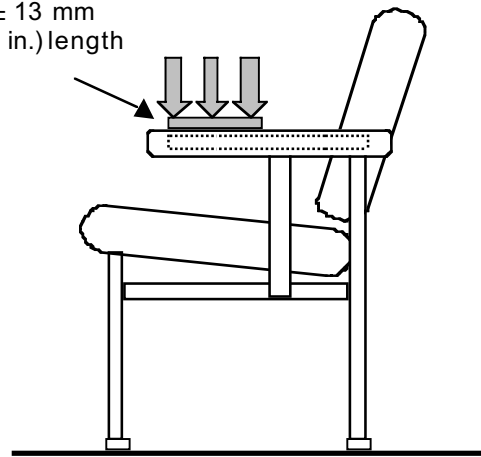


Figure 13a - Arm Strength Test - Vertical - Static

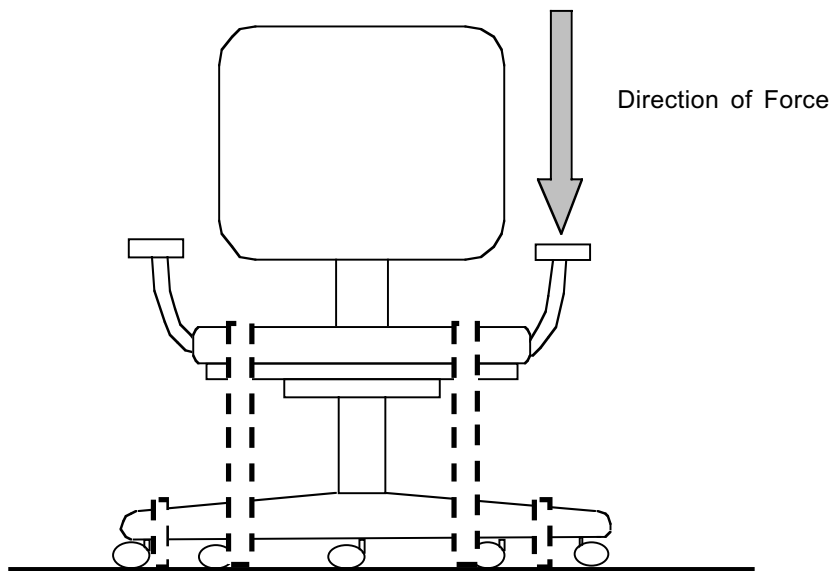


Figure 13b - Arm Strength Test - Vertical - Static

13 Arm Strength Test - Vertical - Static (See Figure13a and 13b)**13.1 Applicability**

This test applies to all chairs with arms.

13.2 Purpose of Test

The purpose of the test is to evaluate the ability of a chair arm to withstand stresses caused by applying vertical forces on the arm(s).

13.3 Test Setup

- a) The chair shall be placed on a test platform and restrained from movement. (See Figure 13b.)
- b) If adjustable features are available, all adjustments shall be set at normal use conditions.
- c) A loading device shall be attached to apply an initially vertical load uniformly along a 127mm (5 in.) length along the width and length of the arm at the apparent weakest point that is forward of the chair backrest.
- d) If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley.

13.4 Test Procedures**13.4.1 Functional Load**

- a) A force of 890 N (200 lbf.) shall be applied for one (1) minute.
- b) Remove the force.

13.4.2 Proof Load

- a) A force of 1334 N (300 lbf.) shall be applied for one (1) minute.
- b) Remove the force.

13.5 Acceptance Level**13.5.1 Functional Load**

There shall be no loss of serviceability.

13.5.2 Proof Load

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

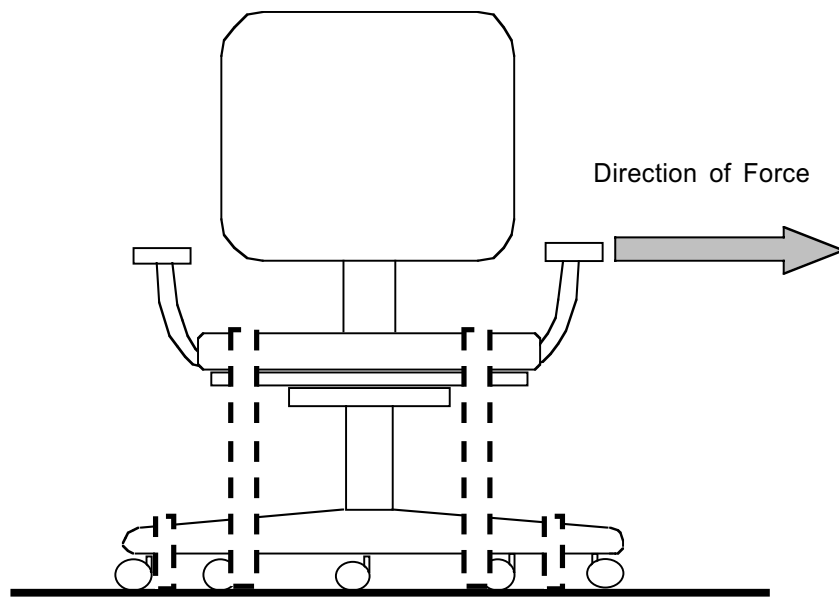


Figure 14 - Arm Strength Test - Horizontal – Static

14 Arm Strength Test - Horizontal - Static (See Figure 14)

14.1 Applicability

This test applies to all chairs with arms.

14.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chair to withstand stresses caused by applying outward forces to the arm(s).

14.3 Test Setup

- a) The chair shall be placed on a test platform. Restrain the chair from horizontal movement and tipping. The restraints shall not restrict the chair arm movement. Figure 14 shows one acceptable method of restraining the chair.
- b) If adjustable features are available, all adjustments shall be set at normal use conditions.
- d) A loading device or strap, not greater than 25 mm (1 in.) in horizontal width, shall be attached to the arm so that the load is initially applied horizontally to the armrest structure at the apparent weakest point. For armrests that pivot in the horizontal plane, apply the load at the pivot point.
- e) If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley.

14.4 Test Procedures

14.4.1 Functional Load

- a) A force of 445 N (100 lbf.) shall be applied for one (1) minute in the outward direction.
- b) Remove the force.

14.4.2 Proof Load

- a) A force of 667 N (150 lbf.) shall be applied for one (1) minute in the outward direction.
- b) Remove the force.

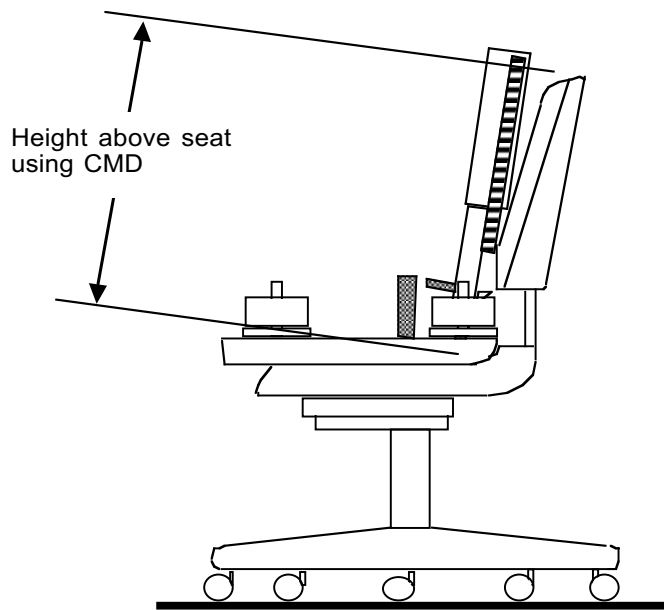
14.5 Acceptance Level

14.5.1 Functional Load

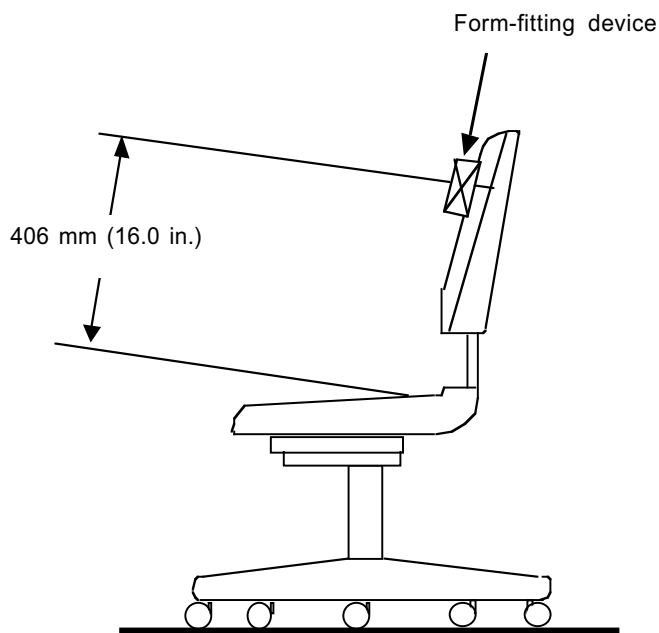
A functional load applied once shall cause no loss of serviceability.

14.5.2 Proof Load

A proof load applied once shall cause no sudden and major change in the structural integrity of the unit. Loss of serviceability is acceptable.



**Figure 15a - Test Height Determination
Backrest Durability Test - Type I**



**Figure 15b - Positioning of Form-Fitting Device for Backrests Higher than 452 mm
(17.8 in.) Backrest Durability Test - Type I**

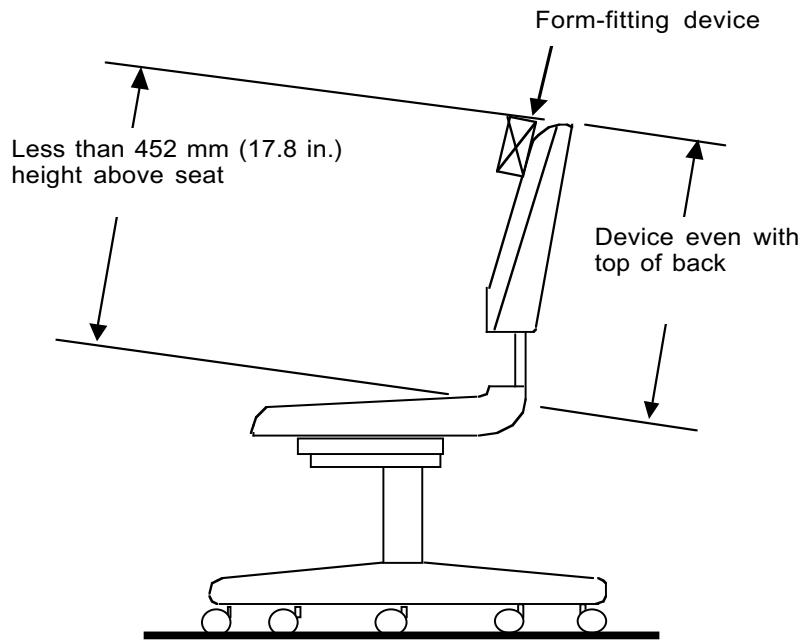


Figure 15c - Positioning of Form-Fitting Device for Backrests Lower than 452 mm (17.8 in.) Backrest Durability Test - Type I

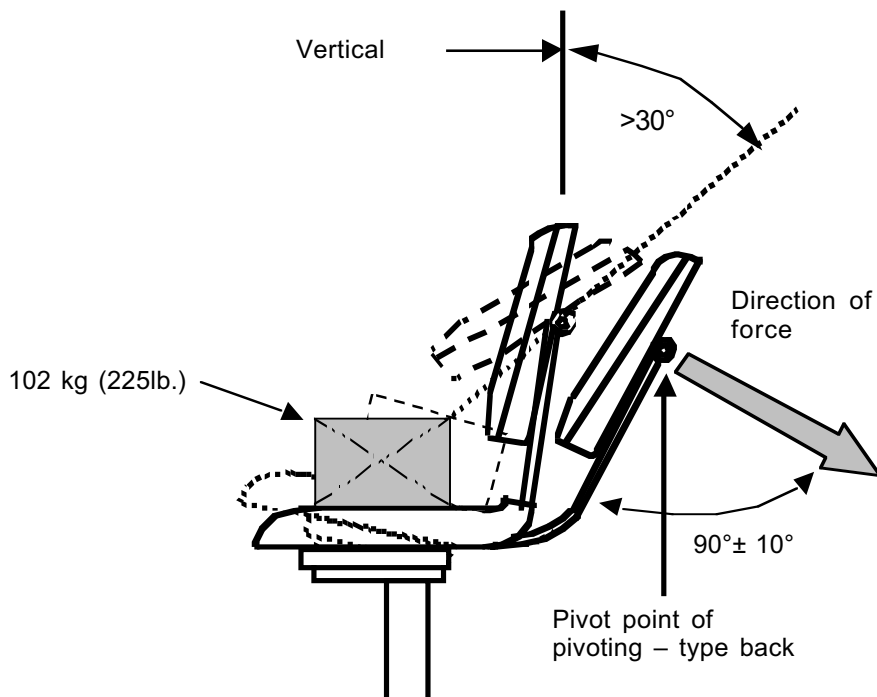


Figure 15d - Force Application for Backrests that Pivot Greater than 30° Backrest Durability Test - Cyclic - Type I

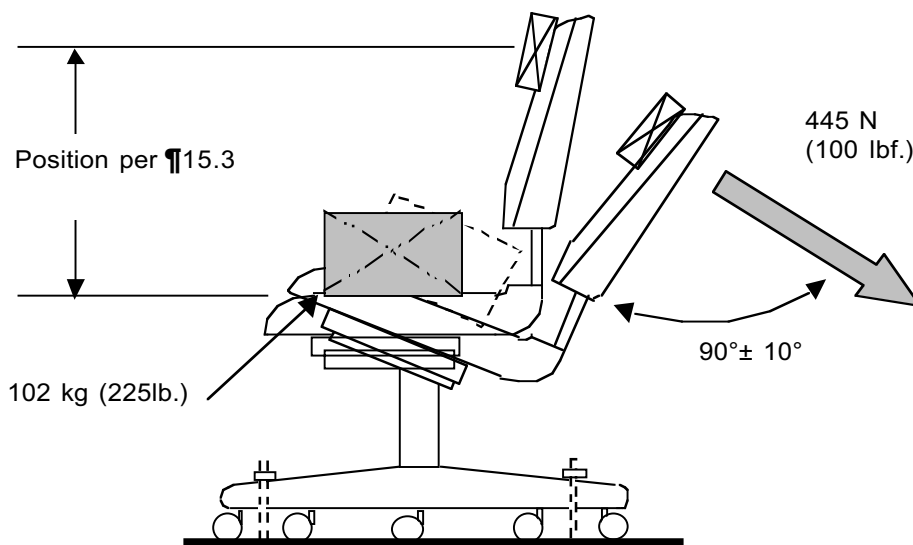


Figure 15e - Force Application for All Other Backrests
Backrest Durability Test - Cyclic

15 Backrest Durability Test - Cyclic - Type I (See Figures 15a through 15e)

15.1 Applicability

This test shall be performed on Type I Tilting chairs.

15.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chairs to withstand fatigue stresses and wear caused by rearward force on the backrest of the chair.

15.3 Test Setup

15.3.1 The chair shall be placed on a test platform in an upright position with the base/legs restrained from movement. If pushing on the backrest with the test device, the chair must be restricted from rotating. Clamping shall be done so as not to restrict the movement of the backrest(s) or arm(s) of the chair.

15.3.2 If adjustable features are available, all adjustments shall be set at normal use conditions.

Note: For chairs with tilt mechanisms that lock, locking the mechanism changes the classification of the chair. (See Section 4). Chairs with tilt mechanisms in an unlocked position shall be tested according to this section and an additional chair shall also be tested according to Section 16. When testing in accordance with Section 16, the chair shall be tested in the upright locked position.

(Continued)

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15 Backrest Durability Test - Cyclic - Type I (Continued)**15.3 Test Setup (Continued)**

- 15.3.3** Determine points 406 mm (16 in.) and 452 mm (17.8 in.) above the seat. Mark these points on the vertical centerline of the backrest.
- a) If the top of the load-bearing structure/surface of the backrest is greater than or equal to 452 mm (17.8 in.) above the seat, position the center of the form-fitting device (See Definition 2.10) 406 mm (16 in.) above the seat. (See Figure 15b).
 - b) If the top of the load-bearing structure/surface of the backrest is less than 452 mm (17.8 in.) above the seat, position the top of the form-fitting device even with the top of the load-bearing structure/surface. (See Figure 15c), or
 - c) If the unit has a pivoting backrest that stops at a position less than or equal to 30 degrees rearward of vertical (with the support structure in its most upright position), position the form-fitting device as directed in a) or b). If the unit has a pivoting backrest that stops at a position greater than 30 degrees rearward of vertical (with the support structure in its most upright position), position the center of the form-fitting device at the height of the pivoting point. (See Figure 15d).
- 15.3.4** Attach a loading device (front push or back pull) to the horizontal center of the backrest as determined above. The force shall be applied $90^\circ \pm 10^\circ$ to the plane of the backrest(s) when at the back stop position. If applying the load with a cable and pulley system, the cable must initially be a minimum of 750mm (30 in.) in length from the attachment point to the pulley. Note: Where the design of the chair does not allow the transfer of force(s) from the loading device to the load-bearing structure/surface, a bridging device not exceeding $89\text{mm} \pm 13\text{mm}$ (3.5 in. \pm 0.5 in.) in height may be used to span the width of the load-bearing structure/surface. The plane of the backrest may be defined by the front of the CMD upright. (See Figure 15a).
- 15.3.5** A weight of 102 kg (225 lb.) shall be secured in the center of the seat.
(See Figure 15d and 15e)
- 15.3.6** The loading device shall be adjusted to apply a 445 N (100 lbf.) total force to the backrest. (See Figure 15e). If the backrest/tilt lock mechanism will not accept the load due to gradual slipping of the adjustment mechanism during the load application, set the backrest to its most rearward (stopped) position, then apply the specified load(s).
- 15.3.7** The loading device shall be set at an appropriate rate between 10 and 30 cycles per minute.

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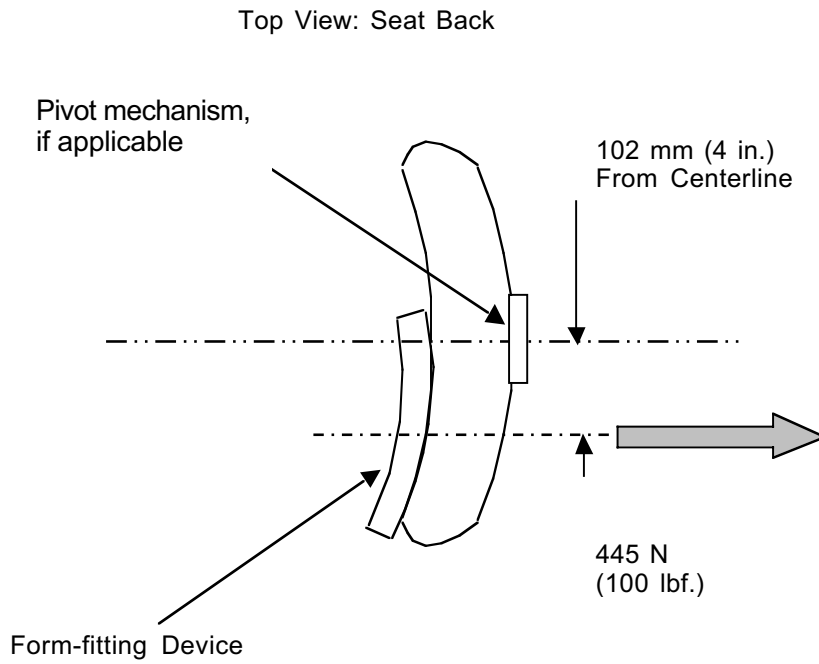


Figure 15f - Off-center Backrest Durability Loading - Left

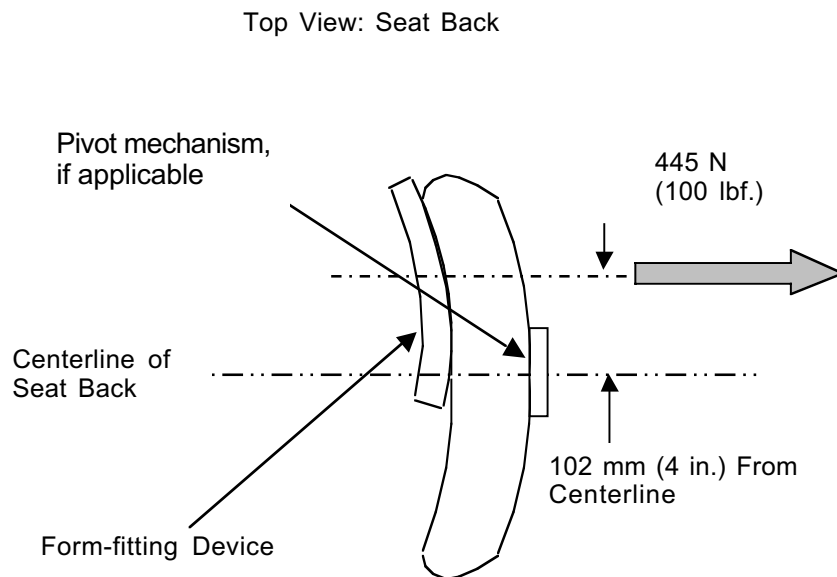


Figure 15g - Off-center Backrest Durability Loading - Right

15 Backrest Durability Test - Cyclic - Type I (Continued)**15.4 Test Procedures**

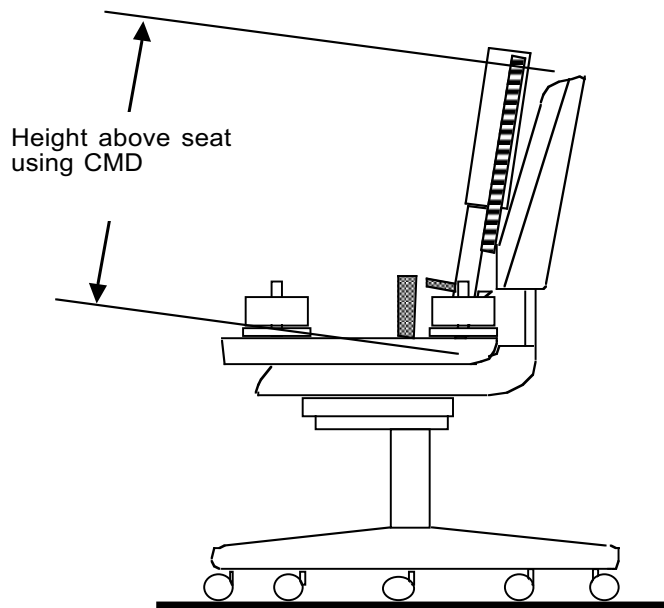
15.4.1 For chairs with backrest widths less than 406 mm (16 in.) at the height of the loading point, apply the load to the backrest for 120,000 cycles.

15.4.2 For chairs with backrest widths greater than 406 mm (16 in.) at the height of the loading point, apply the load to the backrest for 80,000 cycles.

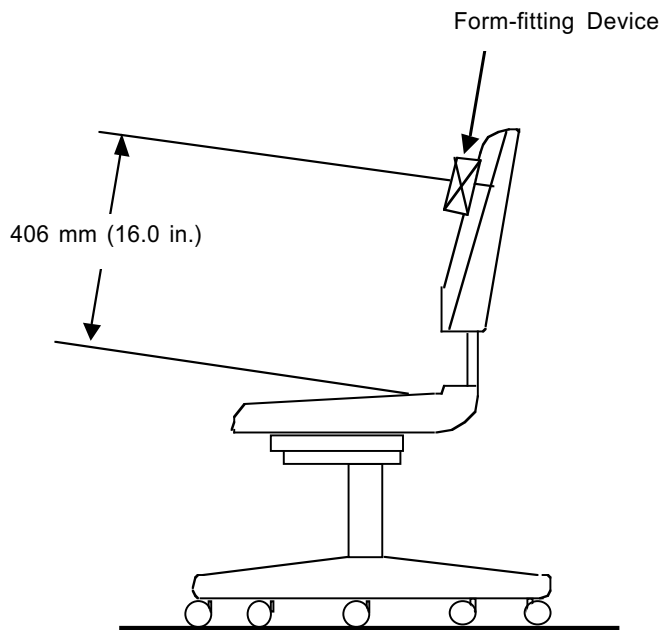
- a) Keeping the load at the height determined above, reposition the load 102 mm (4 in.) to the right of the vertical centerline. The load may be applied through a form-fitting device if necessary. (See Figure 15f and 15g). The force shall be applied $90^\circ \pm 10^\circ$ to the plane of the backrest when at the back stop position. If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley. Apply this load for 20,000 cycles.
- b) Keeping the load at the height determined above, reposition the load 102 mm (4 in.) to the left of the vertical centerline. The load may be applied through a form-fitting device if necessary. (See Figure 15f and 15g). The force shall be applied $90^\circ \pm 10^\circ$ to the plane of the backrest when at the back stop position. If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley. Apply this load for 20,000 cycles.

15.5 Acceptance Level

There shall be no loss of serviceability.



**Figure 16a - Test Height Determination
Backrest Durability Test - Type II and III**



**Figure 16b - Positioning of Form-Fitting Device for Backrests Higher than 452 mm
(17.8 in.) Backrest Durability Test - Type II and III**

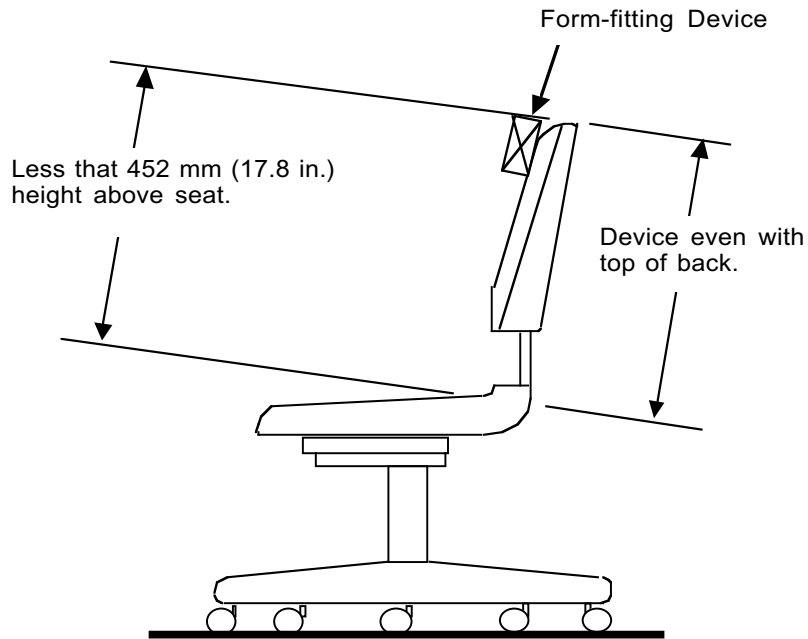


Figure 16c - Positioning of Form-Fitting Device for Backrests Lower than 452 mm (17.8 in.) Backrest Durability Test - Type II and III

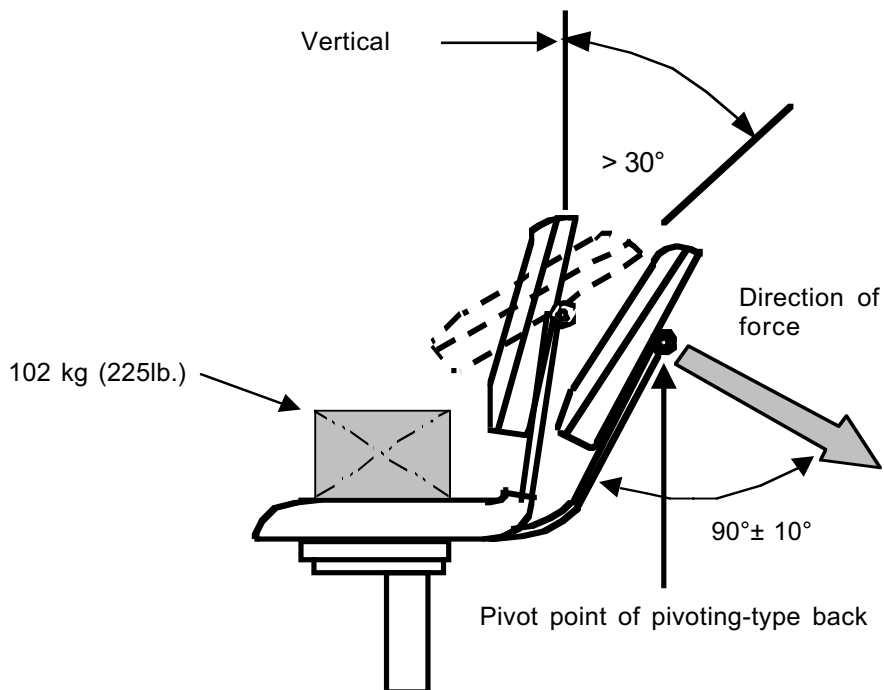
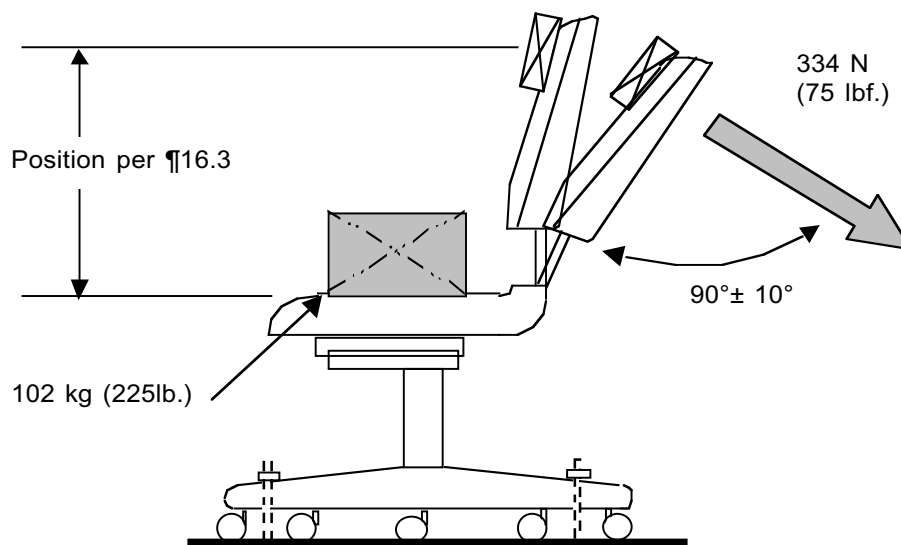


Figure 16d - Force Application for Backrests that Pivot Greater than 30° Backrest Durability Test – Cyclic – Type II and III



**Figure 16e - Force Application for All Other Backrests
Backrest Durability Test – Cyclic -- Type II and III**

16 Backrest Durability Test - Cyclic - Type II and III (See Figures 16a through 16g)**16.1 Applicability**

This test shall be performed on Type II and III chairs.

16.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chairs to withstand fatigue stresses and wear caused by rearward force on the backrest of the chair.

16.3 Test Setup

16.3.1 The chair shall be placed on a test platform in an upright position with the base/legs restrained from movement. If pushing on the backrest with the test device, the chair must be restricted from rotating. Clamping shall be done so as not to restrict the movement of the backrest(s) or arm(s) of the chair.

16.3.2 If adjustable features are available, all adjustments shall be set at normal use conditions.

16.3.3 Determine points 406 mm (16 in.) and 452 mm (17.8 in.) above the seat. Mark these points on the vertical centerline of the backrest.

- a) If the top of the load-bearing structure/surface of the backrest is greater than or equal to 452 mm (17.8 in.) above the seat, position the center of the form-fitting device (See Definition 2.10) 406 mm (16 in.) above the seat. (See Figure 16b).
- b) If the top of the load-bearing structure/surface of the backrest is less than 452 mm (17.8 in.) above the seat, position the top of the form-fitting device even with the top of the load-bearing structure/surface. (See Figure 16c).
- c) If the unit has a pivoting backrest that stops at a position less than or equal to 30 degrees rearward of vertical (with the support structure in its most upright position), position the form-fitting device as directed in a) or b). If the unit has a pivoting backrest that stops at a position greater than 30 degrees rearward of vertical (with the support structure in its most upright position), position the center of the form-fitting device at the height of the pivoting point. (See Figure 16d).

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16 Backrest Durability Test - Cyclic - Type II and III (Continued)

16.3 Test Setup (Continued)

- 16.3.4** Attach a loading device (front push or back pull) to the horizontal center of the backrest as determined above. The force shall be applied $90^\circ \pm 10^\circ$ to the plane of the backrest(s) when at the back stop position. If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley. Note: Where the design of the chair does not allow the transfer of force(s) from the loading device to the load-bearing structure/surface, a bridging device not exceeding $89 \text{ mm} \pm 13 \text{ mm}$ (3.5 in. \pm 0.5 in.) in height may be used to span the width of the load-bearing structure/surface. The plane of the backrest may be defined by the front of the CMD upright. (See Figure 16a).
- 16.3.5** A weight of 102kg (225 lb.) shall be secured in the center of the seat. (See Figure 16d and 16e)
- 16.3.6** The loading device shall be adjusted to apply a 334 N (75 lbf.) total force to the backrest.
- 16.3.7** The loading device shall be set at an appropriate rate between 10 and 30 cycles per minute.

(Continued)

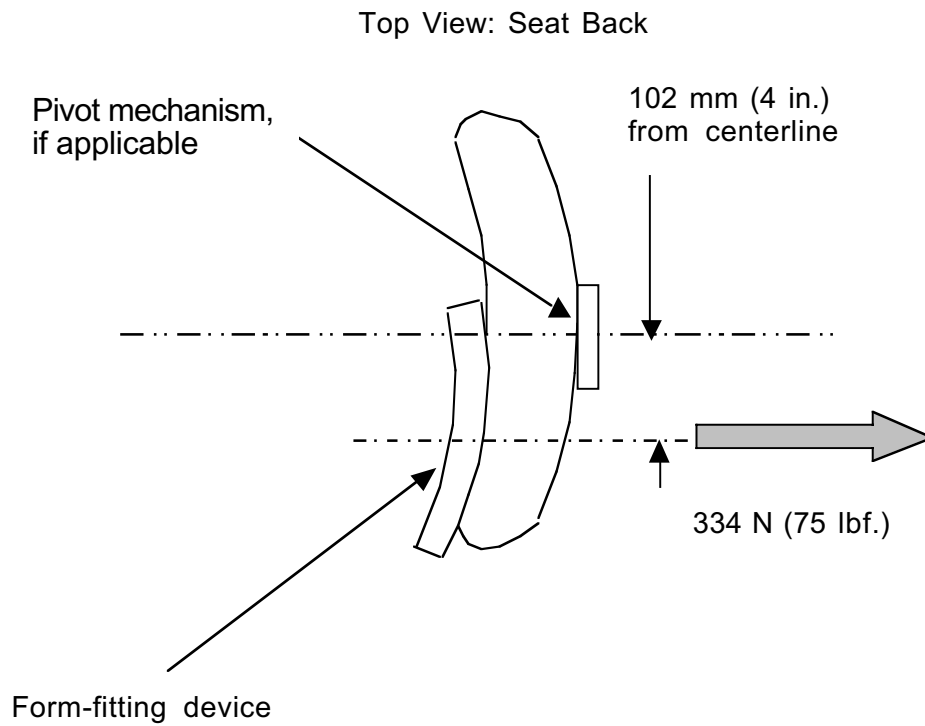


Figure 16f - Off-center Backrest Durability Loading – Left

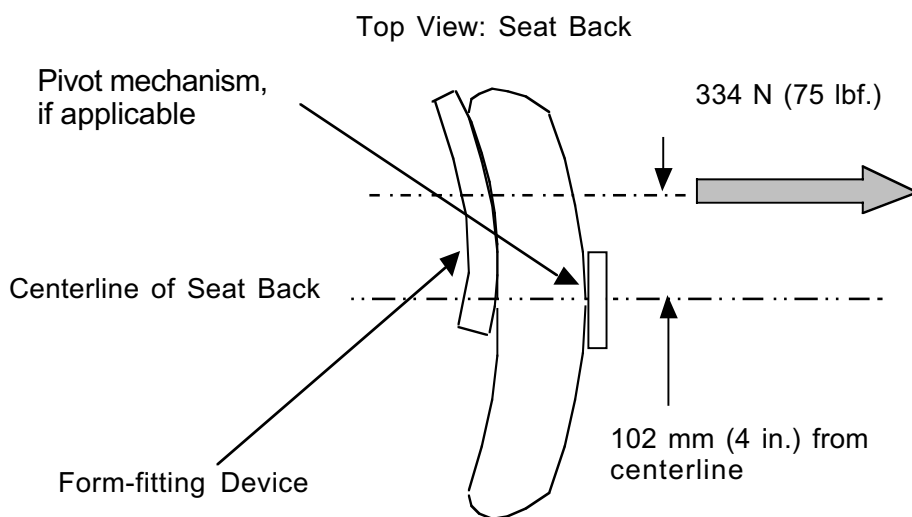


Figure 16g - Off-center Backrest Durability Loading - Right

16 Backrest Durability Test - Cyclic - Type II and III (Continued)**16.4 Test Procedures**

16.4.1 For chairs with backrest widths less than 406 mm (16 in.) at the height of the loading point, apply the load to the backrest for 120,000 cycles.

16.4.2 For chairs with backrest widths greater than 406 mm (16 in.) at the height of the loading point, apply the load to the backrest for 80,000 cycles.

- a) Keeping the load at the height determined above, reposition the load 102 mm (4 in.) to the right of the vertical centerline. The load may be applied through a form-fitting device if necessary. (See Figure 16f and 16g). The force shall be applied $90^\circ \pm 10^\circ$ to the plane of the backrest when at the back stop position. If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley. Apply this load for 20,000 cycles.
- b) Keeping the load at the height determined above, reposition the load 102 mm (4 in.) to the left of the vertical centerline. The load may be applied through a form-fitting device if necessary. (See Figure 16f and 16g). The force shall be applied $90^\circ \pm 10^\circ$ to the plane of the backrest when at the back stop position. If applying the load with a cable and pulley system, the cable must initially be a minimum of 750 mm (30 in.) in length from the attachment point to the pulley. Apply this load for 20,000 cycles.

16.5 Acceptance Level

There shall be no loss of serviceability.

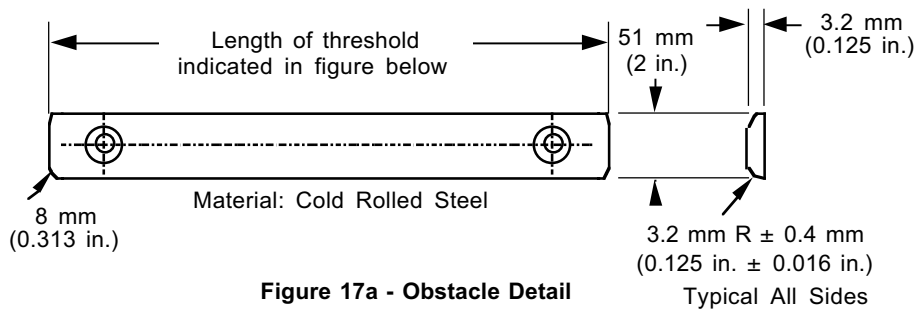


Figure 17a - Obstacle Detail

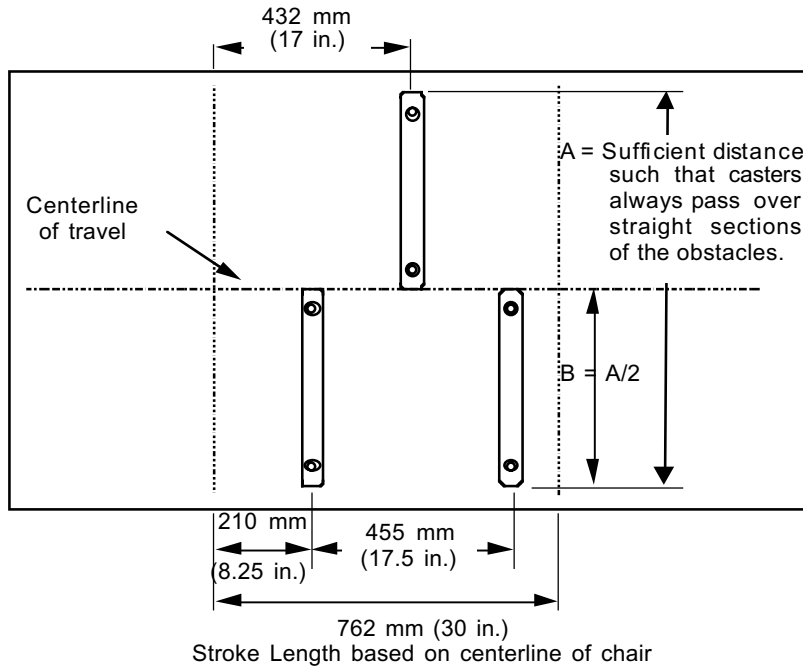


Figure 17b - Obstacle Layout for Pedestal Base Chairs

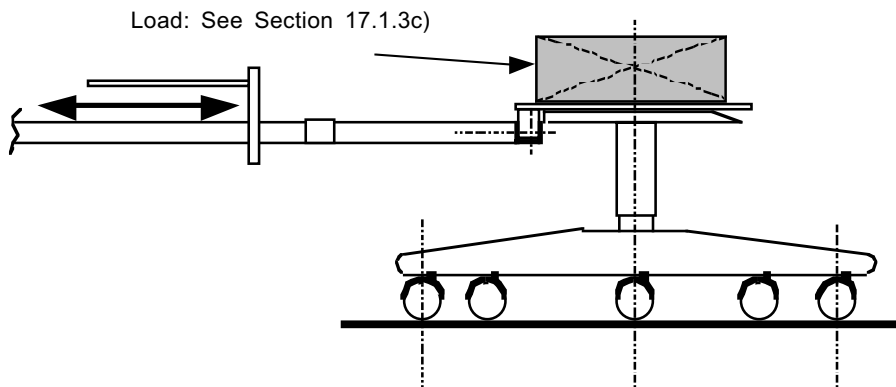


Figure 17c - Machine Schematic for Pedestal Base Chairs

Figures 17a through 17c - Caster/Chair Base Durability Test - Cyclic

17 Caster/Chair Base Durability Test - Cyclic (See Figures 17a through 17e)**17.1 Caster/Chair Base Durability Test for Pedestal Base Chairs****17.1.1 Applicability**

This test applies to pedestal base chairs with casters.

17.1.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chair base and casters to withstand fatigue stresses and wear caused by moving the chair back and forth.

17.1.3 Test Setup

- a) The chair, or chair base with casters, shall be attached to a cycling device similar to Figure 17c.
- b) The chair shall be cycled on a smooth hard surface with three obstacles as shown in Figure 17a in accordance with the obstacle layout as shown in Figure 17b.
- c) If a complete chair is to be tested, place a 102 kg (225 lb.) load on the seat of the chair. If a fixture is used, the weight of the test assembly (base assembly, fixture and weights) shall be equivalent to 102 kg (225 lb.) plus the weight of the chair in its fully assembled configuration. (See Figure 17c). The base and casters shall be free to rotate and swivel.
- d) The stroke of the cycling device shall be adjusted to ensure a minimum of 762 mm (30 in.) of travel. The stroke shall be oriented so the casters roll across the test platform and obstacles as shown in Figure 17b.
- e) The cycling device shall be operated at a rate of 10 ± 2 cycles per minute. One cycle shall consist of a forward and backward stroke of the cycling device.

17.1.4 Test Procedure

- a) The chair or chair base shall be cycled 2,000 cycles over the obstacles as shown in Figure 17b and then 98,000 cycles on a smooth, hard surface without obstacles.
- b) Evaluate the product in accordance with the acceptance level in 17.1.5.1.
- c) At the conclusion of cycling, a 22 N (5 lbf.) pull force shall be applied to each caster in line with the caster stem centerline.
- d) Evaluate the product in accordance with the acceptance level in 17.1.5.2.

17.1.5 Acceptance Level**17.1.5.1 Durability cycling**

There shall be no loss of serviceability.

17.1.5.2 Caster Retention

The caster shall not separate from the base as a result of the application of the 22 N (5 lbf.) force.

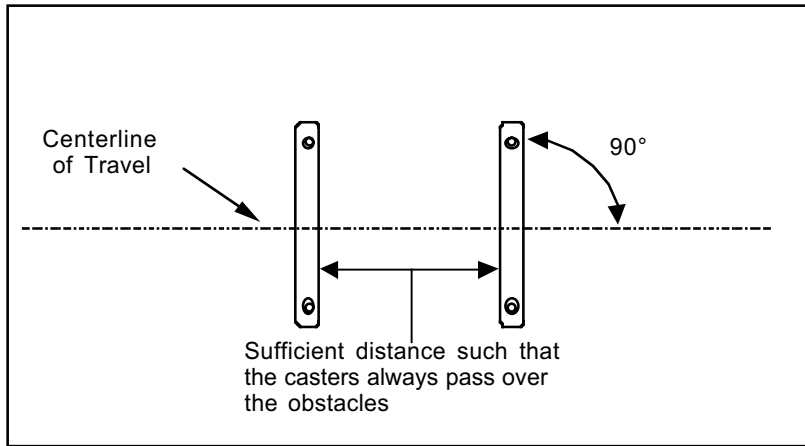


Figure 17d - Obstacle Layout for Chairs with Legs

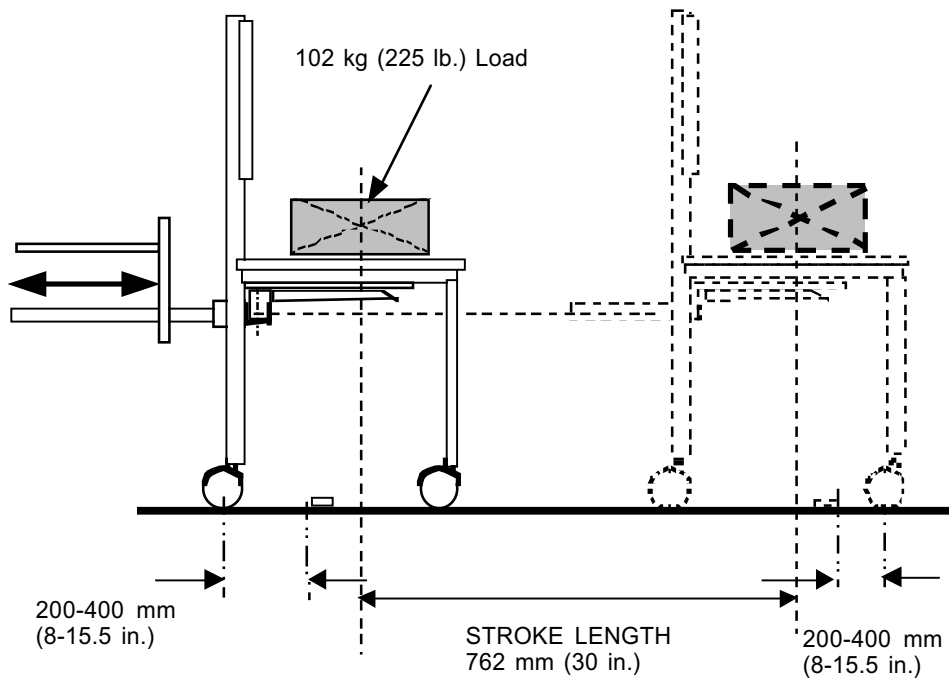


Figure 17e - Machine Schematic for Chairs with Legs

Figure 17d & 17e Caster/Chair Base Durability Test - Cyclic Obstacle Layout and Machine Stroke

17 Caster/Chair Base Durability Test - Cyclic (Continued)**17.2 Caster/Chair Frame Durability Test for Chairs with Legs****17.2.1 Applicability**

This test applies to chairs with legs and casters.

17.2.2 Purpose of Test

The purpose of this test is to evaluate the ability of the chair frame and casters to withstand fatigue stresses and wear caused by moving the chair back and forth.

17.2.3 Test Setup

- a) The chair, or chair frame with casters, shall be attached to a cycling device similar to Figure 17e.
- b) The chair shall be cycled on a smooth hard surface with two obstacle layout as shown in Figure 17d and 17e in accordance with the obstacle detail as shown in Figure 17a.
- c) Place a 102 kg (225 lb.) on the seat of the chair or chair base. The casters shall be free to rotate and swivel.
- d) The stroke of the cycling device shall be adjusted to ensure a minimum of 762 mm (30 in.) of travel. The stroke shall be set and the obstacles shall be oriented such that the casters roll across the test platform and obstacles, and that each caster travels beyond the obstacle by 200 to 400 mm (8 to 15.5 in.) in each direction as shown in Figure 17e.
- e) The cycling device shall be operated at a rate of 10 ± 2 cycles per minute. One cycle shall consist of a forward and backward stroke of the cycling device.

17.2.4 Test Procedure

- a) The chair or chair base shall be cycled for 2,000 cycles over the obstacles as shown in Figures 17d and 17e and then 98,000 cycles on a smooth hard surface without obstacles.
- b) Evaluate the product in accordance with the acceptance level in 17.2.5.1.
- c) At the conclusion of cycling, a 22 N (5 lbf.) pull force shall be applied to each caster in line with the caster stem centerline.
- d) Evaluate the product in accordance with the acceptance level in 17.2.5.2.

17.2.5 Acceptance Level**17.2.5.1 Durability cycling**

There shall be no loss of serviceability.

17.2.5.2 Caster Retention

No part of the caster shall separate from the base as a result of the application of the 22 N (5 lbf.) force.

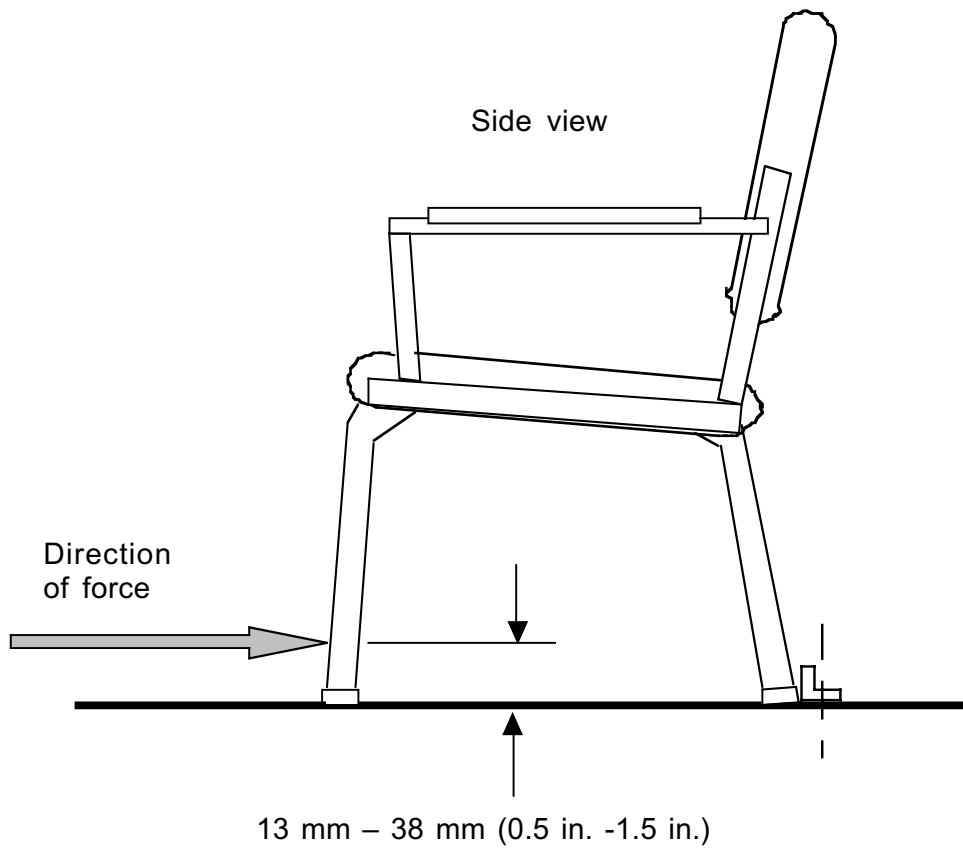


Figure 18a - Leg Strength Test – Front Application

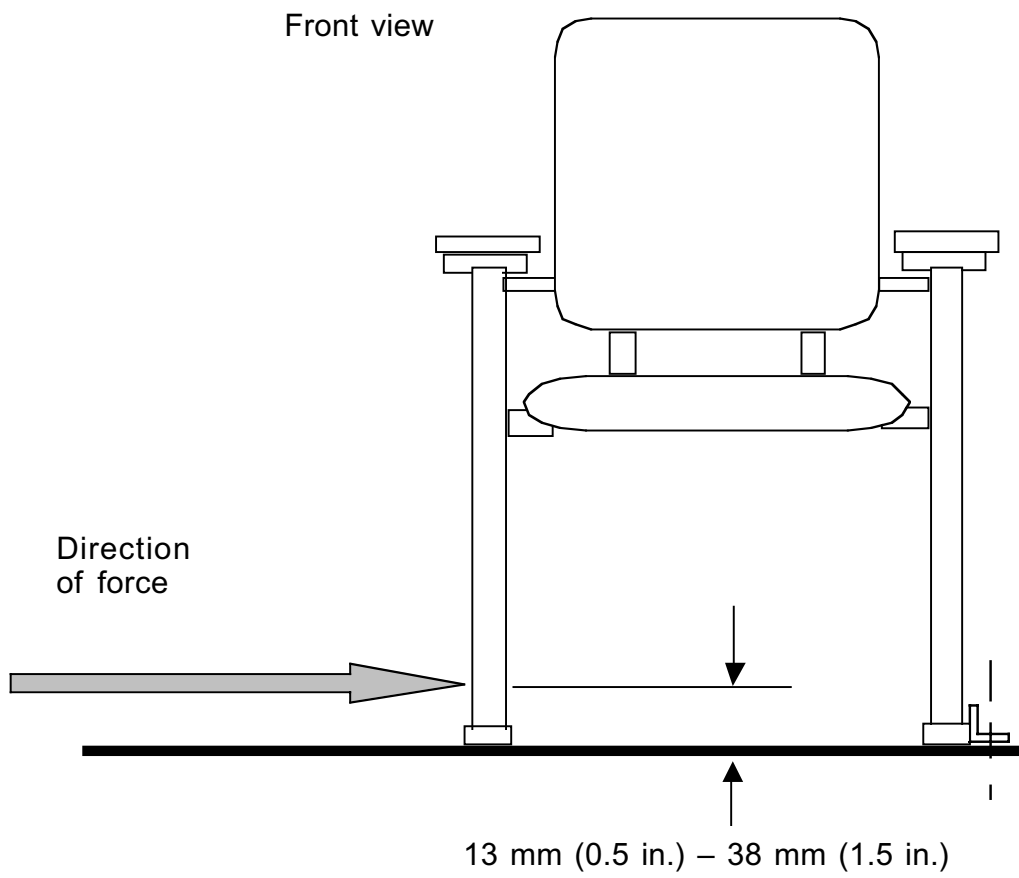


Figure 18b - Leg Strength Test - Side Application - Static

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18 Leg Strength Test - Front and Side Application (See Figure 18a & 18b)

18.1 Applicability

This test applies to all chairs without pedestal bases.

18.2 Purpose of Test

The purpose of this test is to evaluate the ability of legs to withstand horizontal side and frontal forces.

18.3 Front Load Test

18.3.1 Test Setup

- a) The chair shall be placed on a test platform, with the back legs restrained. Figure 18a shows one acceptable method of restraining the chair.
- b) If adjustable features are available, all adjustments shall be set at normal use conditions.
- c) The loading device shall be attached to the chair so that an initially horizontal force is applied inward and parallel to the front-to-rear axis of the chair, between 13 mm (0.5 in.) and 38 mm (1.5 in.) from the bottom of a leg as shown in Figure 18a. The load shall be applied to the apparent weakest point of the leg. Where the apparent weakest point is the left or right edge of the leg, apply the load so that it is no greater than 25 mm (1.0 in.) from the edge.

18.3.2 Test Procedures

18.3.2.1 Functional Load Test

- a) A force of 334 N (75 lbf.) shall be applied once to each front leg individually for one (1) minute.
- b) Remove the force and evaluate the product in accordance with the acceptance level in 18.5.1.

18.3.2.2 Proof Load Test

- a) A force of 556 N (125 lbf.) shall be applied once to each front leg individually for one (1) minute.
- b) Remove the force and evaluate the product in accordance with the acceptance level in Section 18.5.2.

18 Leg Strength Test - Front and Side Application (Continued)**18.4 Side Load Test**

Note: A separate chair may be used for the side load portion of the test.

18.4.1 Test Setup

- a) The chair shall be placed on a test platform, with the side leg(s) restrained. Figure 18b shows one acceptable method of restraining the chair.
- b) If adjustable features are available, all adjustments shall be set at normal use conditions.
- c) The loading device shall be attached to the chair so that an initially horizontal force is applied inward and parallel to the side-to-side axis of the chair, between 13 mm (0.5 in.) and 38 mm (1.5 in.) from the bottom of a leg as shown in Figure 18b. The load shall be applied to the apparent weakest point (front-to-back) of the leg. Where the apparent weakest point is the front or rear edge of the leg, apply the load so that it is no greater than 25 mm (1.0 in.) from the edge.

18.4.2 Test Procedure**18.4.2.1 Functional Load Test**

- a) A force of 334 N (75 lbf.) shall be applied once to a front and rear leg individually for one (1) minute.
- b) Remove the force and evaluate the product in accordance with the acceptance level in 18.5.1.

18.4.2.2 Proof Load Test

- a) A force of 512 N (115 lbf.) shall be applied once to a front and rear leg individually for one (1) minute.
- b) Remove the force and evaluate the product in accordance with the acceptance level in 18.5.2.

18.5 Acceptance Level - Front and Side Load Tests**18.5.1 Functional Load**

Functional load(s) applied once in each direction shall cause no loss of serviceability.

18.5.2 Proof Load

Proof load(s) applied once each direction shall cause no sudden and major change in the structural integrity of the chair. Loss of serviceability is acceptable.

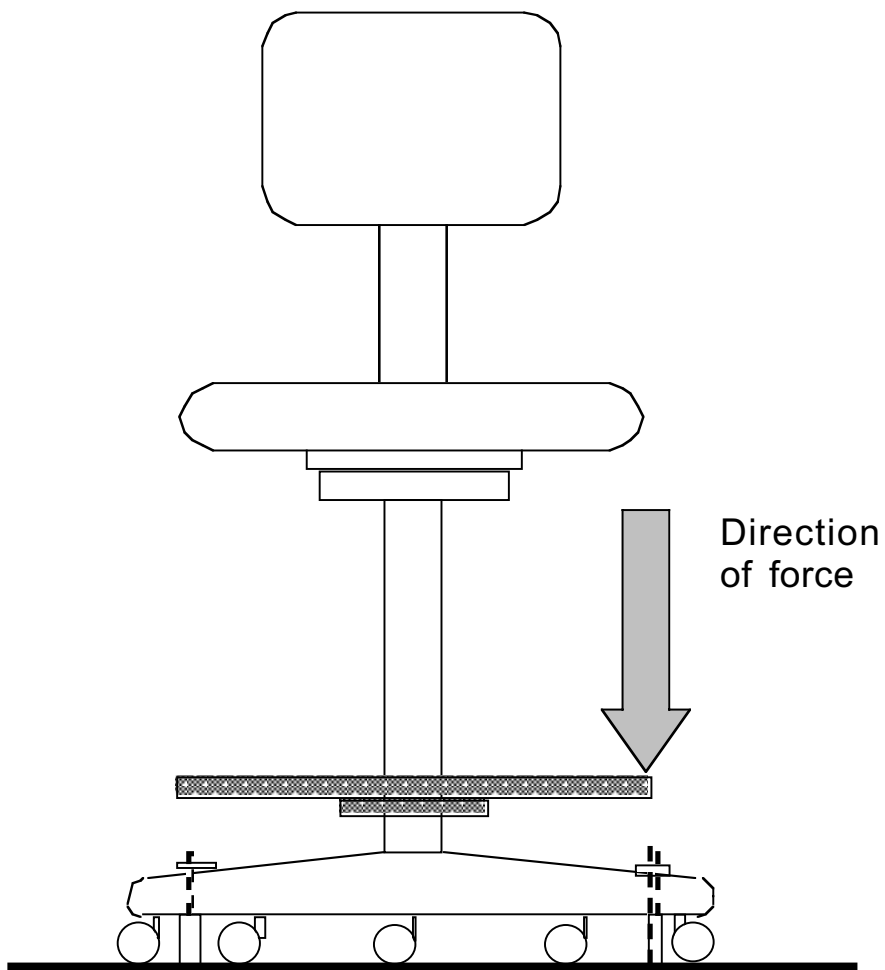


Figure 19 - Footrest Durability Test - Vertical - Cyclic

19 Footrest Durability Test - Vertical - Cyclic (See Figure 19)

19.1 Applicability

The footrest durability test shall be performed on all chairs with a footrest feature.

19.2 Purpose of Test

The purpose of this test is to evaluate the ability of the footrest structure to withstand stresses that occur as a result of repetitive loading that can be imposed on the footrest structure.

19.3 Test Set Up

- a) The chair shall be placed on a test platform and restrained as shown in Figure 19.
- b) On chairs with adjustable features, all adjustments shall be set at normal use position. The seat and upper structure shall be restrained as necessary to prevent rotation during the test. Chair cushions and/or other components not related to the structure of the footrest may be removed to facilitate load application. Note: this test is not intended to evaluate the performance of casters or glides. Casters may be removed, left in place or replaced by spacers to provide clearance if necessary.

19.4 Test Procedure

- a) A 890 N (200 lbf.) force shall be applied uniformly along a 102 mm (4 in.) length of the footrest at the apparent weakest point of the structure.
- b) The force shall be applied and removed 50,000 cycles at a rate between 10 and 30 cycles per minute.

19.5 Acceptance level

There shall be no loss of serviceability.

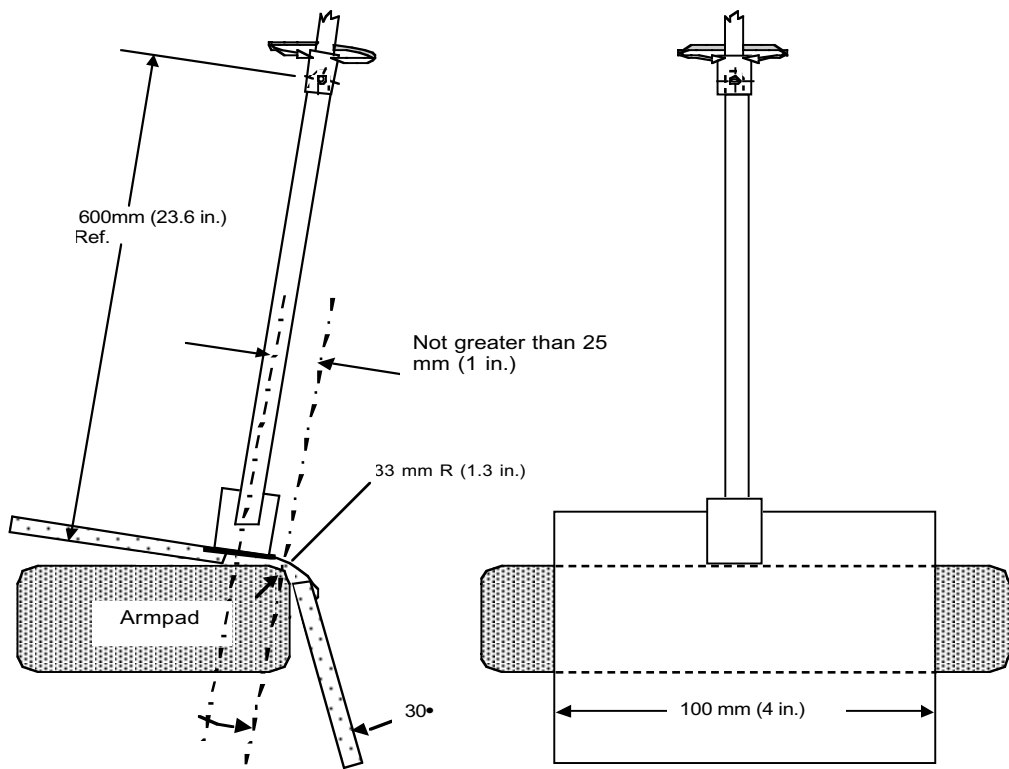


Figure 20a- Arm Loading Device

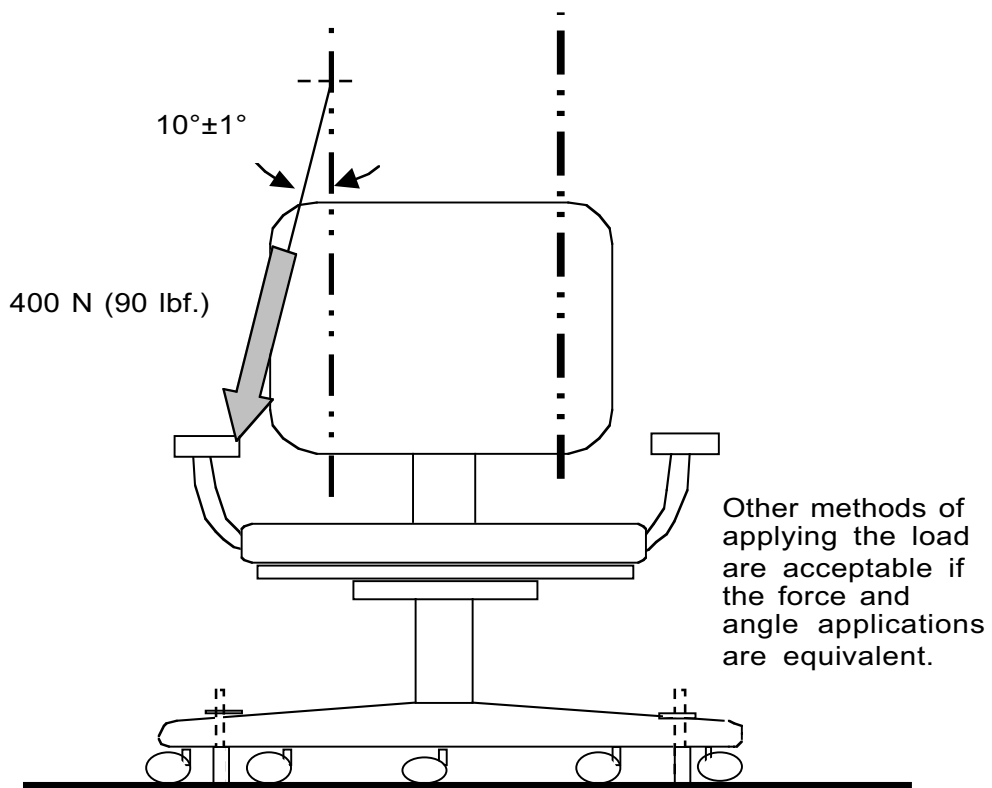


Figure 20b - Arm Durability Test - Cyclic

20 Arm Durability Test - Cyclic (Figure 20a and 20b)

20.1 Purpose of test

The purpose of this test is to evaluate the ability of the chair armrests to withstand stresses that occur as a result of repetitive loading that can be imposed on the armrest structure. Loading of this type is the result of using the armrests as a support when getting out of the chair.

20.2 Test setup

- a) The chair shall be placed on a test platform in an upright position as shown in Figure 20b. If necessary, the seat may be restrained from rotational movement. Clamping shall be done in such a manner as not to restrict the arms of the unit.
- b) Height-adjustable arms must be set at the apparent weakest position. When the weakest position is not obvious, several load applications positions may be necessary to properly test the product.
- c) Width-adjustable arms must be set at the apparent weakest position.
- d) Unrestrained pivoting armrests (i.e. the armrest cap pivots freely) shall be loaded in line with the pivot point.
- e) The arm loading device should distribute the load over a length of 100 mm (4 in.) on the arm pad. Center of load shall not be applied more than 25 mm (1.0 in.) in from the inside edge of the arm pad. One suggested arm loading device is shown in Figure 20a. Position the arm loading device on the armrest structure at its apparent weakest point consistent with using the armrest as a support for exiting the chair.

20.3 Test procedure

Simultaneously apply a force of 400 N (90 lbf.) to each arm initially at a $10^{\circ} \pm 1^{\circ}$ angle as shown in Figure 20b. If using a test device similar to that shown in Figure 20b, the load application distance must initially be the length specified in the figure. Other methods of applying the load are acceptable if the force and angle applications are equivalent. The arm loading device must follow the arm as it deflects or pivots. The force shall be applied and removed for 60,000 cycles at an appropriate rate between 10 and 30 cycles per minute.

20.4 Acceptance level

Structural breakage or loss of serviceability shall constitute failure.

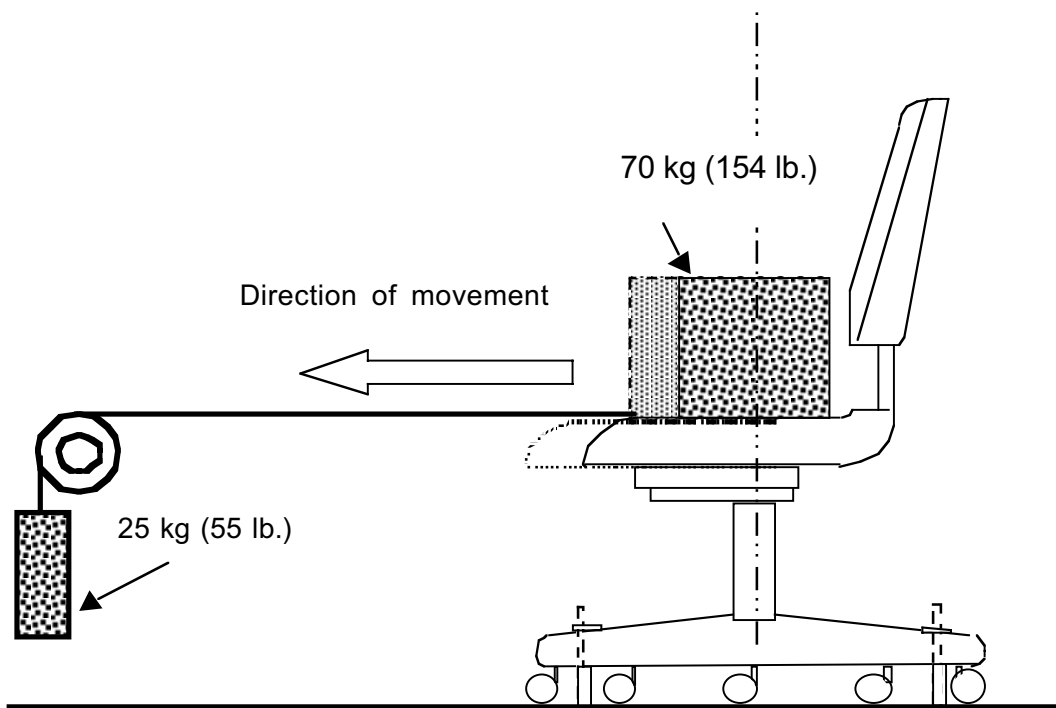


Figure 21 - Out Stop Test for Chairs with Manually Adjustable Seat Depth

21 Out Stop Tests for Chairs with Manually Adjustable Seat Depth (See Figure 21)**21.1 Purpose of Test**

The purpose of this test is to evaluate the ability of the seat slide out stops to withstand excessive impact forces that may result from user adjustment of the seat depth. Note: this test does not apply to chairs where seat depth adjustments must occur with the user out of the chair.

21.2 Test Setup

- a) The chair shall be placed on a test platform and restrained to prevent it from moving. The method of securing shall not interfere with the operation of the seat slide being tested. For chairs with an adjustable seat angle, set the angle to its most forward (negative seat slope) angle. Disable any seat depth adjustment locks or interim stops.
- b) A stranded metallic cable or equivalent shall be attached to the most rigid point of the vertical centerline of the seat. This may be accomplished by means of a clamp or similar device that does not affect the test results.
- c) The opposite end of the cable shall extend in line forward from the seat and in line with the plane of the seat movement to a pulley and then downward to an attached weight of 25 kg (55 lb.). Place the seat in its most rearward position and restrain.
- d) Place a 70 kg (154 lb.) rigid mass in the center of the seat.

21.3 Test Procedure

The seat with the hanging weight shall be held at its most rearward position, then released, permitting it to move forward rapidly and impact the out stops. Repeat this procedure for a total of 25 cycles.

21.4 Acceptance Level

There shall be no loss of serviceability to the unit.

Location of the 203 mm
(8 in.) disk

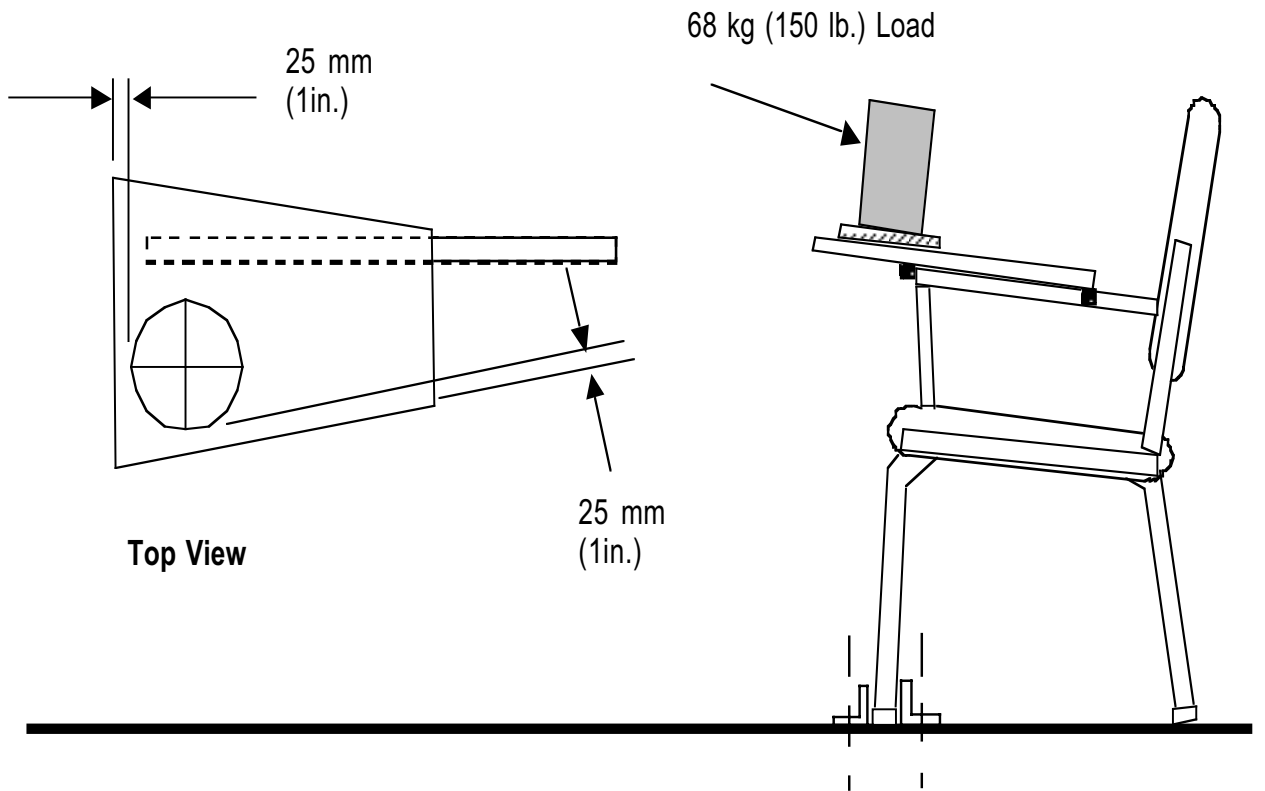


Figure 22 - Tablet Arm Test - Static

22 Tablet Arm Static Load Test (See Figure 22)**22.1 Applicability**

This test shall be performed on all units that come equipped with tablet arms to be used as an auxiliary writing surface.

22.2 Purpose of Test

The purpose of this test is to evaluate the ability of the unit equipped with a tablet arm or other attached auxiliary writing surface to withstand stresses caused by vertical loading.

22.3 Test Setup

- a) The unit shall be placed on a test platform and restrained to prevent movement. Any height adjustment of the chair and/or tablet arm shall be set at the midpoint of adjustment.
- b) Apply the load through a 203 mm \pm 13 mm (8.0 in. \pm 0.51 in.) diameter area 25 mm (1 in.) from the edge of the surface at its apparent weakest point. When the weakest point is not obvious, several load applications may be necessary to properly test the product.

22.4 Test Procedure

Apply a load of 68 kg. (150 lb.) at the location described in 22.3 b) for five (5) minutes and remove the load.

22.5 Acceptance Level

The load applied once shall cause no sudden and major change in the structural integrity of the chair. After performing the test, the tablet arm must allow egress from the unit; other losses of serviceability are acceptable.

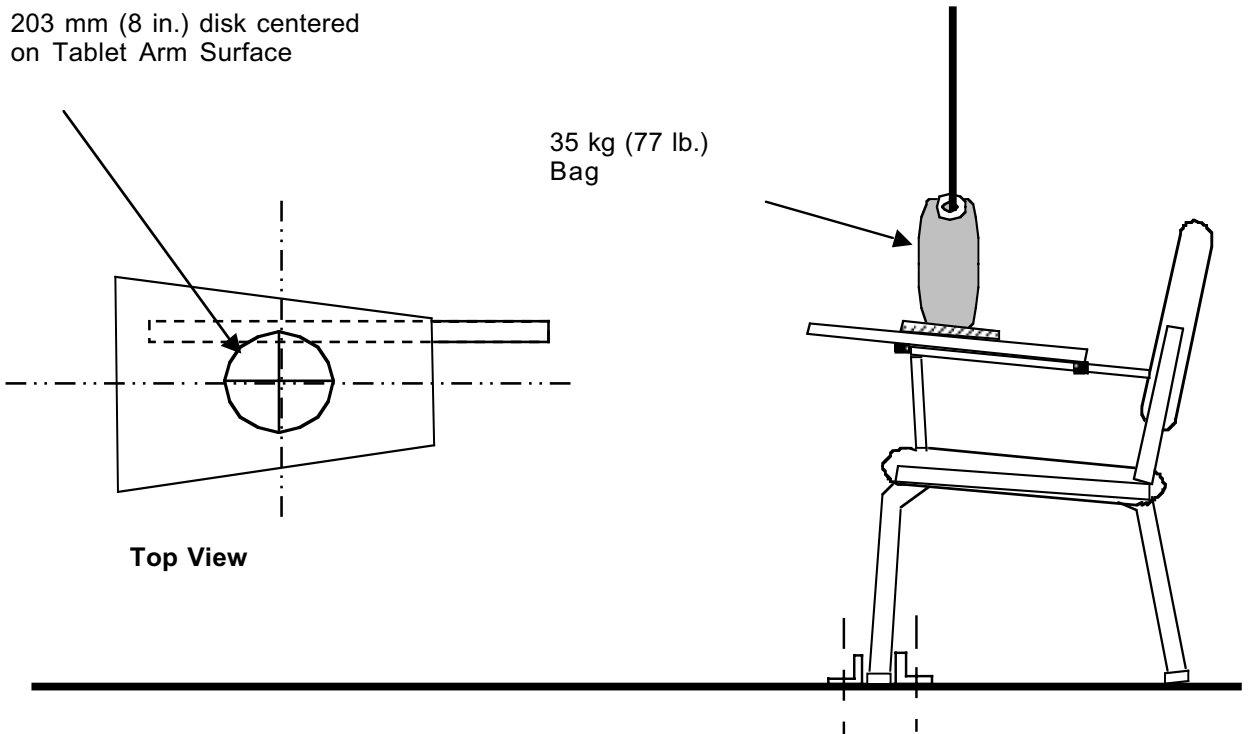


Figure 23 - Tablet Arm Load Ease Test – Cyclic

23 Tablet Arm Load Ease Test - Cyclic (See Figure 23)**23.1 Purpose of Test**

The purpose of this test is to evaluate the durability of the tablet arm chair to withstand cyclic loading of the Tablet.

23.2 Test Setup

- a) The unit shall be leveled in its normal operating position. The unit shall be placed on a test platform and restrained to prevent movement. Any height adjustment of the chair and/or tablet arm shall be set at the midpoint of adjustment.
- b) A 35 kg (77 lb.) weight applied by means of a 203 mm \pm 13 mm (8.0 in. \pm 0.51 in.) diameter bag shall be centered on the writing area of the tablet.
- c) The cycling device shall be set to operate at a rate of 14 \pm 6 cycles per minute.

23.3 Test Procedure

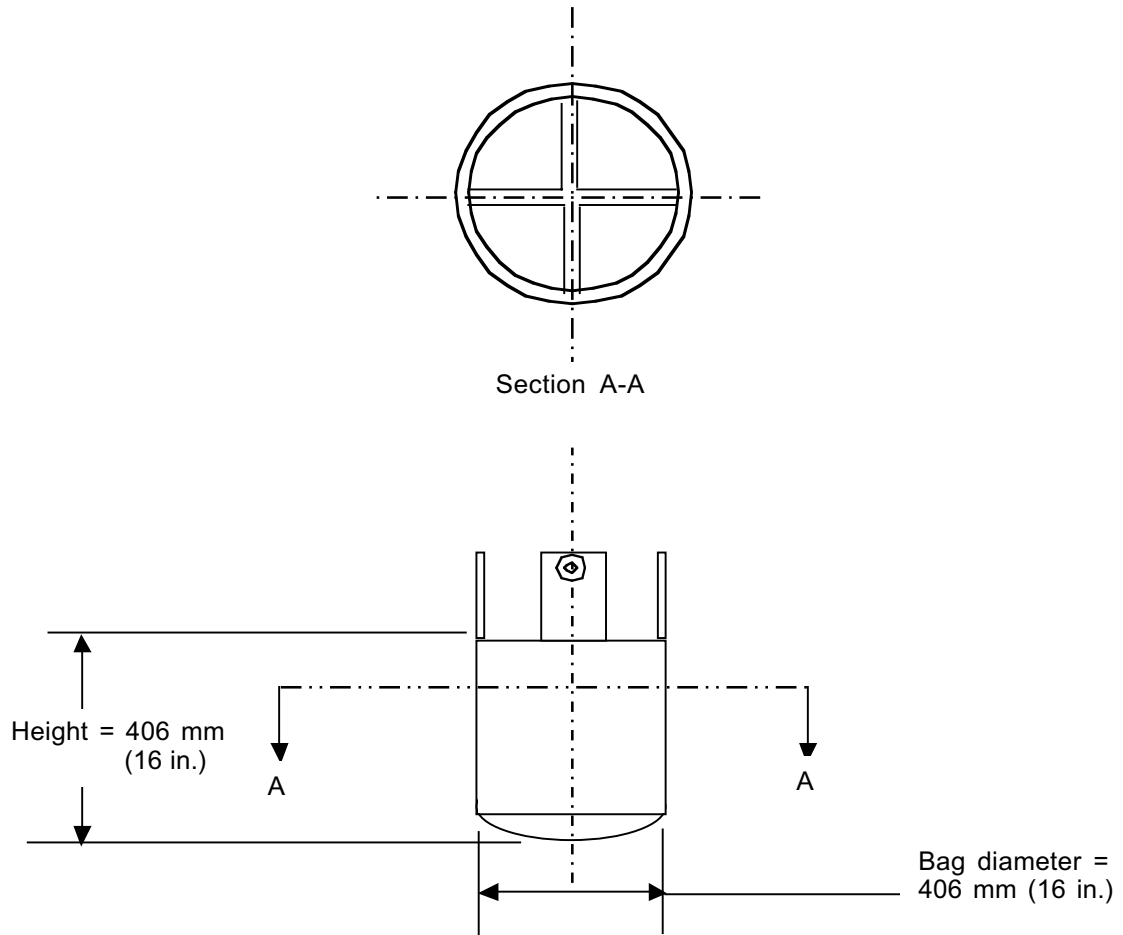
- a) The bag shall be raised until the entire weight is off the tablet surface and then eased (without impact) onto the surface, so that it takes the entire weight without any support from the cycling device.
- b) Repeat Step (a) for a total of 100,000 cycles.

23.4 Acceptance Level

There shall be no loss of serviceability to the unit.

Appendix A --- Impact Test Bag Construction

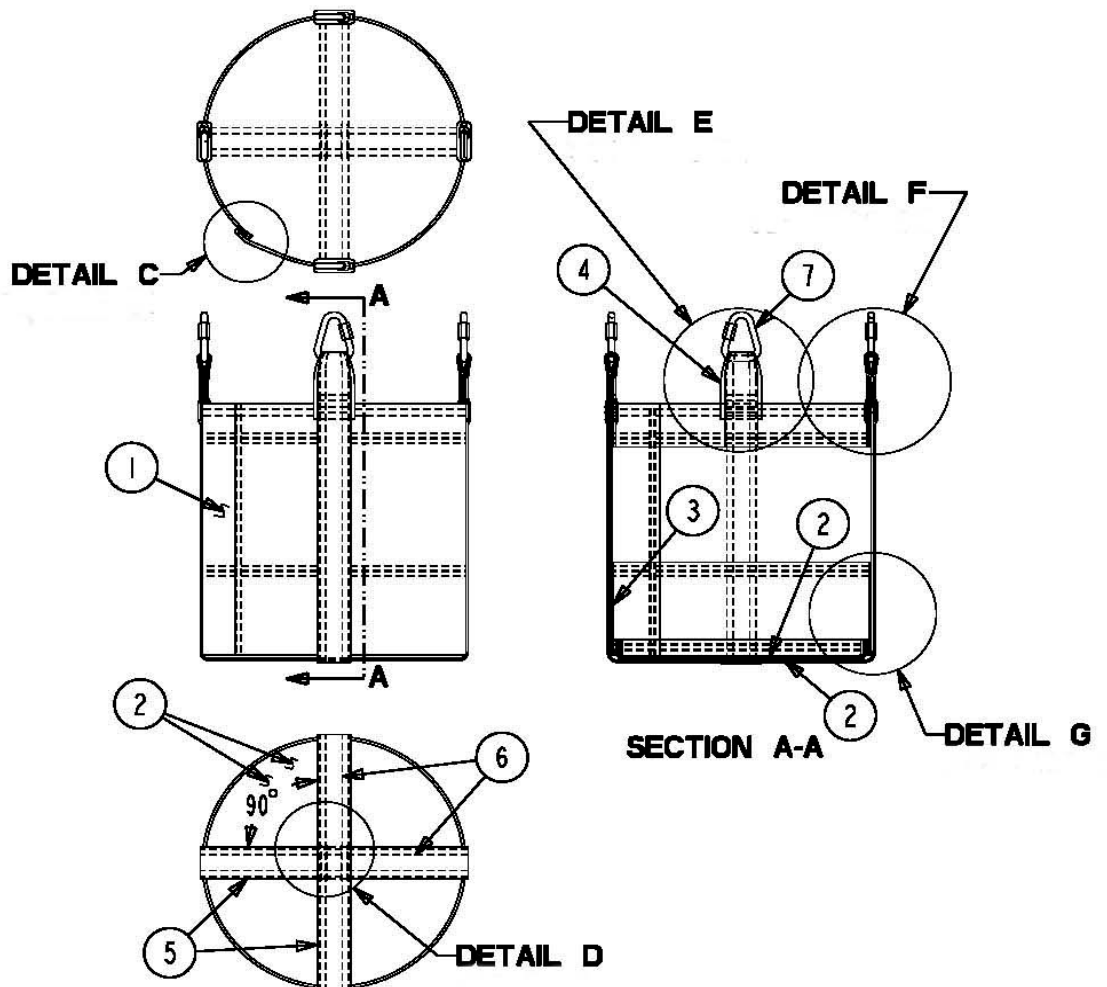
Example: 406 mm (16 in.) diameter bag



Appendix A (Continued) – Impact Test Bag – Typical Construction

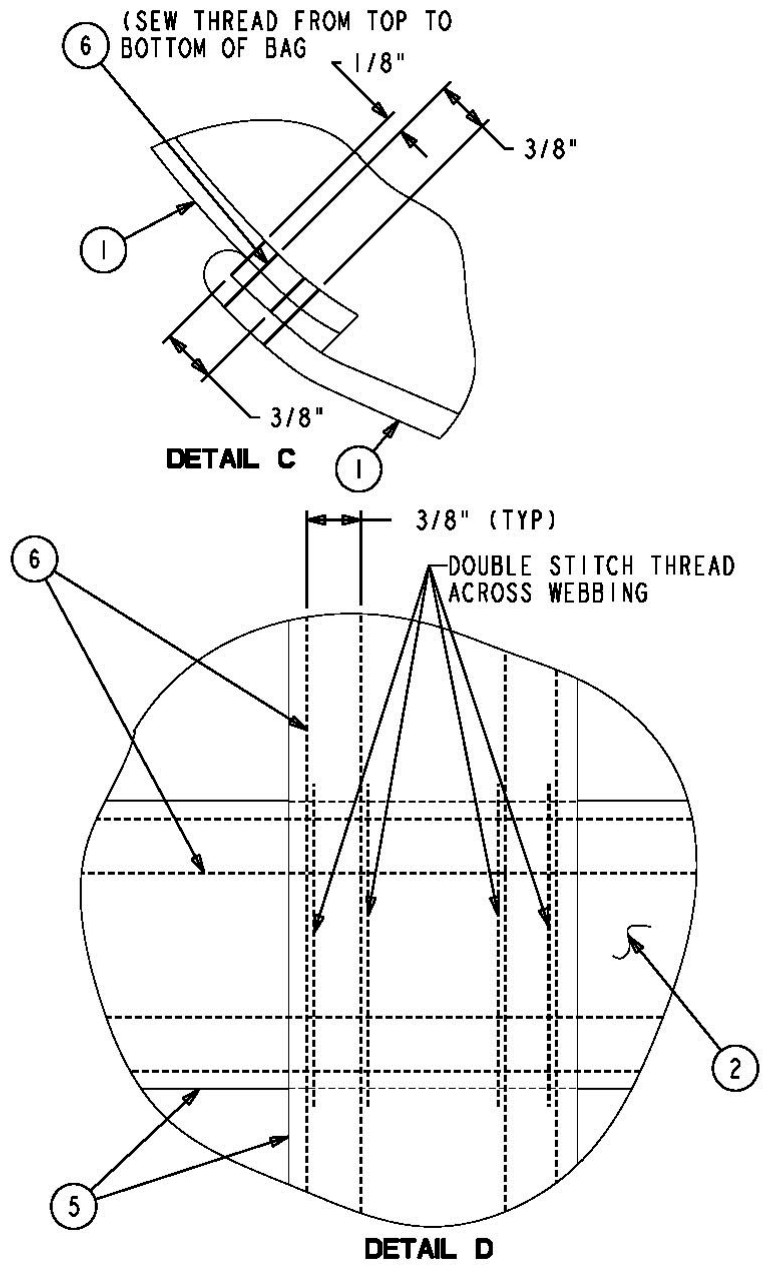
DROP BAG

DET NO	DESCRIPTION	MATERIAL	QTY
1	SIDE PANEL	22 OZ. VINYL COATED POLYESTER	1
2	BOTTOM PANEL	22 OZ. VINYL COATED POLYESTER	2
3	INSIDE PANEL	22 OZ. VINYL COATED POLYESTER	1
4	REINFORCEMENT	22 OZ. VINYL COATED POLYESTER	4
5	WEBBING	2" WIDE POLYESTER, ABRASION GRADE, TENSILE STRENGTH OF 2900 LBS.	2
6	THREAD	POLYESTER #305	X
7	STEEL RINGS	3/8" DIA. STOCK x 2-3/8" WIDE x 3-1/8" HIGH	4

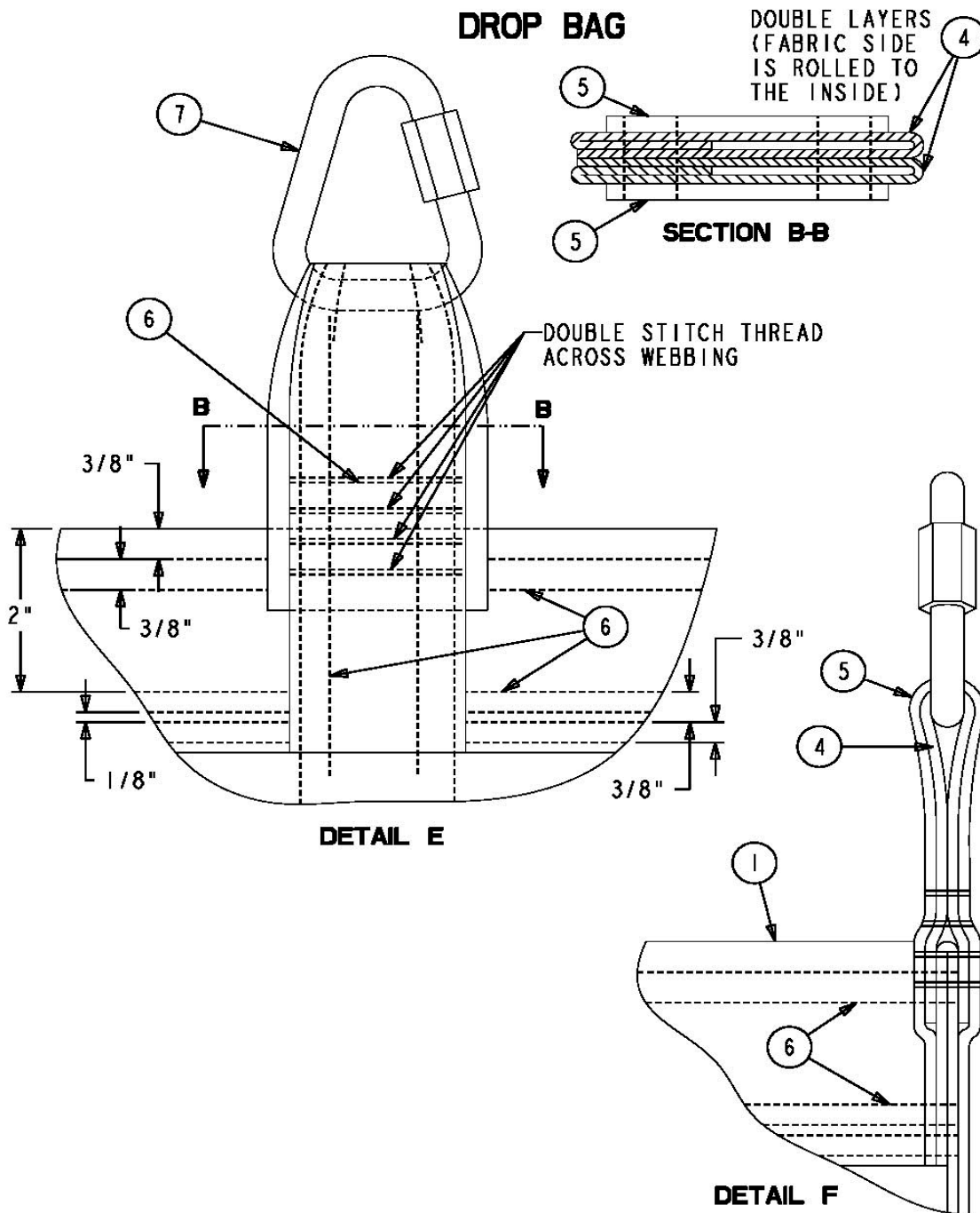


Appendix A (Continued) - Impact Test Bag -- Typical Construction

DROP BAG



Appendix A (Continued) - Impact Test Bag -- Typical Construction

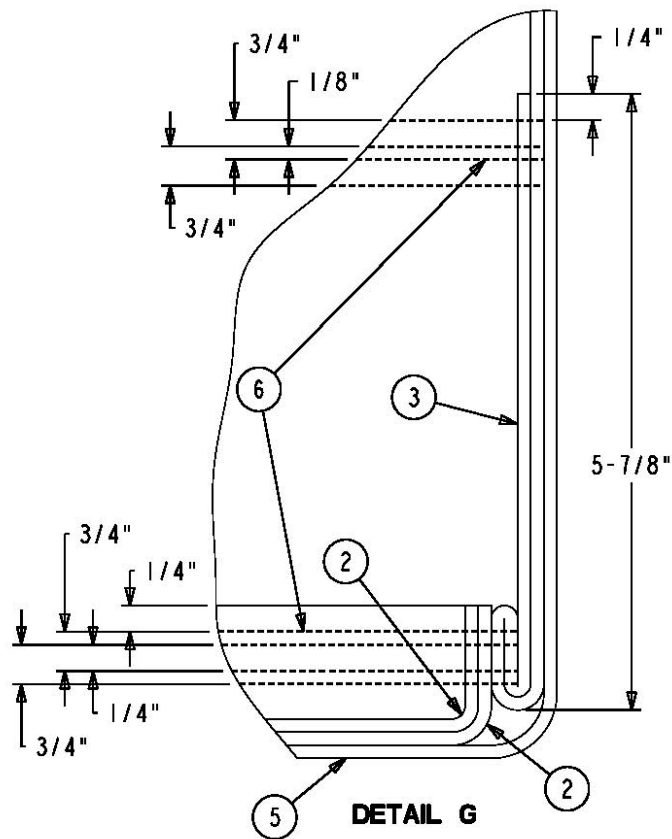


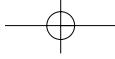
Appendix A (Continued) - Impact Test Bag -- Typical Construction

DROP BAG

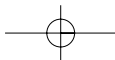
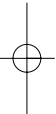
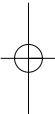
BAG CONSTRUCTION:

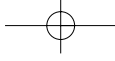
1. THE BAG IS TO BE SEWN TO BE 16" OUTSIDE DIAMETER AND 16" DEEP.
2. THE BAG IS CONSTRUCTED AS SHOWN ON ALL SHEETS.
3. THE TWO LIFTING STRAPS ARE OF 2" WIDE POLYESTER WEBBING SEWN IN AT 90° TO ONE ANOTHER ON THE OUTSIDE OF THE BAG.
4. THEY EXTEND DOWN ONE SIDE OF THE BAG, UNDER THE BOTTOM AND UP THE OTHER SIDE.
5. THE STEEL LIFTING RINGS ARE SEWN INTO THE FOUR ENDS OF THE TWO STRAPS.



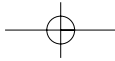
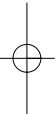
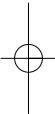


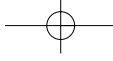
Notes





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