



Standard Specifications for Personal Climbing Equipment¹

This standard is issued under the fixed designation F 887; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 These specifications cover acceptance testing of climbers and climber straps, body belts and positioning straps with locking snaphooks, and harnesses used by workers in the climbing of poles, trees, towers, and other structures. Minimum performance criteria for arc resistance of harnesses are included for workers who may be exposed to thermal hazards of momentary electric arcs or flame.

1.2 Three types of climbers, Types A, B, and C, and two types of climber straps, Types A and B, are covered.

1.3 Two types of body belts, Types A and B, are covered.

1.4 Three types of positioning straps, Types A, B, and C, are covered.

1.5 Two types of harnesses, Types A and B, are covered.

1.6 The values stated in inch-pound units are to be regarded as the standard.

1.7 The following safety hazards caveat pertains only to the test method portions, 9.2, 14.3, 15.3, and Sections 18.3, 19, and 20 of these specifications: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

B 117 Practice for Operating Salt Spray (Fog) Apparatus
E 1891 Specification for Arc and Flame Resistant Rainwear
F 1958/F 1958M Test Method for Determining the Ignitability of Non-flame-Resistant Materials for Clothing by Electric Arc Exposure Method Using Mannequins

2.2 ANSI Standard:

Z359.1 Safety Requirements for Personal Fall Arrest Sys-

tems, Subsystems and Components³

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *billet*—the free (buckle hole) end of a belt or strap as opposed to the buckle end, which is designed to pass through the buckle for closing.

3.1.2 *body belt attachment*—a system of straps and buckles which allow the harness wearer to use a body belt in conjunction with the harness.

3.1.3 *dee-ring, D-ring*—a steel straight-sided (no protrusions along edge of dee-ring; see Fig. 1) forging in a circle configuration with an integral stirrup to accept the belt, assembled into a body belt for the purpose of accepting the snaphooks of a positioning strap.

3.1.4 *design test, n—for arc and flame resistant materials*, one made on a sample treated as representative of an industrial product; these tests will not generally be repeated in quantity production.

3.1.5 *dripping, n—in electric arc testing*, a material response evidenced by flowing of the fiber polymer, the fabric, or the fabric coating, and the evidence of droplets from the material, that characterizes overall performance relative to reducing the transfer of heat that is sufficient to cause a second-degree burn.

3.1.6 *electric arc ignition, n—as related to electric arc exposure*, a response that causes the ignition of the material which is accompanied by heat and light, and then subsequent burning for at least 5 s, or consumption of at least 25 % of the exposed test specimen area.

3.1.7 *full body harness*—a component with a design of straps which is fastened about the person in a manner so as to contain the torso and distribute the fall arrest forces over at least the upper thighs, pelvis, chest, and shoulders with means for attaching it to other components or sub-systems.

3.1.8 *gaff*—a component of a pole or tree climber attached to the climber shank, similar to a spur, which is shaped to permit the secure penetration of the pole or tree trunk.

¹ These specifications are under the jurisdiction of ASTM Committee F18 on Electrical Protective Equipment for Workers and are the direct responsibility of Subcommittee F18.15 on Worker Personal Equipment.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from the American National Standards Institute, ANSI, 25 W. 43rd St., 4th Floor, New York, NY 10036.

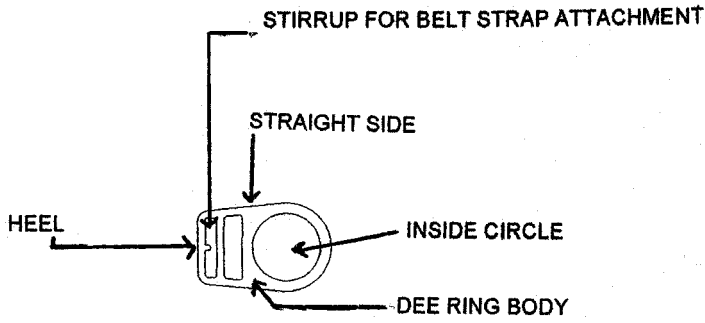


FIG. 1 Typical Dee-Ring

3.1.9 *keeper*—a component of the snaphook, used as a latching device and held in a closed position by a spring (see Fig. 2).

3.1.10 *locking mechanism*—a component of the snaphook used in conjunction with the keeper to retain the keeper in a closed position until intentionally released and opened. A snaphook thus equipped, becomes a “locking snaphook.”

3.1.11 *locking snaphook*—a snaphook with a locking mechanism (see 3.1.10).

3.1.12 *nose*—the curved end of the snaphook which the keeper rests on. It is rounded and overlaps the keeper latch in such a manner as to prevent the dee-ring from inadvertently releasing the snaphook (see Fig. 2).

3.1.13 *part (body belt), load-bearing*—a part of the body belt or positioning strap that, when in use with both snaphooks of the positioning strap engaged in one dee-ring of the body belt, will be required to support all or part of the mass of the user. This includes all the material in the positioning strap, and, in the case of the body belt, the material to which the dee-rings are directly fastened, and the material of the buckle strap that passes across the wearer’s abdomen.

3.1.13.1 *Discussion*—This definition and the strength requirements described in 15.3.2 are designed to ensure that the buckle strap is strong enough to withstand certain emergency conditions, but are not to be construed as approval of attaching both snaphooks to the same dee-ring when working aloft.

OSHA Subpart M (1926.502) prohibits working with two load-bearing snaphooks in the same dee-ring unless snaphooks are of the locking type and designed for such application.

3.1.14 *part (harness), load bearing*—a component of a harness to which arrest forces are directly transmitted in the event of a fall.

3.1.15 *protector, gaff*—a cap or guard designed to cover the points of pole or tree gaffs to protect the gaffs from damage or from injuring people or from damaging equipment.

3.1.16 *stirrup, climber*—the footrest of the pole or tree climber.

3.1.17 *stirrup, snaphook/dee-ring*—the closed rectangular portion of the positioning strap snaphook, or body belt dee-ring (see Fig. 1 and Fig. 2), that accepts the strap or belt material in a permanent manner.

4. Significance and Use

4.1 The following personal tools or equipment covered by these specifications are:

4.1.1 Climbers and climber straps used to ascend and descend poles and trees.

4.1.2 Body belts and positioning straps utilized for work positioning on poles, ladders, or structures.

4.1.3 Full body harnesses utilized in preventing and arresting falls.

4.2 Test methods included in these specifications are intended to provide uniform test procedures.

4.3 Snaphooks (non-locking)—(not permitted by this standard).

4.3.1 Locking snaphooks (required by this standard) manufactured to meet the requirements of these specifications, effectively prevent rollout from occurring and are able to be operated with one hand when working aloft.

4.4 Illustrations are furnished only to amplify the text. They are not to be considered restrictive as to specific design details, except where so stated.

4.5 Except for the restrictions set forth in these specifications because of design limitations, the use and maintenance of this equipment is beyond the scope of the standard.

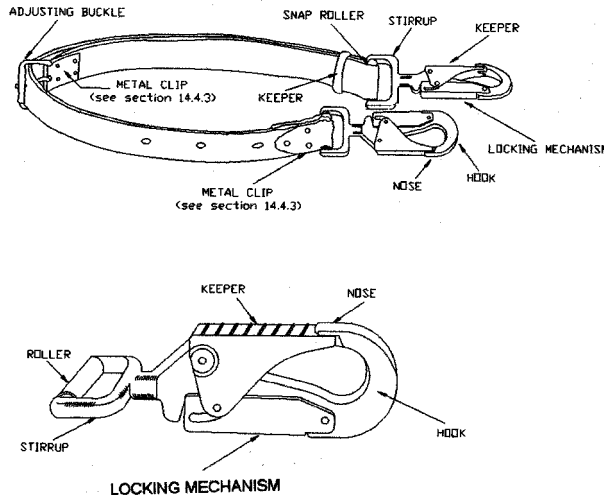


FIG. 2 Components of Positioning Strap

4.5.1 It is common practice and the responsibility of the user of this type of protective equipment to provide complete instructions and detailed procedures for the safe use of such equipment.

POLE AND TREE CLIMBERS

5. Classification

5.1 Climbers covered under these specifications shall be designated as Type A, B, or C, as follows:

5.1.1 *Type A*—Fixed length, non-adjustable, with permanently attached gaffs.

5.1.2 *Type B*—Adjustable length, with permanently attached gaffs.

5.1.3 *Type C*—Adjustable length, with replaceable and interchangeable gaffs (that is, pole to tree).

5.2 Climber straps covered under these specifications shall be designated as Type A or B, as follows:

5.2.1 *Type A*—One-piece straps that pass through the loops or rings on climbers and buckle one end to the other.

5.2.2 *Type B*—Two-piece ankle or bottom straps made so that each section can be attached to the climber ring, leaving the buckle end free to engage with the free billet end of the other piece.

6. Ordering Information

6.1 Orders for equipment under this specification shall include the following information:

6.1.1 Nomenclature,

6.1.2 Type,

6.1.3 Material,

6.1.4 Size, and

6.1.5 Gaff type (pole or tree).

6.2 The listing of equipment, types, and sizes is not intended to mean that all shall necessarily be available from the manufacturer; this listing signifies only that, if made, the equipment, types, and sizes shall conform to the details of these specifications.

7. Pole and Tree Climbers

7.1 *Sizes*:

7.1.1 Type A shall be available in sizes from 14 to 22 in. (35 to 55 cm) in ½-in. (12.5-mm) graduations.

7.1.2 Types B and C shall be available with the size adjustment capability of 14¾ to 21 in. (37 to 53 cm) by increments of ¼ in. (6.5 mm).

7.1.3 Adjustable climbers shall be equipped with positive locking, length-adjusting sections that can be double locked securely to the leg iron, permitting full compliance with standards established for fixed length climbers.

7.2 *Materials and Properties*—Leg irons shall be forged, utilizing forging-quality alloy steel or aluminum alloys. SAE 4140, SAE 8630 and SAE 8640 steel alloys with quenched and tempered structure, and 2014 T6 aluminum alloy are recommended. Other steel and aluminum alloys having properties listed in Table 1 are acceptable.

7.3 *Processing*—Manufacturers shall use a heat treatment to provide the required characteristics of the climber. The finished temperature of the forging shall be at the critical temperature of

TABLE 1 Properties of Steel and Aluminum Alloys Acceptable for Climbers

	For Fixed Gaff Climbers	For Replaceable Gaff Climbers ^A
<i>Steel:</i>		
Elongation in 2 in. (5 cm), min	14 %	14 %
Hardness	23 to 38 HRC 243 to 353 HB ^B	32 to 40 HRC 300 to 375 HB ^B
Yield strength, min, psi (MPa)	118 000 (815)	130 000 (895)
<i>Aluminum:</i>		
Elongation in 2 in. (5 cm), min	...	10 %
Hardness	...	125 to 140 HB ^B
Yield Strength, min, psi (MPa)	...	65 000 (450)

^A Data from Federal Specification RR-C-430 C.

^B Brinell hardness number with 3000-kg load, 10-mm ball.

the material used. Cold working or overheating shall be avoided. Scaling, pitting, and surface decarbonization shall be removed on the inside critical section of the leg iron from 2 in. (5.1 cm) below the gaff to 6 in. (15.2 cm) above the gaff (see Fig. 3).

7.4 *Design*—The design of the leg iron shall be such that the maximum tensile stress at the point subjected to a fluctuating bending force of 300 lbf (1.3 kN) applied to the center of the stirrup section of the leg iron with sleeve in position shall be as indicated in the table below. The climber shall be held in the climbing position by the gaff and at the top of the climber with the sleeve extended to provide a 16-in. (40.6 cm) length.

Leg Iron	Max Tensile Stress, psi (MPa)
Type A—Steel	27 000 (185)
Type B—Aluminum	9 000 (60)

7.5 *Finish*—Leg irons shall be free of surface cracks and seams. All steel leg irons shall be finished with a rust-resistant coating.

7.6 *Inspection, Marking, and Testing*:

7.6.1 All climbers shall be subjected to careful inspection by the manufacturer. When requested, the manufacturer shall provide certification that the climbers meet all requirements set forth in these specifications.

7.6.2 Completed leg irons shall be permanently marked by the manufacturer with the manufacturer's name, size (if fixed size), right or left, and the year of manufacture.

8. Climber Gaffs

8.1 *Sizes*—Pole gaffs shall measure at least 1⅞ in. (37 mm) on the underside. Tree gaffs shall measure not more than 3½ in. (89 mm), nor less than 2¼ in. (57 mm) on the underside. Gaff design shall be as shown in Fig. 4.

8.2 *Material*—All gaffs shall be forged of forging-quality steel having the properties listed in Table 2.

8.3 *Finish*:

8.3.1 All fins or burrs shall be removed from the cutting edges of gaff.

8.3.2 All gaffs shall be finished with a rust-resistant coating.

8.4 *Inspection*:

8.4.1 All gaffs shall be subjected to careful inspection by the manufacturer. When requested, the manufacturer shall certify that the gaffs meet all requirements set forth in these specifications.

8.4.2 The size and shape of gaffs shall be checked with a gauge available from the same manufacturer.

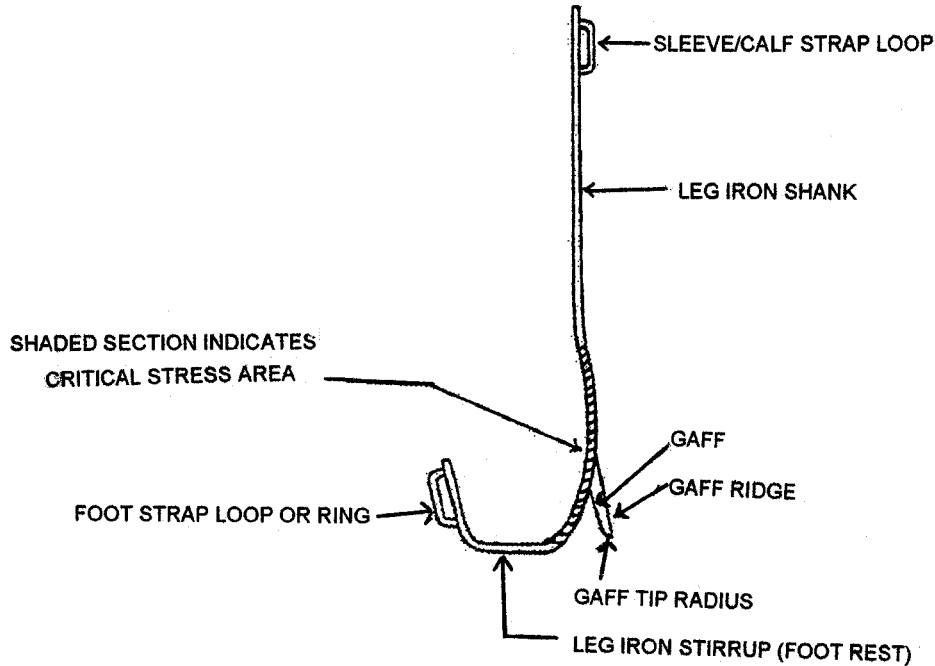
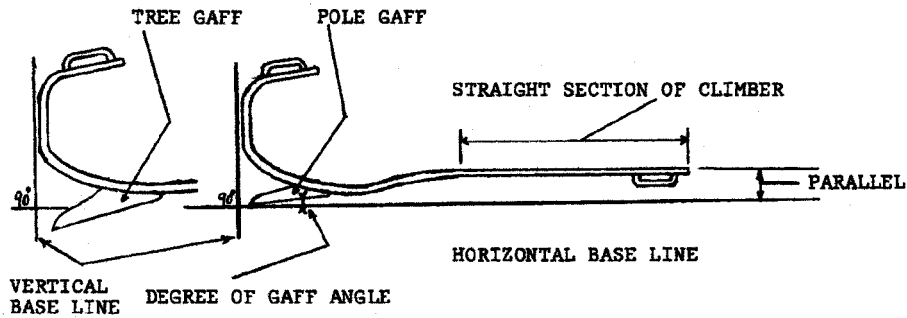


FIG. 3 Critical Stress Area of the Climber



NOTE 1—Degree of angle of the gaff, measured as shown, shall range from 11° to 17°, and the point of the gaff shall be a minimum of 3/8 in. (9.5 mm) above the lowest point of the leg iron stirrup. Tree gaffs are excluded from this requirement. The inside flat surface of the gaff at the tip shall be finished with a radius of approximately 1/4 in. (6.4 mm) in accordance with the gage profile.

FIG. 4 Gaff Design

TABLE 2 Properties of Steel Alloy Acceptable for Gaffs

Elongation in 2 in. (5 cm), min	12 %
Hardness (tip)	45 to 55 HRC ^A
	421 to 546 HB ^B
Yield strength, psi (MPa)	212 000 (1460)

^A There may be a variation of no more than three points in the Rockwell Hardness readings taken from the tip of the gaff to a point 1 1/4 in. (3.2 cm) back from the tip on the fixed gaff climber, 1 in. (2.5 cm) from the tip on replaceable gaff climbers.

^B Brinell hardness number with 3000-kg load, 10-mm ball.

NOTE 1—Replaceable gaffs, whether pole or tree, fit only the climber iron of the particular manufacturer.

9. Climber Straps

9.1 *Sizes*—Climber straps shall be a minimum of 1 in. (2.5 cm) in width and 1/8 in. (3.18 mm) in thickness. The length shall be not less than 22 in. (55 cm) for the calf strap, or 24 in.

(61 cm) for the one-piece ankle strap. Two-piece ankle straps shall be not less than 24 in. (61 cm) in length.

9.2 *Material and Properties:*

9.2.1 Leather used in the manufacture of climber straps shall be top grain cowhide and shall have a breaking strength of not less than 450 lbf/in. (79 kN/m) of width with buckle holes. The buckle holding strength of leather shall be not less than 200 lb (90 kg) static load when determined as follows:

9.2.1.1 Punch a hole 3/16 in. (4.76 mm) in diameter, centrally located in a 1-in. (25.4-mm) wide piece of strap, 1 in. from the end of the test piece. Into this hole, fit the tongue of a 1-in. assembled buckle of the design to be supplied with the climber strap. Apply the load to the buckle and to the free end of the strap. The buckle tongue shall not tear the leather under the specified static load of 200 lb (90 kg).

9.2.2 The leather shall show no cracking on the grain side when bent slowly over a 1/2-in. (12.7 mm) diameter mandrel,

grain side out, through an angle of 180°. The leather shall not show piping or wrinkling of the grain side when bent over a mandrel 1-in. (25.4 mm) in diameter, with the grain side in, through an angle of 180°.

9.2.3 Fabric used in the manufacture of climber straps shall have a breaking strength of not less than 600 lbf/in. (105 kN/m) of width with buckle holes. Construction shall be a minimum of four plies of thickness of folded nylon, or of woven nylon, or equivalent material, constructed in such a way that no raw edges are exposed. The fabric shall be impregnated with neoprene or its equivalent, so that the plies or strands are not readily separable, except by chemical means.

9.2.4 The buckle holding strength of the finished fabric strap shall be not less than 300 lb (135 kg) static load without evidence of failure. Buckle tear shall be in the direction of load application when tested to failure.

9.3 *Hardware*—Buckle frames shall be of welded wire or forged construction. Tongues shall be of an adequate gage wire to meet the strength criteria of 9.2.

9.4 *Design*—Buckle holes in the climber straps shall not exceed 3/16 in. (4.76 mm) in diameter. Straps shall be riveted to the buckles by at least two rivets, with the strap keeper centered between the rivets. The completed assembly shall meet the strength requirements of 9.2. Buckle pads or chafes may be added when desired.

10. Climber Pads

10.1 Climber pad assemblies are intended for use with the climber to enhance comfort.

10.2 Velcro⁴ style wrap pads covered under these specifications cover the function of both the climber strap and pad.

10.3 *Materials*—Materials used in the manufacture of pads shall be of a type that will result in a finished product capable of meeting the requirements for this section outlined below.

10.3.1 Wrap style pads shall maintain a minimum wrap that shall not release at a force of less than 1000 lb (453.6 kg) when statically tested.

10.3.2 Wrap style pads must display a minimum wrap location warning. Warning must be permanently attached (label or marking).

10.3.3 Sleeve retaining straps (see Fig. 5a) shall be a minimum of 1 in. (2.5 cm) in width. Leather sleeve retaining straps shall have a breaking strength of not less than 450 lb/in. (79 kN/m) of width. Finished fabric sleeve retaining straps shall have a breaking strength of not less than 600 lb/in. (105 kN/m) of width.

⁴ Velcro is a trademark of Registrant Velcro Industries, B.V. Limited Liability Company Netherlands, Castorweg 22-24, Curacao Netherld Antilles.

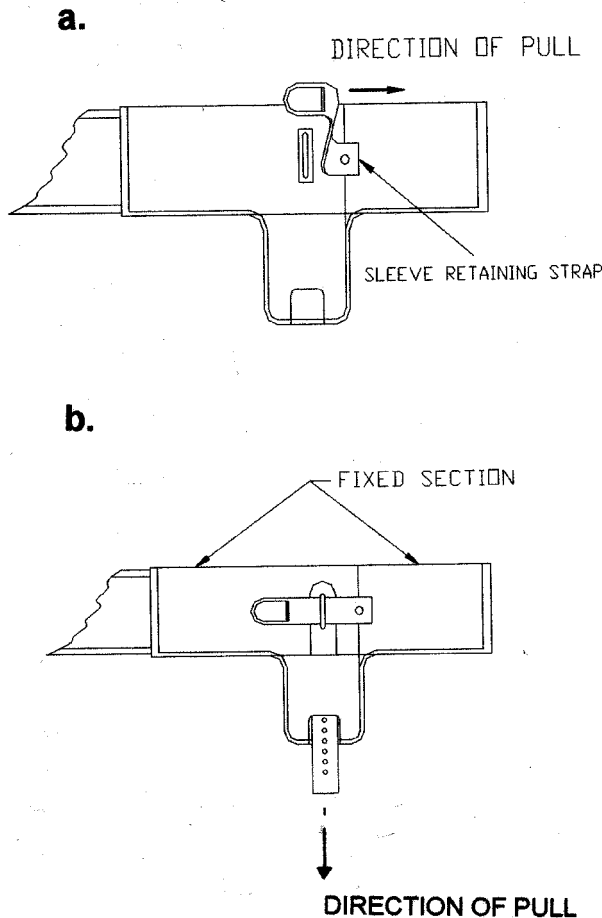


FIG. 5 Sleeve Retaining Straps on Velcro Wrap Style Pads

10.3.4 Sleeve retaining straps shall be capable of withstanding a direct pull of 175 lb (79.4 kg). (See Fig. 5a).

10.3.5 Sleeve retaining straps in place within the climber sleeve shall be capable of withstanding a direct pull of 700 lb (317.5 kg) (see Fig. 5b).

11. Climber Footplates

11.1 Climber footplate assemblies are intended for use with the climber to enhance comfort.

11.2 *Materials and Properties*—Materials used in the manufacture of footplates shall be of a type that will result in a finished product capable of meeting the requirements for this section outlined below. Material used in the manufacture of footplates must maintain its integrity and resist permanent deformation under normal use conditions for the expected life of the product.

11.3 *Removable*—Footplates if removable shall be equipped with positive locking fasteners to secure the footplates to the leg iron stirrup.

11.4 *Articulation*—Footplates may swivel slightly on the climber stirrup to allow for ease of movement when working aloft.

11.5 *Shape*—Shape must be smaller than the outsole of a standard climbing boot while providing sufficient support to the outsole.

11.6 *Non-Skid*—Bottom surfaces of the footplate must be as a minimum 90 % covered by a rubber sole or an equivalent non-skid coating.

11.7 Steel footplates are not intended for and may not be used on aluminum climbers unless provisions are implemented to prevent premature wear on the climber.

11.8 Footplates shall be permanently marked by the manufacturer with the manufacturer’s name, month and year of manufacture and designated as right and left.

11.9 *Finish*—Footplates shall be free of surface cracks and seams. All steel or ferrous material footplates shall be finished with a rust-resistant coating.

BODY BELTS AND POSITIONING STRAPS

12. Classification

12.1 Body belts covered under these specifications shall be designated as Type A or B, as follows:

12.1.1 *Type A*—Belt with dee-ring piece in fixed position.

12.1.2 *Type B*—Belt with dee-ring piece that has limited freedom of movement.

12.2 Positioning straps covered under this specification shall be designated as Type A, B, or C as follows:

12.2.1 *Type A*—Adjustable length, with tongue buckle.

12.2.2 *Type B*—Adjustable length, with friction buckle.

12.2.3 *Type C*—Nonadjustable length strap.

13. Ordering Information

13.1 Orders for equipment under these specifications should include the following information:

13.1.1 Nomenclature,

13.1.2 Type,

13.1.3 Style,

13.1.4 Material, and

13.1.5 Size.

13.2 The listing of equipment, types, styles, and sizes is not intended to mean that all shall necessarily be available from the manufacturer. The listing signifies only that, if made, the equipment, types, styles, and sizes shall conform to the details of these specifications.

14. Body Belts

14.1 *Sizes*—The “dee” measurement will be the nominal distance from the heel or bar of one dee ring to the heel or bar of the other dee ring (see Fig. 6). Body belts shall be marked with the “dee” sizes since the dee size is the most critical. Body belts are normally furnished in the combination belt strap and dee sizes listed in Table 3 (see Fig. 7), however, belt strap measurements may vary on different style belts and with different manufacturers.

14.2 *Materials and Properties:*

14.2.1 *Leather*—Top grain leather or leather substitute may be used in the manufacture of body belts and accessories, but shall not be used alone as a load bearing component of the assembly.

14.2.2 *Fabric*—Plied fabric used in the manufacture of load bearing parts of body belts shall be constructed in such a way that no raw edges are exposed. Fabric shall be impregnated with neoprene, or its equivalent, so that the plies are not readily separable, except by chemical means. If webbing is used, it need not be impregnated.

14.3 *Test Method:*

14.3.1 *Tension Test*—A sample of new fabric used in a load bearing part shall be soaked in water for 24 h. It shall then be placed in a freezer at –40°F (–40°C) for 4 h. At –40°F (–40°C), it shall be bent over a 5/8-in. (15.9 mm) diameter mandrel and reverse bent over the same mandrel through 180°. The sample shall then be stabilized at room temperature and the tensile strength determined. The breaking strength shall be at least 80 % of that of new material or not less than 3600 lbf (16 kN) for a section free from buckle holes, and not less than

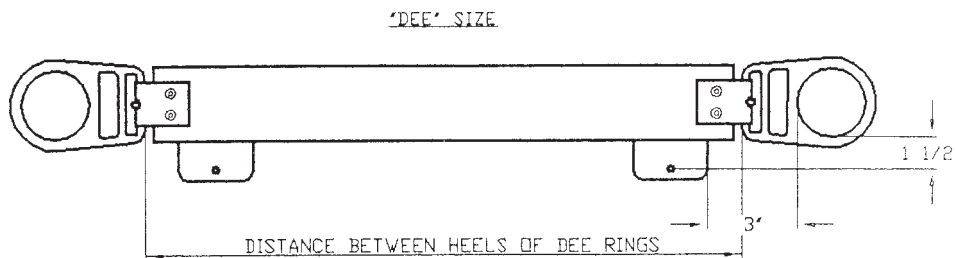
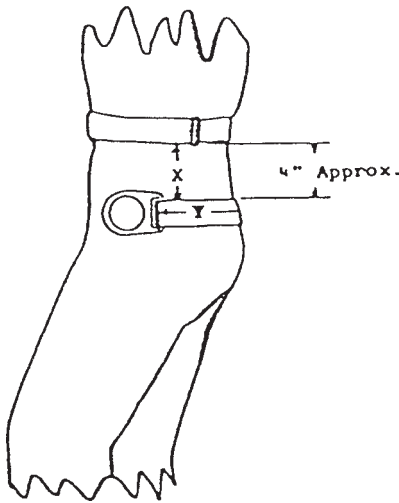


FIG. 6 “Dee” Measurement

TABLE 3 Available Body Belts Listed by Dee Size With Corresponding Belt Strap Size

Dee Size		Min		Center Hole		Max		No. of Tool Loops
in.	cm	in.	cm	in.	cm	in.	cm	
D18	46	32	81	36	91	40	102	3
D19	48	33	84	37	94	41	104	3
D20	51	34	86	38	97	42	107	3
D21	53	36	91	40	102	44	112	4
D22	56	37	94	41	104	45	114	4
D23	58	38	97	42	107	46	117	4
D24	61	40	102	44	112	48	122	4
D25	64	41	104	45	114	49	124	4
D26	66	42	107	46	117	50	127	4
D27	69	44	112	48	122	52	132	4
D28	71	45	114	49	124	53	135	4
D29	74	46	117	50	127	54	137	4
D30	76	47	119	51	130	55	140	4



X— Distance from waist or top of hip bone to where body belt is worn.
Y— Measurement is from front of hip bone around the back to the front of the other hip bone. This measurement is the Dee size.

FIG. 7 A Method Showing Where to Measure to Determine Correct "Dee" Size for a Body Belt

2800 lbf (12.5 kN) for a section containing buckle holes. The tension test to determine the breaking strength shall be made in a straight pull with a dynamometer, or equivalent, with jaws separating at a maximum rate of 1-in. (2.5 cm)/min.

14.4 Design:

14.4.1 *Body Pad*—The cushion part of the body belt shall contain no exposed rivets on the inside and shall be at least 3 in. (7.6 cm) in width. The belt shall have pocket tabs extending at least 1½ in. (3.8 cm) down, and with the point of attachment at least 3 in. (7.6 cm) back of inside of the circle of dee-rings

on each side for attachment of plier or tool pockets (see Fig. 8). On shifting dee belts, the measurement for pocket tabs shall be taken when the dee ring section is centered.

14.4.2 *Belt Straps*—Belt straps shall be made of fabric described in 14.2.2. Buckle holes shall be spaced on 1-in. (2.5-cm) centers, round or oval, to accommodate the tongue of the belt buckle. Buckle holes shall be spaced not in excess of ¼ in. (6.4 mm) in diameter if round, or ¼ by ⅜ in. (6.4 by 9.5 mm) if oval shaped, the greater dimension to be in the direction of the length of the strap. For grommet construction, holes shall be no larger than No. 2 grommet. No hole shall be permitted within 4 in. (10 cm) of the end of the strap. The nominal minimum body strap width shall be 1¾-in. (4.5 cm) (see Fig. 9).

14.4.3 *Tool Loops*—Tool loops shall be so situated on the body of the belt that 4 in. (10 cm) of the body belt in the center of the back, measuring from dee-ring to dee-ring, shall be free of tool loops and any other attachments (see Fig. 8). The material may be either leather or fabric ⅛-in. (3.175 mm) thick, 1-in. (2.5 cm) nominal width, with the loops having a maximum diameter of 1¾ in. (4.5 cm) and a minimum diameter of ¾ in. (1.9 cm). If a hammer loop is desired, it should be ordered in the position nearest the belt buckle.

14.4.4 *Circle Dee-Rings*—The design of the dee-ring (see Fig. 1) shall be such that its minimum inside circle to outside circle opposite side dimension is 3.125 in. (7.94 cm), it is straight-sided and it shall not have any obstructions, protrusions, or a configuration that can allow pressure to be put on the snaphook keeper. The dee-ring strap and the body strap shall not pass through or attach to that part of the dee-ring to which the positioning strap snaphooks are engaged. The dee-rings shall be installed in the body belt in such a manner that vertical travel in the assembly is prevented.

14.4.5 *Liners for Dee-Rings*—Suitable copper, steel, or equivalent liners shall be used around the bar of dee rings to prevent wear.

14.4.6 *Stitching and Thread*—All stitching shall be of nylon or equivalent thread and shall be lock stitched, not less than four nor more than seven stitches to the inch. The thread shall have a minimum breaking strength of 42 lbf (0.18 kN). Stitching parallel to an edge shall be approximately ⅜ in. (4.8 mm) from the edge of the narrowest member caught by the thread.

14.5 Inspection, Marking, and Testing:

14.5.1 All body belts shall be subjected to careful inspection by the manufacturer. When requested, the manufacturer shall provide certification that the body belts meet all requirements set forth in these specifications.

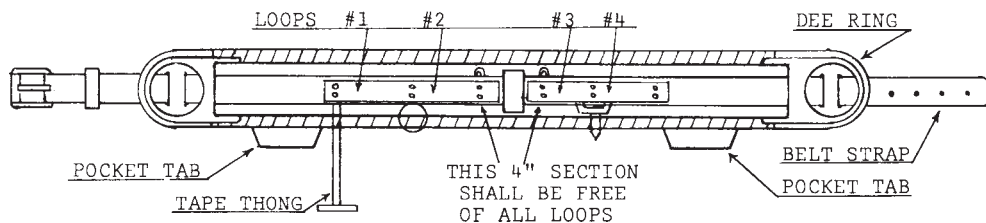


FIG. 8 Body Belt Nomenclature

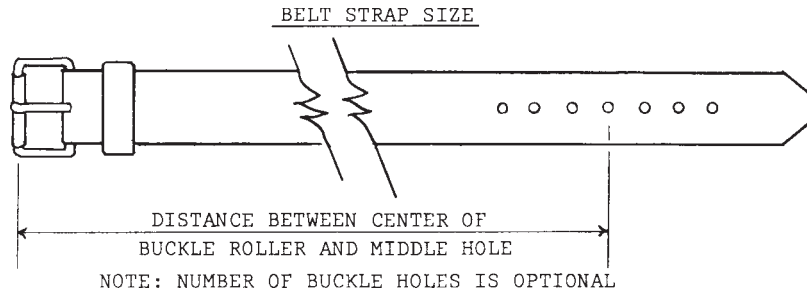


FIG. 9 Body Belt Strap Size

14.5.2 Completed body belts shall be permanently marked by the manufacturer with the manufacturer's name, "dee" size, and the year of manufacture.

15. Positioning Straps

15.1 *Sizes*—Positioning straps can be made to whatever length the user specifies, measured from inside snaphook to inside snaphook (see Fig. 10). The positioning strap shall have a nominal width of 1 3/4 in. (4.5 cm).

15.2 *Materials and Properties:*

15.2.1 *Leather*—Top grain leather or leather substitute shall be used in the manufacture of straps and accessories but shall not be used alone as a load bearing component of the assembly.

15.2.2 *Fabric*—All fabric used in the manufacture of positioning straps shall consist of a minimum of six-ply folded nylon, or of woven nylon, or equivalent material constructed in such a way that no raw edges are exposed. Folded fabric shall be impregnated with neoprene or its equivalent so that the plies are not readily separable except by chemical means. Folded material shall have two center plies of contrasting color. Woven material shall have center threads of contrasting color (red is the suggested wear indicator in both instances).

15.3 *Test Methods:*

15.3.1 *Leakage Current Test*—All fabric and leather used shall be tested for leakage current. The leakage current shall not exceed 1 mA when a potential of 3000 V ac is applied to the electrodes positioned 12 in. (30.5 cm) apart.

NOTE 2—Direct current tests may be used in place of alternating current tests by mutual agreement between the manufacturer and purchaser. All fabric used for pole straps shall withstand an a-c dielectric test of not less than 25 000 V/ft, in a dry condition, for 3 min without visible deterioration.

15.3.2 *Tension Test*—A sample of new fabric to be used in a load bearing part shall be soaked in water for 24 h. It shall then be placed in a freezer at -40°F (-40°C) for 4 h. At -40°F (-40°C), it shall be bent over a 5/8-in. (15.9 mm) diameter mandrel and reverse bent over the same mandrel through 180°. The sample shall then be stabilized at room temperature and the tensile strength determined. The breaking strength shall be at least 80 % of that of new material or not less than 3600 lbf

(16 kN) for a section free from buckle holes and not less than 2800 lbf (12.5 kN) for a section containing buckle holes. Tension tests shall be made in a straight pull with a dynamometer or equivalent, with jaws separating at a maximum rate of 1 in. (2.5 cm) per minute.

15.3.3 *Buckle Tear Test*—When tested for buckle holding strength, the strap shall withstand a load of 1000 lbf (4.4 kN) in a straight line pull, snap to snap, without visual evidence of failure. The strap shall be considered failed if the buckle tongue tears through the strap for at least 1 in. (2.5 cm) in the direction parallel to the longitudinal axis of the strap.

15.3.4 *Flammability Test:*

15.3.4.1 Vertically suspend a section of strapping to which a 220.5-lb (100-kg) mass has been attached. The length of strapping shall provide 19.7 in. (500 mm) of strapping above the point to which the flame is directed.

15.3.4.2 Adjust a butane or propane burner to a clean-burning blue flame approximately 3 in. (76 mm) in height.

15.3.4.3 Direct the flame to an edge of the strapping for a period of 5 s. The top of the burner shall be maintained at 1 in. (25 mm) from the strapping edge.

15.3.4.4 Permit any flames generated to continue burning until they self-extinguish.

15.3.4.5 The strap material shall continue to support the 220.5-lb (100-kg) mass.

15.4 *Hardware:*

15.4.1 *Locking Snaphook*—As assembled, shall consist of a body, keeper, lock mechanism, spring(s), and roller. The snaphook shall snap over the curved portion of the dee-ring from any angle, without interference or tendency to bind at any point. The nose of the snaphook shall be rounded with an indentation(s), contain the keeper and overlap the keeper latch by 3/16-in. (5-mm) minimum. The keeper, with locking mechanism released, shall be attached such that side movement at the snaphook nose is no greater than 3/32-in. (2.38-mm). Also, the keeper shall be capable of withstanding a minimum side-load of 750 lbf (3.34 kN) applied to a point midway between the nose and the keeper rivet. The keeper shall remain engaged within the nose and shall not break or have permanent deformation greater than 3/16 in. (5 mm) (see Fig. 11). The

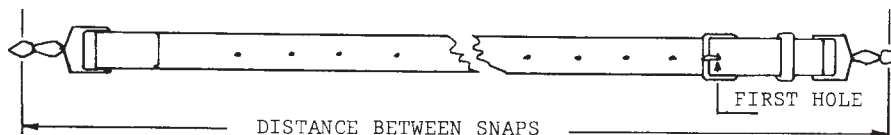


FIG. 10 Positioning Strap Measurement

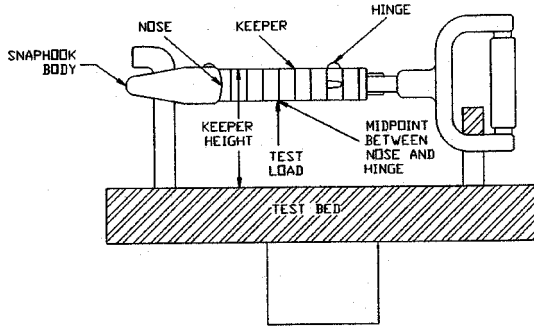


FIG. 11 Side Load Testing of Snaphook

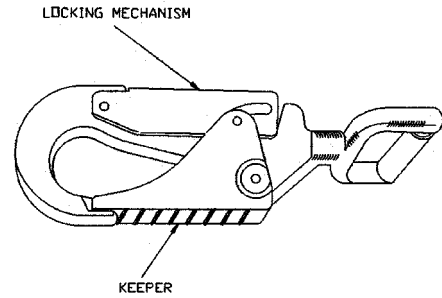


FIG. 13 Typical Locking Snaphook

keeper spring tension shall be such that the keeper shall begin to open with a force between 2.5 lbf (11.12 N) and 4 lbf (17.79 N). The force shall be applied on the keeper and against the face of the snaphook nose with the upper surface of the keeper held horizontally (see Fig. 12). A force in the range of 1.5 lbf (6.67 N) to 4 lbf (17.79 N) shall be required to properly activate and release the locking mechanism. This requirement applies regardless of the design of the locking mechanism (see Fig. 13).

15.4.2 Clip configuration and number of rivets used for attachment of components is at the discretion of the manufacturer as long as the completed product complies with the testing outlined in Section 20 (see Fig. 14).

15.4.3 *Design*—Standard positioning straps shall be so constructed that the snaphooks will be keeper side up when the strap is laid out flat with buckle tongue side up (see Fig. 10). Snaphooks shall move freely within their rollers. A leather or fabric keeper shall be supplied on the loop or doubled end. Stitching and thread, if any, shall be as specified in 14.4.6. The buckle holes shall not exceed 1/4-in. (6.4 mm) in diameter if round, or 1/4 by 3/8 in. (6.4 by 9.5 mm) if oval, the greater dimension to be in the direction of the length of the strap.

15.4.4 *Finish*—Hardware shall have a smooth finish and rivets shall be set with no rough ends. The fabric shall be cleanly cut and punched.

15.5 *Inspection, Marking, and Testing:*

15.5.1 All positioning straps shall be subjected to careful inspection by the manufacturer. When requested, the manufac-

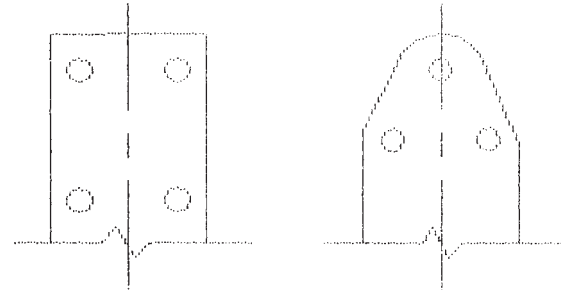


FIG. 14 Pole Strap Metal Clip

turer shall provide certification that the pole straps meet all requirements set forth in these specifications.

15.5.2 Completed positioning straps shall be permanently marked by the manufacturer with the manufacturer's name, model number, and date of manufacture (see Fig. 15).

HARNESSES

16. Classification

16.1 Harnesses (see Fig. 16) covered under these specifications shall be designated as Type A or B as follows:

16.1.1 *Type A*—Full body harness.

16.1.2 *Type B*—Full body harness with body belt attachment.

17. Ordering Information

17.1 Orders for equipment under these specifications should include the following information:

- 17.1.1 Nomenclature,
- 17.1.2 Type,
- 17.1.3 Material, and
- 17.1.4 Size.

17.2 The listing of equipment, type, and sizes is not intended to mean that all shall necessarily be available from the manufacturer; the listing signifies only that, if made, the equipment, types, and sizes shall conform to the details of these specifications. Additional designs or modifications of equipment or hardware may be specified by the user for a particular application providing equipment or hardware meets the performance requirements of this standard.

18. Harnesses

18.1 *Sizes*—Harnesses may be manufactured and designated by the sizes small, medium, large, X-large, and XX-large. The manufacturer's harness design shall accommodate the height and chest sizes shown in Table 4.

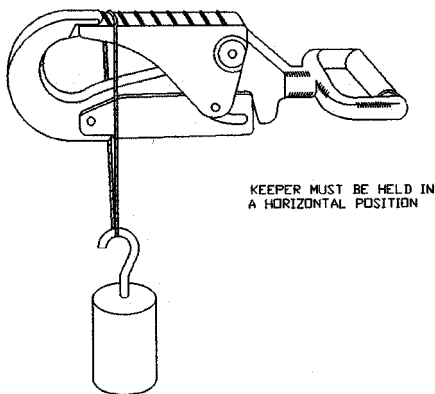


FIG. 12 Latch Test Method

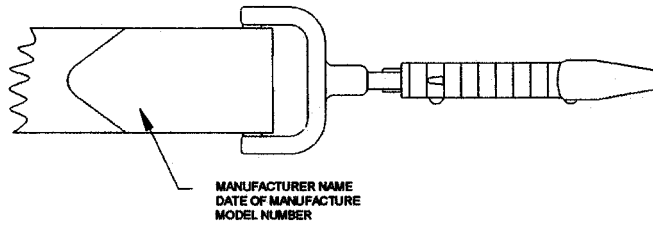
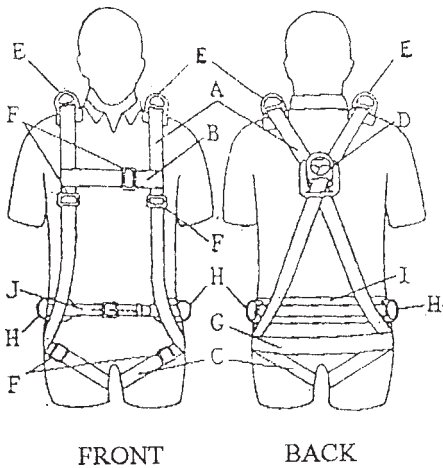


FIG. 15 Manufacturer's Marking



FRONT

BACK

Legend:

- A—Shoulder straps
- B—Chest strap
- C—Thigh strap
- D—Fall arrest attachment
- E—Retrieval dee-rings
- F—Adjustment points
- G—Sub-pelvis strap
- H—Work positioning attachment
- I—Body pad
- J—Waist strap

NOTE 1—Adjust harness to a snug fit at adjustment points. Attach to “E” for retrieval only. Attach lanyard/energy absorber to point “D”. Point “D” may be used for retrieval purposes when harness does not include shoulder dee-rings (“E”).

FIG. 16 Typical Harness Arrangement

TABLE 4 Harness Sizes

Height	Chest Sizes (Wearing Winter Clothing), in.				
	34–36	38–40	42–44	46–48	50–54
Short (5 ft 4 in. – 5 ft 7 in.)	small	small	medium	large	X-large
Reg. (5 ft 8 in. – 5 ft 11 in.)	small	medium	large	X-large	XX-large
Tall (6 ft 0 in. – 6 ft 3 in.)	medium	medium	large	X-large	XX-large
Extra tall (6 ft 3 in. +)	large	large	X-large	X-large	XX-large

18.2 Harnesses manufactured under these specifications shall be labeled as meeting the standard and shall meet the specifications, tests and requirements of ANSI Z359.1 (current revision) with the exception that the webbing used in the construction of harnesses shall have a minimum breaking strength of 7000 lb (31 kN) and harnesses shall meet the Electric Arc Performance criteria outlined in 18.3.

18.3 Electric Arc Performance:

18.3.1 Electric Arc Test—Each product shall be electric arc tested using the Test Method F 1958/F 1958M mannequin test set up.

18.3.2 Six test specimens shall be placed on mannequins as normally worn and exposed to a $40 \text{ cal/cm}^2 \pm 5 \text{ cal/cm}^2$ arc. Three of the test specimens shall be exposed on the front and three of the test specimens shall be exposed on the back.

18.3.3 The arc shall be centered on the chest in the case of a harness front exposure or on the fall arrest attachment in the case of a back exposure.

18.3.4 This is a design test and need not be retested unless components change. Specimens shall be chosen to represent load bearing materials and any permanently attached options or accessories.

18.3.5 The arc material response characteristics for personal climbing device materials, including *afterflame time*, *electric arc ignition*, and *dripping*, shall be reported for six exposures.

18.3.6 When arc testing according to Test Method F 1958/F 1958M, dripping shall be determined by observing all arc test specimen exposures. There shall be no dripping for arc test specimen exposures.

18.3.7 The exposed test specimens shall be exposed to the required drop test (ANSI Z359.1) after the arc exposure as soon as is practically possible.

18.3.8 To meet these specifications, exposed test specimens shall pass the following criteria in addition to the other test criteria in the standard:

18.3.8.1 No electric arc ignition as defined by Specification F 1891.

18.3.8.2 No melting and dripping as defined by Specification F 1891.

18.3.8.3 Pass specified drop test after electric arc exposure defined above.

18.3.8.4 No greater than 5 s of afterflame as defined by Specification F 1891.

19. Hardware, Hardware Testing, and General Design Requirements

19.1 Hardware for body belts and positioning straps shall be drop-forged steel, and shall have a corrosion-resistant finish tested to meet the requirements of Practice B 117 (50-h test). Surfaces shall be smooth and free of sharp edges.

19.2 All buckles shall withstand a 2000-lbf (8.9-kN) tension test with a maximum permanent deformation no greater than $1/64$ in. (0.4 mm) (see Fig. 17).

19.3 The load bearing parts of the dee-rings shall withstand a 5 000-lbf (22-kN) tension test without cracking or breaking (see Fig. 18).

19.4 Snaphooks shall withstand a 5000 lbf (22 kN) tensile test. Tensile failure is indicated by distortion of the snaphook sufficient to release the keeper (see Fig. 19).

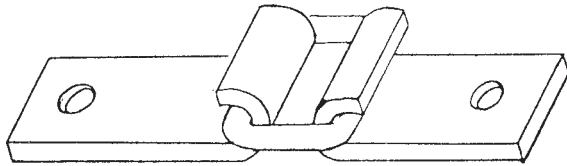
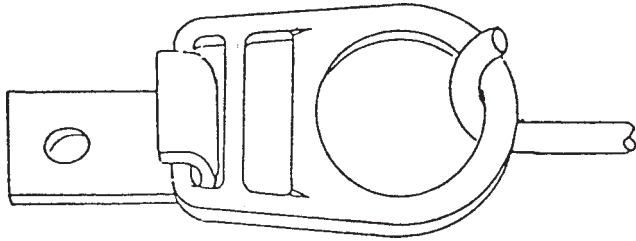


FIG. 17 Maximum Permanent Buckle Deformation Test



NOTE 1—Apply force to bar used to attach dee-ring to belt.

FIG. 18 Dee-Ring Test

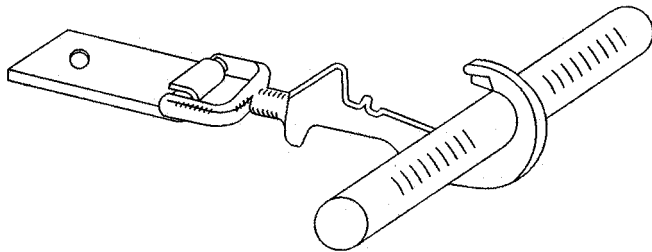


FIG. 19 Snaphook Test

19.5 The test fixtures of the testing apparatus used in the above tensile tests shall closely represent their mating hardware components.

19.6 Hardware when heat treated shall provide a hardness of a maximum of 42, measured on the Rockwell C-Scale.

20. Test Methods for Body Belts and Positioning Straps

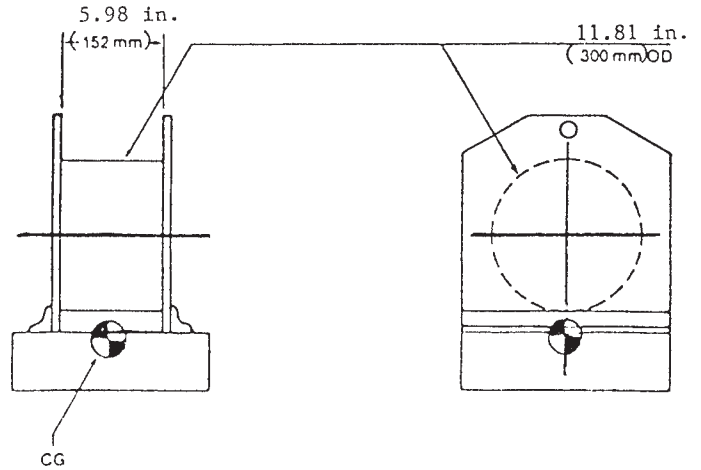
20.1 Test Equipment:

20.1.1 *Structure*—The test frame shall be a structure of sufficient rigidity to prevent significant deflection under the drop test and of sufficient height to accommodate the longest positioning strap to be tested (including stretch), and shall be provided with an eye-bolt anchorage point positioned vertically downward.

NOTE 3—For safety reasons, the structure should have ample stability to accommodate possible lateral loading under rebound.

20.1.2 *Test Mass*—The test mass shall have a mass of 220.5 ± 2 lb (100 ± 1 kg) and shall be rigidly constructed of steel in accordance with Fig. 20. The test mass shall include the mass of the instrumentation load cell when used to test positioning straps or an equivalent supplementary mass.

20.1.3 *Wire Rope*—A wire rope lanyard equipped with snaphooks shall be provided for the body belt tests. The lanyard must be of sufficient length to ensure a 39.4-in. (1-m) vertical drop, but in no case shall it exceed a length of 96.06 in. (2.44 m) when measured from snaphook to snaphook. The lanyard shall be fabricated from Type 302 stainless steel in a 0.375-in. (9.5-mm) diameter, 7×19 aircraft-cable construc-



CG
Where the center of gravity shall be below the base of the mandrel.

FIG. 20 Test Mass

tion. To prevent slippage, the lanyard eyes shall be formed by flemish splices and secured with mechanical sleeves.

20.1.4 *Quick Release Mechanism*—This mechanism which is required for all drop tests is remotely operated and shall release the test mass without imparting any motion to it.

20.1.5 *Load Measuring Instrumentation*—A load cell or equivalent device capable of measuring and permanently recording the arrest force. This instrument shall be used during all positioning strap drop tests. The load cell, or the equivalent measuring device, shall be capable of withstanding a shock force of at least 8003 lbf (35.6 kN) and shall have a frequency of 300 to 1000 cycles per s (0.3-1kHz) with an accuracy of $\pm 2\%$.

20.2 Body Belt Drop Test:

20.2.1 *Drop Test Samples*—Samples of body belts of each specific design and construction shall be tested. Samples shall be supplied without positioning straps but shall include all hardware and fittings intended to be attached to the commercial product.

20.2.2 *Drop Test Procedures*—The belt shall be snugly secured around the mandrel of the test mass. The belt shall be positioned such that the dee-ring closest to the buckle is pointing upward. One end of the wire rope shall be hooked into the dee-ring. The quick-release mechanism shall be hooked into the same point. Raise the mass until the opposite end of the wire rope can be snapped into the test-structure anchorage point. Note the level of the dee-ring attachment point and raise the test mass until the dee-ring attachment point has been raised a distance of 39.4 in. (1 m) (see Fig. 21). Release the test mass by means of the quick-release mechanism.

20.2.3 *Drop Test Requirements*—Examine belt for damage such as broken stitching, slipped grommets in buckle holes, and bent buckle tongue. Any such damage shall be recorded for the manufacturer's information. Body belts shall successfully arrest the fall of the test mass and shall be capable of supporting the mass after the test. When tested at any buckle hole adjustment, the tongue may rip 2.95 in. (75 mm) maximum along the belt. The circumference of the belt in its buckled condition, shall not increase more than 3.94 in. (100 mm), including the ripping, as a result of the test.

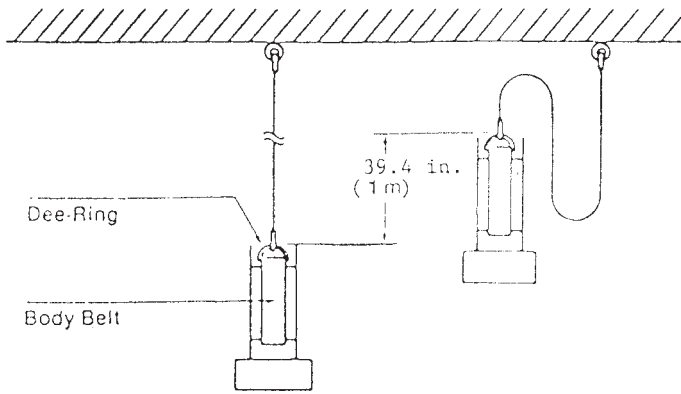


FIG. 21 Body-Belt Drop Test

20.3 Positioning Strap Drop Test:

20.3.1 Drop Test Samples—When a positioning strap of a specific material, type, size, and range design is intended to be manufactured in a range of sizes, the range shall be specified by the manufacturer. Samples shall be tested at the shortest length adjustment that permits a 39.4-in. (1 m) drop. All positioning straps provided as samples shall be separate from the body belts but shall include all hardware and fittings intended to be attached to the commercial product.

20.3.2 Drop Test Procedures—The positioning strap shall be attached to the test-structure anchorage point. The opposite end shall be attached to the upper end of the load cell, which shall be connected to the test mass as shown in Fig. 22. The load cell may alternatively be positioned between the test-structure and the positioning strap. The quick-release mechanism shall be hooked into the same point as the lower end of the positioning strap. Raise the test mass until its full mass is

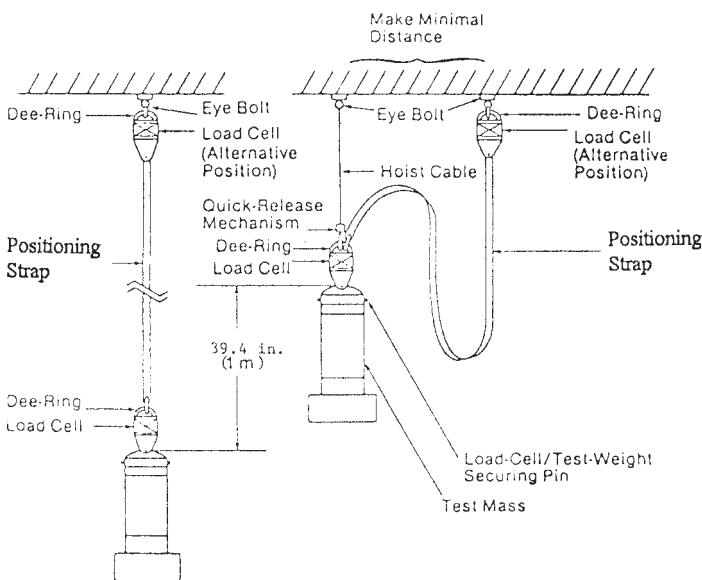


FIG. 22 Positioning Strap Drop Test

being supported by the positioning strap. Note the level of the upper load cell attachment point, or the test mass attachment point if the load cell is positioned between the test structure and the positioning strap. Raise the test mass until the lower attachment point has been raised a distance of 39.4 in. (1 m). Release the test mass by means of the quick release mechanism.

20.3.3 Drop Test Requirements—Positioning straps shall successfully arrest the fall of the test mass without breaking and the arrest force shall not exceed 4000 lbf (17.8 kN). In addition, the snaphooks on the positioning strap shall not have distorted sufficiently to allow the keeper to be released.

20.4 The tests described in 20.2 and 20.3 are destructive tests. Components so tested shall not be returned to service, but shall be destroyed.

20.5 It is required that production samples (body belts and positioning straps) shall be approved by a nationally recognized testing laboratory or by a qualified professional engineer as having been tested in accordance with and meeting the specific design requirements for components and finished products as stated in Sections 14, 15, 19, and 20. This approval will remain in effect as long as no material changes or substitutions have been made.

21. Guarantee and Rejection

21.1 This specification covers the minimum electrical, mechanical, and physical properties to be guaranteed by the manufacturer and the detailed procedures by which such properties are to be determined. The purchaser may, at his option, perform or have performed any of these tests in order to verify the guarantee. Claims for failure to meet this specification are subject to verification by the manufacturer.

21.2 The manufacturer or supplier shall replace, without charge to the purchaser, unused equipment purchased under this specification which upon examination or test within six months of initial delivery of the shipment fail to meet any of the criteria of these specifications.

21.3 If 5 % or more, but not less than two items in a lot or shipment, fail to meet the criteria of these specifications, the entire lot or shipment may be rejected.

21.4 If there is rejection of 5 % or more, but not less than two items in a lot or shipment, the testing shall be discontinued and the manufacturer notified. The manufacturer or supplier may request that his representative witness the testing of additional samples.

21.5 All rejected material shall be returned as directed by the manufacturer, at his or the supplier's request, without defacement beyond that already created by testing. Rejected material shall be tagged with an indication of the cause for rejection.

22. Keywords

22.1 body belts; climber; climbing equipment; dee-rings; gaff; keeper; locking snaphook; positioning strap; stirrup

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