



Designation: F887 – 05<sup>ε1</sup>

## Standard Specifications for Personal Climbing Equipment<sup>1</sup>

This standard is issued under the fixed designation F887; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

<sup>ε1</sup> NOTE—Metric conversions were corrected editorially in July 2006.

### 1. Scope

1.1 These specifications cover acceptance testing of climbers and climber straps, body belts and positioning straps with locking snaphooks, harnesses and shock absorbing lanyards 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 Two types of shock absorbing lanyards, Types A and B, are covered.

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

1.8 The following safety hazards caveat pertains only to the test method portions, 9.2, 10.3, 11.2, 14.3, 15.3, 18.2, 21.2, 22, 23, and 24 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*:<sup>2</sup>

**B117** Practice for Operating Salt Spray (Fog) Apparatus

**E1891** Guide for Determination of a Survival Curve for Antimicrobial Agents Against Selected Microorganisms

<sup>1</sup> 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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<sup>2</sup> 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.

and Calculation of a D-Value and Concentration Coefficient

**F1958/F1958M** 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 Systems, Subsystems and Components<sup>3</sup>

### 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.

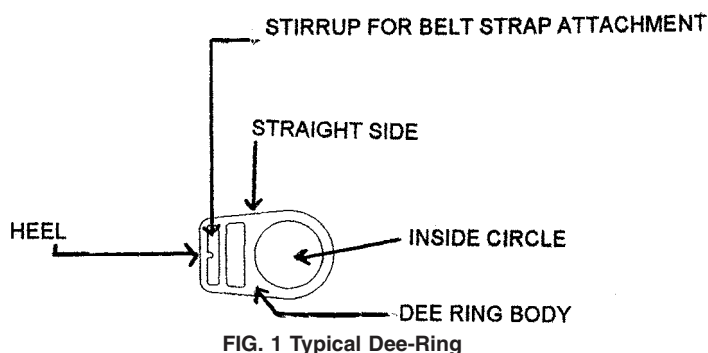
3.1.4 *design test, n*—for arc and flame resistant materials, one made on a sample treated as representative of an industrial product; these tests will not generally be repeated in quantity production.

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

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



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.

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 *shock absorbing lanyard*—a lanyard containing a component whose primary function is to dissipate energy and limit deceleration forces which the system imposes on the body during fall arrest.

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

3.1.18 *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 and shock absorbing lanyards utilized in preventing and arresting falls.

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

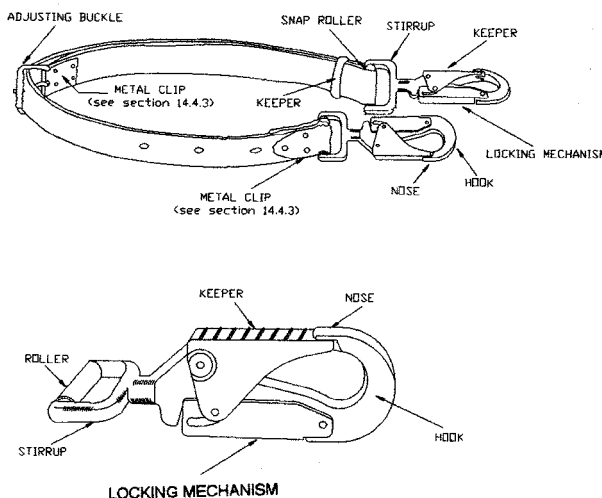


FIG. 2 Components of Positioning Strap

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.

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. (355.6 to 558.8 mm) in ½ in. (12.7 mm) graduations.

7.1.2 Types B and C shall be available with the size adjustment capability of 14¾ to 21 in. (374.7 to 533.4 mm) by increments of ¼ in. (6.4 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 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. (50.8 mm) below the gaff to 6 in. (152.4 mm) 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 (1.34 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. (406.4 mm) 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. (36.5 mm) on the underside. Tree gaffs shall measure not more than 3½ in. (88.9 mm), nor less than 2¼ in. (57.2 mm) on the underside. Gaff design shall be as shown in Fig. 4.

TABLE 1 Properties of Steel and Aluminum Alloys Acceptable for Climbers

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

<sup>A</sup> Data from Federal Specification RF-C-430 C.

<sup>B</sup> Brinell hardness number with 3000-kg load, 10-mm ball.

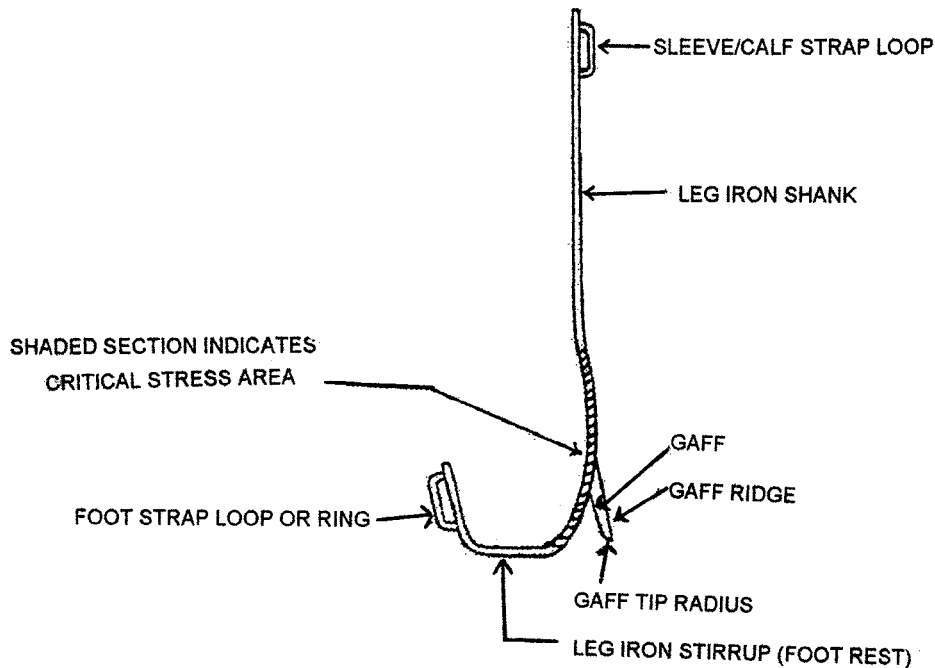


FIG. 3 Critical Stress Area of the Climber

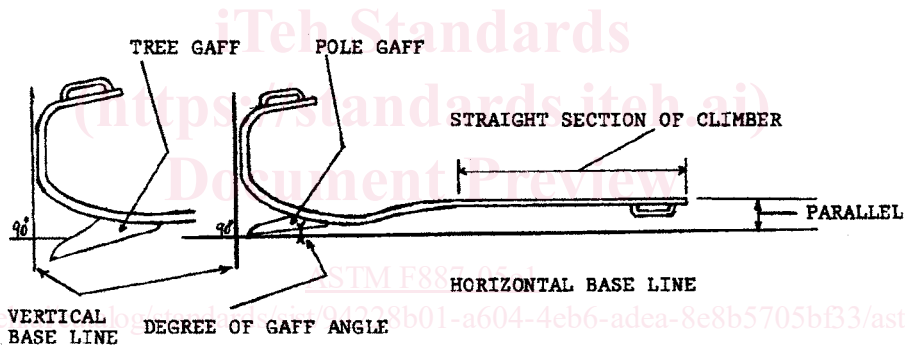


FIG. 4 Gaff Design

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. (9.6 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.

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.

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. (25.4 mm) in width and 1/8 in. (3.18 mm) in thickness. The length shall be not less than 22 in. (55.9 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*:

TABLE 2 Properties of Steel Alloy Acceptable for Gaffs

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

<sup>A</sup> 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.

<sup>B</sup> Brinell hardness number with 3000-kg load, 10-mm ball.



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. (78.9 kN/m) of width with buckle holes. The buckle holding strength of leather shall be not less than 200 lbf (0.89 kN) static load when determined as follows:

9.2.1.1 Punch a hole  $\frac{3}{16}$  in. (4.76 mm) in diameter, centrally located in a 1 in. (25.4 mm) wide piece of strap, 1 in. (25.4 mm) 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 lbf (0.89 kN).

9.2.2 The leather shall show no cracking on the grain side when bent slowly over a  $\frac{1}{2}$  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. (105.1 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 lbf (1.34 kN) 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  $\frac{3}{16}$  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 Velcro<sup>4</sup> 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 lbf (4.45 kN) 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. (25.4 mm) in width. Leather sleeve retaining

straps shall have a breaking strength of not less than 450 lbf/in. (78.9 kN/m) of width. Finished fabric sleeve retaining straps shall have a breaking strength of not less than 600 lbf/in. (105.1 kN/m) of width.

10.3.4 Sleeve retaining straps shall be capable of withstanding a direct pull of 175 lbf (0.78 kN). (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 lbf (3.12 kN) (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:

<sup>4</sup> Velcro is a trademark of Registrant Velcro Industries, B.V. Limited Liability Company Netherlands, Castorweg 22–24, Curacao Netherld Antilles.

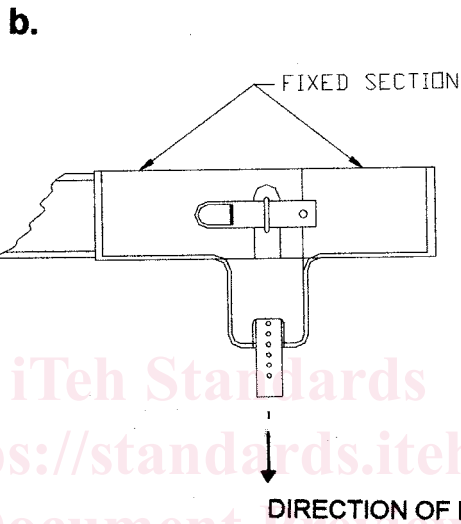
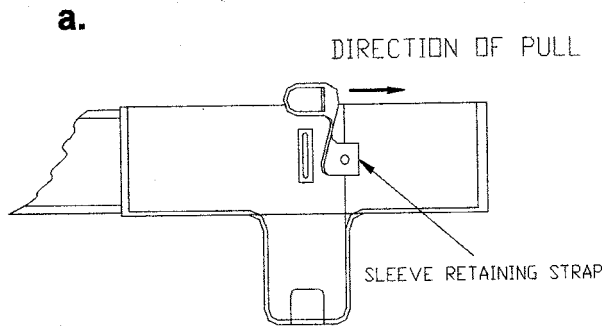


FIG. 5 Sleeve Retaining Straps on Velcro Wrap Style Pads

- 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

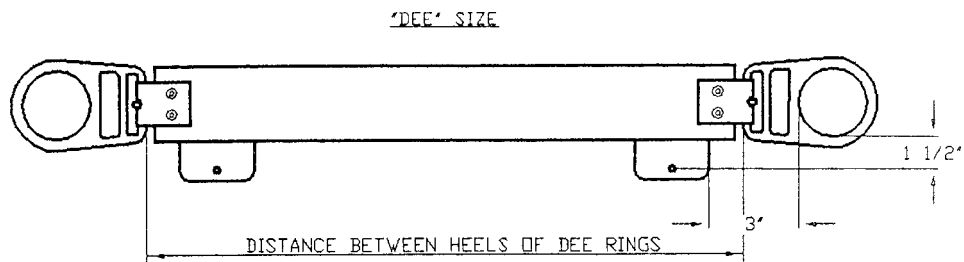


FIG. 6 “Dee” Measurement