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**Subchapter 7. General Industry Safety Orders**  
**Group 1. General Physical Conditions and Structures Orders**  
**Article 6. Powered Platforms and Equipment for Building Maintenance**

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**Appendix C to Article 6.**

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Personal Fall Arrest System  
(Sections I and II-Mandatory);  
(Section III Non-Mandatory).

Use of the Appendix

Section I of Appendix C sets out the criteria for personal fall arrest systems used by all employees using powered platforms, as required by Section 3299. Section II sets out test procedures which shall be used to determine compliance with applicable requirements contained in Section I of this Appendix. Section III provides non-mandatory guidelines which are intended to assist employers in complying with these provisions.

I. Personal Fall Arrest Systems.

- (a) Scope and Application. This section establishes the application of and performance criteria for personal fall arrest systems which are required for use by all employees using powered platforms under Article 6.
- (b) Definitions. Definitions that apply to terms used in Appendix C are located in Article 5, Section 3281.
- (c) Design for System Components.
- (1) Connectors shall be drop forged, pressed or formed steel, or made of equivalent materials.
  - (2) Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of the system.
  - (3) Lanyards and vertical safety lines which tie-off one employee shall have a minimum breaking strength of 5,000 pounds. All ends shall be spliced or swaged as per the manufacturer's specifications. Knots shall

not be permitted at ends or anywhere along the length of the lanyard or "safety line".

(4) Self-retracting safety lines and lanyards which automatically limit free fall distance to two feet or less shall have components capable of sustaining a minimum static tensile load of 3,000 pounds applied to the device with the safety line or lanyard in the fully extended position.

(5) Self-retracting safety lines and lanyards which do not limit free fall distance to two feet or less, ripstitch lanyards, and tearing and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds applied to the device with the safety line or lanyard in the fully extended position.

(6) Dee-rings and snap-hooks shall be capable of sustaining a minimum tensile load of 5,000 pounds.

(7) Dee-rings and snap-hooks shall be 100 percent proof-tested to a minimum tensile load of 3,600 pounds without cracking, breaking, or taking permanent deformation.

(8) Snap-hooks shall be sized to be compatible with the member to which they are connected. Only double-acting snap-hooks designed to prevent accidental disengagement shall be used.

(9) Horizontal safety lines, where used, shall be designed under the supervision of a professional engineer currently registered in the State of California and installed as part of a complete personal fall arrest system, which maintains a safety factor of at least two.

(10) Anchorages to which personal fall arrest equipment is attached shall be capable of supporting at least 5,000 pounds per employee attached, or shall be designed under the supervision of a professional engineer currently registered in the State of California and installed and used as part of a complete personal fall arrest system which maintains a safety factor of at least two.

(11) Ropes and straps (webbing) used in lanyards, safety lines, and strength components of body harnesses, shall be made from synthetic fibers or wire rope.

(12) All body harnesses and lanyards manufactured on or before January 1, 1998, shall be designed and built to conform to ANSI A10.14-1975, Requirements for Safety Belts, Harnesses, Lanyards, Lifelines and Drop Lines for Construction and Industrial Use, which is hereby incorporated by reference.

(13) All personal fall arrest, personal fall restraint and positioning device systems manufactured after January 1, 1998, shall be designed and built to conform to either ANSI A10.14-1991 American National Standard for Construction and Demolition Use, or ANSI Z359.1-1992 American National Standard Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components, which are hereby incorporated by reference.

(d) System Performance Criteria.

(1) Personal fall arrest systems shall, when stopping a fall:

(A) Limit maximum arresting force on an employee to 1,800 pounds when used with a body harness;

(B) Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet; and (C) Have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of six feet, or the free fall distance permitted by the system, whichever is less.

(2)(A) When used by employees having a combined person and tool weight of less than 310 pounds,

personal fall arrest systems which meet the criteria and protocols contained in paragraphs (b), (c) and (d) in Section II of this Appendix shall be considered as complying with the provisions of subparagraphs (d)(1)(A) through (d)(1)(C) above.

(B) When used by employees having a combined tool and body weight of 310 pounds or more, personal fall arrest systems which meet the criteria and protocols contained in paragraphs (b), (c) and (d) in Section II may be considered as complying with the provisions of subparagraphs (d)(1)(A) through (d)(1)(C), provided that the criteria and protocols are modified appropriately to provide proper protection for such heavier weights.

(e) Care and Use.

(1) Body belts shall not be used as part of a personal fall arrest system.

(2) Devices used to connect to a horizontal safety line which may become a vertical safety line shall be capable of locking in either direction on the safety line.

(3) Personal fall arrest systems shall be rigged such that an employee can neither free fall more than six feet, nor contact any lower level obstacle.

(4) The attachment point of the body belt shall be located in the center of the wearer's back. The attachment point of the body harness shall be located in the center of the wearer's back near shoulder level or above the wearer's head.

(5) When vertical safety lines are used, each employee shall be provided with a separate safety line.

(6) Personal fall arrest systems or components shall be used only for employee fall protection.

(7) Personal fall arrest systems or components subjected to impact loading shall be immediately removed from service and shall not be used again for employee protection until repaired or replaced. Repaired or replaced components or component parts shall meet the performance and testing requirements of this appendix.

(8) The employer shall provide for prompt rescue of employees in the event of a fall or shall assure the self-rescue capability of employees.

(9) Before using a personal fall arrest system, and after any component or system is changed, employees shall be trained in accordance with the requirements of Section 3298 in the safe use of the system.

(f) Inspections.

(1) Personal fall arrest systems shall be inspected prior to each use for mildew, wear, damage and other deterioration, and defective components shall be removed from service if their strength or function may be adversely affected.

(2) Each personal fall arrest system shall be inspected not less than twice annually by a competent person in accordance with the manufacturer's recommendations. The date of each inspection shall be documented

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(c), Health and Safety Code.

## II. Test Methods for Personal Fall Arrest Systems.

(a) General. Paragraphs (b), (c), (d) and (e) of this Section II set forth test procedures which shall be used to determine compliance with requirements in subparagraphs (d)(1)(A) through d)(1)(D) of Section I of this Appendix.

(b) General conditions for all tests in Section II.

(1) Safety lines, lanyards and deceleration devices shall be attached to an anchorage and connected to the body harness in the same manner as they would be when used to protect employees.

(2) The anchorage shall be rigid, and shall not have a deflection greater than .04 inches when a force of 2,250 pounds is applied.

(3) The frequency response of the load measuring instrumentation shall be 120 Hz.

(4) The test weight used in the strength and force tests shall be a rigid, metal, cylindrical or torso-shaped object with a girth of 38 inches plus or minus four inches.

(5) The lanyard or safety line used to create the free fall distance shall be supplied with the system, or in its absence, the least elastic lanyard or safety line available to be used with the system.

(6) The test weight for each test shall be hoisted to the required level and shall be quickly released without having any appreciable motion imparted to it.

(7) The system's performance shall be evaluated taking into account the range of environmental conditions for which it is designed to be used.

(8) Following the test, the system need not be capable of further operation.

(c) Strength Test.

(1) During the testing of all systems, a test weight of 300 pounds plus or minus five pounds shall be used. (See subparagraph (b)(4), above.)

(2) The test consists of dropping the test weight once. A new unused system shall be used for each test.

(3) For lanyard systems, the lanyard length shall be six feet plus or minus two inches as measured from the fixed anchorage to the attachment on the body harness.

(4) For rope-grab-type deceleration systems, the length of the safety line above the centerline of the grabbing mechanism to the safety line's anchorage point shall not exceed two feet.

(5) For lanyard systems, for systems with deceleration devices which do not automatically limit free fall distance to two feet or less, and for systems with deceleration devices which have a connection distance in excess of one foot (measured between the centerline of the safety line and the attachment point to the body belt or harness) the test weight shall be rigged to free fall a distance of 7.5 feet from a point that is 1.5 feet above the anchorage point, to its hanging location (six feet below the anchorage). The test weight shall fall without interference, obstruction, or hitting the floor or ground during the test. In some cases, a non-elastic wire lanyard of sufficient length may need to be added to the system (for test purposes) to create the necessary free fall distance.

(6) For deceleration device systems with integral safety lines or lanyards which automatically limit free fall distance to two feet or less, the test weight shall be rigged to free fall a distance of four feet.

(7) Any weight which detaches from the belt or harness shall constitute failure for the strength test.

(d) Force Test.

(1) General. The test consists of dropping the respective test weight specified subsection in (d)(2)(A) or (d)(3)(A) once. A new, unused system shall be used for each test.

(2) For lanyard systems.

(A) A test weight of 220 pounds plus or minus three pounds shall be used. (See subparagraph (b)(4), above.)

(B) Lanyard length shall be six feet plus or minus two inches as measured from the fixed anchorage to the attachment on the body harness.

(C) The test weight shall fall free from the anchorage level to its hanging location (a total of six feet free fall distance) without interference, obstruction, or hitting the floor or ground during the test.

(3) For all other systems. (A) A test weight of 220 pounds plus or minus three pounds shall be used. (See subparagraph (b)(4), above.)

(B) The free fall distance to be used in the test shall be the maximum fall distance physically permitted by the system during normal use conditions, up to a maximum free fall distance for the test weight of six feet, except as follows:

1. For deceleration systems which have a connection link or lanyard, the test weight shall free fall a distance equal to the connection distance (measured between the centerline of the safety line and the attachment point to the body harness).

2. For deceleration device systems with integral safety lines or lanyards which automatically limit free fall distance to two feet or less, the test weight shall free fall a distance equal to that permitted by the system in normal use. (For example, to test a system with a self-retracting safety line or lanyard, the test weight shall be supported and the system allowed to retract the safety line or lanyard as it would in normal use. The test weight would then be released and the force and deceleration distance measured).

(4) A system fails the force test if the recorded maximum arresting force exceeds 2,520 pounds when using a body harness.

(5) The maximum elongation and deceleration distance shall be recorded during the force test.

(e) Deceleration Device Tests.

(1) General. The device shall be evaluated or tested under the environmental conditions, (such as rain, ice, grease, dirt, type of safety line, etc.), for which the device is designed.

(2) Rope-grab-type deceleration devices.

(A) Devices shall be moved on a safety line 1,000 times over the same length of line a distance of not less

than one foot, and the mechanism shall lock each time.

(B) Unless the device is permanently marked to indicate the type(s) of safety line which must be used, several types (different diameters and different materials) of safety lines shall be used to test the device.

(3) Other self-activating-type deceleration devices. The locking mechanisms of other self-activating-type deceleration devices designed for more than one arrest shall lock each of 1,000 times as they would in normal service.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(c), Health and Safety Code.

III. Non-Mandatory Guidelines for Personal Fall Arrest Systems. The following information constitutes additional guidelines for use in complying with requirements for a personal fall arrest system.

(a) Selection and Use Considerations. The kind of personal fall arrest system selected should match the particular work situation, and any possible free fall distance should be kept to a minimum. Consideration should be given to the particular work environment. For example, the presence of acids, dirt, moisture, oil, grease, etc., and their effect on the system should be evaluated. Hot or cold environments may also have an adverse affect on the system. Wire rope should not be used where an electrical hazard is anticipated. As required by the standard, the employer must plan to have means available to promptly rescue an employee should a fall occur, since the suspended employee may not be able to reach a work level independently.

Where lanyards, connectors, and safety lines are subject to damage by work operations such as welding, chemical cleaning, and sandblasting, the component should be protected or other securing systems should be used. The employer should fully evaluate the work conditions and environment (including seasonal weather changes) before selecting the appropriate personal fall protection system. Once in use, the system's effectiveness should be monitored. In some cases, a program for cleaning and maintenance of the system may be necessary.

(b) Testing Considerations. Before purchasing or putting into use a personal fall arrest system, an employer should obtain from the supplier information about the system based on its performance during testing so that the employer can know if the system meets this standard. Testing should be done using recognized test methods.

Section II of this Appendix C contains test methods recognized for evaluating the performance of fall arrest systems. Not all systems may need to be individually tested; the performance of some systems may be based on data and calculations derived from testing of similar systems, provided that enough information is available to demonstrate similarity of function and design.

(c) Component Compatibility Considerations. Ideally, a personal fall arrest system is designed, tested, and supplied as a complete system. However, it is common practice for lanyards, connectors, safety lines, deceleration devices, and body harnesses to be interchanged since some components wear out before others. The employer and employee should realize that not all components are interchangeable. For instance, a lanyard should not be connected between a body harness and a deceleration device of the self-retracting type since this can result in additional free fall for which the system was not designed. Any substitution or change to a personal fall arrest system should be fully evaluated or tested by a qualified person to determine that it meets the standard, before the modified system is put in use.

(d) Employee Training Considerations.

Thorough employee training in the selection and use of personal fall arrest systems is imperative. As stated in the standard, before the equipment is used, employees must be trained in the safe use of the system. This should include the following: Application limits; proper anchoring and tie-off techniques; estimation of free fall distance, including determination of deceleration distance, and total fall distance to prevent striking a lower level; methods of use; and inspection and storage of the system. Careless or improper use of the equipment can result in serious injury or death. Employers and employees should become familiar with the material in this appendix, as well as manufacturer's recommendations, before a system is used. Of uppermost importance is the reduction in strength caused by certain tie-offs (such as using knots, tying around sharp edges, etc.) and maximum permitted free fall distance. Also, to be stressed are the importance of inspections prior to use, the limitations of the equipment, and unique conditions at the worksite which may be important in determining the type of system to use.

(e) Instruction Considerations. Employers should obtain comprehensive instructions from the supplier as to the system's proper use and application, including, where applicable:

- (1) The force measured during the sample force test;
- (2) The maximum elongation measured for lanyards during the force test;
- (3) The deceleration distance measured for deceleration devices during the force test;
- (4) Caution statements on critical use limitations;
- (5) Application limits;
- (6) Proper hook-up, anchoring and tie-off techniques, including the proper dee-ring or other attachment point to use on the body harness for fall arrest;
- (7) Proper climbing techniques;
- (8) Methods of inspection, use, cleaning, and storage; and
- (9) Specific safety lines which may be used.

This information should be provided to employees during training.

(f) Inspection Considerations. As stated in the standard (Section I, paragraph (f)), personal fall arrest systems must be regularly inspected. Any component with any significant defect, such as cuts, tears, abrasions, mold, or undue stretching; alterations or additions which might affect its efficiency; damage due to deterioration; contact with fire, acids, or other corrosives; distorted hooks or faulty hook springs; tongues unfitted to the shoulder of buckles; loose or damaged mountings; non-functioning parts; or wearing or internal deterioration in the ropes must be withdrawn from service immediately, and should be tagged or marked as unusable, or destroyed.

(g) Rescue Considerations. As required by the standard (Section I, subparagraph (e)(8)), when personal fall arrest systems are used, the employer must assure that employees can be promptly rescued or can rescue themselves should a fall occur. The availability of rescue personnel, ladders or other rescue equipment should be evaluated. In some situations, equipment which allows employees to rescue themselves after the fall has been arrested may be desirable, such as devices which have descent

capability.

(h) Tie-off Considerations.

(1) One of the most important aspects of personal fall protection systems is fully planning the system before it is put into use. Probably the most overlooked component is planning for suitable anchorage points. Such planning should ideally be done before the structure or building is constructed so that anchorage points can be incorporated during construction for use later for window cleaning or other building maintenance. If properly planned, these anchorage points may be used during construction, as well as afterwards.

(2) Employers and employees should at all times be aware that the strength of a personal fall arrest system is based on its being attached to an anchoring system which does not significantly reduce the strength of the system (such as properly dimensioned eye-bolt/snap-hook anchorage). Therefore, if a means of attachment is used that will reduce the strength of the system, that component should be replaced by a stronger one, but one that will also maintain the appropriate maximum arrest force characteristics.

(3) Tie-off using a knot in a rope lanyard or safety line (at any location) can reduce the safety line or lanyard strength by 50 percent or more. Therefore, a stronger lanyard or safety line should be used to compensate for the weakening effect of the knot, or the lanyard length should be reduced (or the tie-off location raised) to minimize free fall distance, or the lanyard or safety line should be replaced by one which has an appropriately incorporated connector to eliminate the need for a knot.

(4) Tie-off a rope lanyard or safety line around an "H" or "I" beam or similar support can reduce its strength as much as 70 percent due to the cutting action of the beam edges. Therefore, use should be made of a webbing lanyard or wire core safety lines around the beam; or the lanyard or safety line should be protected from the edge; or free fall distance should be greatly minimized.

(5) Tie-off where the line passes over or around rough or sharp surfaces reduces strength drastically. Such a tie-off should be avoided or an alternative tie-off rigging should be used. Such alternatives may include use of a snaphook/dee ring connection, wire rope tie-off, an effective padding of the surfaces, or an abrasion-resistance strap around or over the problem surface.

(6) Horizontal safety lines may, depending on their geometry and angle of sag, be subjected to greater loads than the impact load imposed by an attached component. When the angle of horizontal safety line sag is less than 30 degrees, the impact force imparted to the safety line by an attached lanyard is greatly amplified. For example, with a sag angle of 15 degrees, the force amplification is about 2:1 and at 5 degrees sag, it is about 6:1.

Depending on the angle of sag, and the line's elasticity, the strength of the horizontal safety line and the anchorages to which it is attached should be increased a number of times over that of the lanyard. Extreme care should be taken in considering a horizontal safety line for multiple tie-offs. The reason for this is that in multiple tie-offs to a horizontal safety line, if one employee falls, the movement of the falling employee and the horizontal safety line during arrest of the fall may cause other employees to also fall. Horizontal safety line and anchorage strength should be increased for each additional employee to be tied-off. For these and other reasons, the design of systems using horizontal safety lines must only be done by qualified persons. Testing of installed safety lines and anchors prior to use is recommended.

(7) The strength of an eye-bolt is rated along the axis of the bolt and its strength is greatly reduced if the

force is applied at an angle to this axis (in the direction of shear). Also, care should be exercised in selecting the proper diameter of the eye to avoid accidental disengagement of snap-hooks not designed to be compatible for the connection.

(8) Due to the significant reduction in the strength of the safety line/lanyard (in some cases, as much as a 70 percent reduction), the sliding hitch knot should not be used for safety line/lanyard connections except in emergency situations where no other available system is practical. The "one-and-one" sliding hitch knot should never be used because it is unreliable in stopping a fall. The "two-and-two" or "three-and-three" knot (preferable), may be used in emergency situations; however, care should be taken to limit free fall distance to a minimum because of reduced safety line/lanyard strength.

(i) Vertical Safety Line Considerations. As required by the standard, each employee must have a separate safety line when the safety line is vertical. The reason for this is that in multiple tie-offs to a single safety line, if one employee falls, the movement of the safety line during the arrest of the fall may pull other employees' lanyards, causing them to fall as well.

(j) Free Fall Considerations. The employer and employee should at all times be aware that a system's maximum arresting force is evaluated under normal use conditions established by the manufacturer, and in no case using a free fall distance in excess of six feet. A few extra feet of free fall can significantly increase the arresting force on the employee, possibly to the point of causing injury. Because of this, the free fall distance should be kept at a minimum, and, as required by the standard, in no case greater than six feet. To help assure this, the tie-off attachment point to the safety line or anchor should be located at or above the connection point of the fall arrest equipment to harness. (Since otherwise additional free fall distance is added to the length of the connecting means (i.e. lanyard)). Attaching to the working surface will often result in a free fall greater than six feet. For instance, if a six foot lanyard is used, the total free fall distance will be the distance from the working level to the body harness attachment point plus the six feet of lanyard length. Another important consideration is that the arresting force which the fall system must withstand also goes up with greater distance of free fall, possibly exceeding the strength of the system.

(k) Elongation and Deceleration Distance Considerations. Other factors involved in a proper tie-off are elongation and deceleration distance. During the arresting of a fall, a lanyard will experience a length of stretching or elongation, whereas activation of a deceleration device will result in a certain stopping distance. These distances should be available with the lanyard or device's instructions and must be added to the free fall distance to arrive at the total fall distance before an employee is fully stopped. The additional stopping distance may be very significant if the lanyard or deceleration device is attached near or at the end of a long safety line, which may itself add considerable distance due to its own elongation. As required by the standard, sufficient distance to allow for all of these factors must also be maintained between the employee and obstructions below, to prevent an injury due to impact before the system fully arrests the fall. In addition, a minimum of 12 feet of safety line should be allowed below the securing point of a rope grab type deceleration device, and the end terminated to prevent the device from sliding off the safety line should extend to the ground or the next working level below. These measures are suggested to prevent the worker from inadvertently moving past the end of the safety line and having the rope grab become disengaged from the safety line.

(l) Obstruction Considerations. The location of the tie-off should also consider the hazard of obstructions in the potential fall path of the employee. Tie-offs which minimize the possibilities of exaggerated swinging should be considered.

(m) Other Considerations. Because of the design of some personal fall arrest systems, additional considerations may be required for proper tie-off. For example, heavy deceleration devices of the self-retracting type should be secured overhead in order to avoid the weight of the device having to be supported by the employee. Also, if self-retracting equipment is connected to a horizontal safety line, the sag in the safety line should be minimized to prevent the device from sliding down the safety line to a position which creates a swing hazard during fall arrest. In all cases, manufacturer's instructions should be followed.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and section 18943(c), Health and Safety Code.

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