

AIR FORCE SPECIALTY CODE 1S0X1 OCCUPATIONAL SAFETY

Fall Protection



QUALIFICATION TRAINING PACKAGE
(QTP)

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RELEASABILITY: There are no releasability restrictions on this publication.

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Chapter 1

INTRODUCTION

1.1. Overview. This publication implements training requirements found in DAFMAN 91-203, *Air Force Occupational Safety, Fire, and Health Standards*, under the following chapters: Chapter 7 *Walking-Working Surfaces*, Chapter 13 *Fall Protection*, Chapter 16 *Mobile Elevating Work Platforms and Scaffolding*, and fall protection requirements found in Chapter 24 *Aircraft Flightline – Ground Operations and Activities*. This training requirements ensure safety professionals can meet requirements found in DAFI 91-202, *The US Air Force Mishap Prevention Program*, that implement requirements under 29 Code of Federal Regulations (CFR) 1960.56, *Training of Safety and Health Specialists*. This assures Safety and Health Specialists can competently perform consultation, inspection, and hazard recognition responsibilities under the Air Force Mishap Prevention Program. This publication is applicable to all personnel in the Occupational Safety career field regardless of service affiliation.

1.1.1. This Qualification Training Package (QTP) is used to ensure basic competency for 5-level upgrade of Occupational Safety Professionals to effectively inspect, consult, and recognize hazards associated with the fall protection program. Additionally, this QTP can be used to train DAF civilian safety personnel who require initial or additional training on fall protection requirements. Chapter topics are not all inclusive and trainers are encouraged to expand on information by sharing statistics, experiences, and stories about fall protection with their trainees to enhance training.

1.1.2. Send comments and suggested improvements on DAF Form 847, *Recommendation for Change of Publication*, through your MAJCOM/FLDCOM to the Air Force Safety Center (AFSEC) (afscseg@us.af.mil).

1.2. Objectives.

1.2.1. After completing the required lectures, demonstrations, and hands-on sessions, trainees will be able to complete the Knowledge Check with a passing score and be able to perform a program assessment without the assistance of a trainer.

1.2.2. This training will ensure the trainee has the knowledge and skills to achieve the desired learning outcomes.

1.3. Desired Learning Outcomes. Trainee can assess, inspect, and provide recommendations on fall protection activities based on DoD, DAF, Occupational Safety and Health Administration (OSHA), and American National Standards Institute (ANSI) consensus standards.

1.4. Lesson Duration. Recommended minimum training time is thirty-eight (38) hours with an overall training timeframe of 3-6 months to develop a base-level proficiency in performing consultations, inspections, hazard recognition, and program assessments. See **Table 1.1.** for a recommended breakdown.

1.5. Optional Training, Aids, and Equipment.

1.5.1. Contact local Aircrew Flight Equipment shop or equivalent to coordinate a harness hang event to familiarize the trainee with real world conditions after a fall and how suspension trauma occurs. Depending on the airframe they support, the Aircrew Flight Equipment shop will be familiar with the process because aircrew have a recurring requirement to accomplish harness hang training.

1.5.2. Contact local fall protection companies to request a fall protection equipment demonstration.

1.5.3. Attend internal fall protection training for work centers at your installation (Civil Engineering, Fire Department, tower climbers, etc.).

1.5.4. Attend a national safety conference and have the vendors provide a demonstration.

1.5.5. Complete OSHA 3115 – *Fall Protection Course*.

1.5.6. Review online videos of applicable fall protection topics, safety equipment, and manufacturer's instructions.

Table 1.1. Recommended Training Time for Training Activities

Training Activity	Recommended Training Time (hrs.)
Trainee's independent review of related publications and references.	8
Trainer led review of related publications and references.	4
Trainer's lecture and demonstration	4
Trainer led hand-on training	4
Trainee led hand-on demonstration	4
Work center visits and Confined Space program evaluation.	8
Trainer's lecture and demonstration	4
Complete and review the Knowledge Check	2
TOTAL	38

Chapter 2

QTP ROLES AND RESPONSIBILITIES

2.1. Trainer Responsibilities.

2.1.1. Ensure Comprehensive Training: The trainer is responsible for providing comprehensive training on Fall Protection concepts and procedures to all trainees, as outlined in this QTP and relevant regulations, which encompass those described within this QTP, including those listed in Attachment 1.

2.1.1.1. Furthermore, multiple chapters conclude with several "Visual Aid" links, offering further elaboration and visual support on the respective topic.

2.1.1.2. The trainer should ensure all trainees and additional trainers have access to the applicable safety milSuite and milBook websites. This is required to access some Visual Aids.

2.1.2. Integrate Real-World Scenarios: Customize the training program to incorporate real-world scenarios, offering practical insights and examples to reinforce understanding.

2.1.3. Organize Hands-On Training: Coordinate and facilitate hands-on training sessions during site visits within the work center or at the nearest installation. This should encompass assessing the Fall Protection program, conducting equipment usage and inspection exercises, evaluating documentation, and identifying and mitigating hazards.

2.1.4. Collaborate with MAJCOM SEG: Establish communication with the respective MAJCOM Occupational Safety (SEG) office to access relevant Fall Protection standards and guidance. This must include access to applicable ANSI standards.

2.1.5. Demonstrate Fall Protection Equipment: Illustrate the proper functioning of fall protection equipment either through on-site practical demonstrations, by employing examples, or through video examples.

2.1.6. Administer Knowledge Check: Conduct a Knowledge Check test for the trainee, see Attachment 2 Knowledge Check for the test and answer key. Thoroughly review any questions missed by the trainee during the test, ensuring a comprehensive understanding.

2.2. Trainee Responsibilities.

2.2.1. Actively Engage in their Confined Space training program.

2.2.2. Familiarize themselves with this QTP, relevant Fall Protection regulations, and forms, including those listed on Attachment 1.

2.2.3. Effectively communicate with the trainer or supervisor if any aspect of the training is unclear or if there are questions regarding procedures.

2.2.4. Successfully complete the Knowledge Check administered by the instructor with a score of **90% or higher**. Collaborate with the instructor to review and address any incorrectly answered questions.

Chapter 3

FALL PROTECTION PROGRAM

3.1. Overview. Falls are one of the most common causes of serious work-related injuries and deaths in the workplace. Employers must take measures in their workplaces to prevent employees from falling off overhead platforms, elevated workstations, or into holes in the floor or walls.

3.2. General Definitions.

3.2.1. Fall Protection: Means any equipment, device, or system that prevents an employee from falling from an elevation or mitigates the effect of such a fall.

3.2.2. Fall Protection's Purpose: To protect employees from serious injury or death that need to work in elevated locations which meet the OSHA trigger heights. Hazards include working at heights, floor openings, wall openings, and open sides of floors and platforms with access to lower levels.

3.2.3. Fall Prevention: Preventing workers from falling by using engineering controls (e.g., guardrails and hole covers) or restraint systems.

3.2.4. Fall Arrest/Rescue: Preventing injury during and after a fall by using Personal Fall Arrest Systems (PFAS) or safety nets and having an effective rescue plan in place.

3.3. Requirements. A fall protection program is required when employees are working at heights. See **Table 3.1.** for the trigger heights, which requires the implementation of a fall protection program.

Table 3.1. Fall Protection Program Trigger Heights.

Work Area	Trigger Height	Reference
General Industry	4 feet	29 CFR 1910.28(b)(1)(i)
Construction Industry	6 feet	29 CFR 1926.501(b)(1)
Scaffolding	10 feet	29 CFR 1926.451(g)(1)
Steel Erecting	15 feet 30 feet for connectors	29 CFR 1926.760(a)(1) & (b)(1)

3.4. Fall Protection Program.

3.4.1. Unit Fall Protection Policy. A policy statement will be developed that states the Commander's commitment to providing a safe workplace for employees working at heights. The policy will also provide general goals and guidance for the fall protection program. An example statement can be found in ANSI/ASSP Z359.2-2023, *Minimum Requirements for a Comprehensive Managed Fall Protection Program* (DAFMAN 91-203, 13.3.1.).

3.4.2. Unit Fall Protection Program Administration. The unit fall protection program will be administered and managed by a Competent Person. (DAFMAN 91-203, 13.3.2.2.).

3.5. Roles and Responsibilities.

3.5.1. Unit Commander. The unit commander is ultimately responsible for the development and implementation of the fall protection program that promotes a safe and healthful workplace (DAFMAN 91-203, 13.3.2.1.).

3.5.1.1. The competent person will be identified in writing by the unit commander and meet the requirements of ANSI/ASSP Z359.0 and ANSI/ASSP Z359.2 (DAFMAN 91-203, 13.3.2.2.).

3.5.2. Installation Occupational Safety. The Installation Occupational Safety office will provide advice and guidance to the Unit Fall Protection Program Administrator. (DAFMAN 91-203, 13.3.2.6.). These duties include:

3.5.2.1. Assisting in fall hazard surveys and development of written fall protection and rescue procedures to ensure rescue procedures, equipment, and training meet fall protection requirements.

3.5.2.2. Identifying unabated fall hazards and providing/tracking a Risk Assessment Codes (RACs).

3.5.2.3. Conduct thorough annual review of fall protection program elements and documents annually in safety inspection/assessment reports.

3.5.3. Fire & Emergency Services (F&ES) Flight. The F&ES Flight will assist in the fall hazard surveys and development of written fall protection and rescue procedures (DAFMAN 91-203, 13.3.2.7). Additionally, the F&ES Flight:

3.5.3.1. Will ensure equipment and training meet fall protection requirements.

3.5.3.2. May also act as the competent rescuer when they meet the requirements as defined in ANSI/ASSP Z359.0 to perform rescue at height when included in the organizational rescue plan and agreed to by the installation fire chief.

3.5.4. Authorized Rescuers. Authorized rescuers will meet the definition outlined in ANSI/ASSP Z359.0 and meet all applicable responsibilities in ANSI/ASSP Z359.2 (DAFMAN 91-203, 13.3.2.8).

3.5.5. Supervisors. IAW DAFMAN 91-203, 13.3.2.9., supervisors shall:

3.5.5.1. Ensure each authorized, qualified, and competent person using a fall protection/fall arrest system is trained and evaluated on proper use, application, and inspection of fall protection/fall arrest systems.

3.5.5.2. Be familiar with the shop's typical work assignments and fall protection/fall arrest systems required.

3.5.5.3. Be responsible for the procurement of fall protection/fall arrest systems required by the organization or shop as directed by the qualified person.

3.5.5.4. Be able to provide recommendations for qualified and competent personnel in the organization to the unit commander.

3.5.5.5. Be designated in writing by the unit commander.

3.5.5.6. A supervisor may also be a qualified, competent and/or authorized person if they meet the training requirements listed in DAFMAN 91-203, 13.7. *Training*.

3.5.6. Trainers. Trainers will be designated in writing by the unit commander (DAFMAN 91-203, 13.3.2.10).

3.5.7. Qualified Person. A qualified person supports the fall protection program with expertise in various areas such as engineering and system design. IAW DAFMAN 91-203, 13.3.2.3., ANSI/ASSP Z359.0, and ANSI Z359.2-2017 the qualified person shall:

3.5.7.1. Be designated in writing by the unit commander.

3.5.7.2. Be trained and meet the responsibilities outlined in ANSI/ASSP Z359.2 and as defined in 29 CFR 1910.21(b), *Definitions*.

3.5.7.3. Supervise the design, selection, installation, use, and inspection of anchorages and horizontal lifelines.

3.5.7.4. Calculates, tests, and publishes proper procedures for utilizing PFAS equipment.

3.5.7.5. Certify anchorages below 5000lbs.; HOWEVER, must be rated for a safety factor of 2.

3.5.7.6. Participate in the investigation of all incidents related to falls from heights as required.

3.5.8. Competent Person. A competent person supervises, implements, and monitors the fall protection program. Usually a supervisor or manager, they have more experience in fall protection than authorized persons and can halt work if safety concerns arise. IAW DAFMAN 91-203, 13.3.2.4., ANSI/ASSP Z359.0, and ANSI Z359.2-2017, the competent person shall:

3.5.8.1. Be designated in writing by the unit commander.

3.5.8.2. Be trained and meet the responsibilities outlined in ANSI/ASSP Z359.2 and as defined in 29 CFR 1910.140(b), *Definitions*.

3.5.8.3. Supervise, implement, and monitor the fall protection program.

3.5.8.4. Periodically inspect all fall protection equipment. To include anchors, body harness, and connectors of the fall protection program.

3.5.8.5. Conduct initial Fall Hazard Survey (See Chapter 4).

3.5.8.6. Identify, evaluate, and impose limits, controls, and monitor swing falls.

3.5.8.7. Has authority to STOP work immediately and take prompt corrective actions.

3.5.8.8. Implement a fall protection plan and rescue plan.

3.5.8.9. Participates in the investigation of all mishaps related to falls from heights.

3.5.8.10. Verifies PFAS have been installed and inspected per manufacturer's instructions. Immediately remove from service all damaged PFAS components or components subjected to the forces of arresting a fallen person.

3.5.8.11. Verifies training of authorized persons on fall protection and rescue procedures

3.5.8.12. Establishes clearance requirements prior to authorized persons starting work.

3.5.8.13. Supervise the selection, installation, use, and inspection of anchorages (≥ 5000 lbs.) in consultation with the program administrator and qualified person.

3.5.9. Authorized Person. An authorized person understands their employer's policies and procedures regarding fall protection and follows instructions from the competent person. IAW DAFMAN 91-203, 13.3.2.5., 29 CFR 1910.21(b), ANSI/ASSP Z359.0, ANSI/ASSP Z359.2, and ANSI Z359.2-2017, the competent person shall:

3.5.9.1. Alert the competent person about any unsafe conditions before starting work.

3.5.9.2. Properly use, inspect, maintain, store, and care for fall protection equipment.

3.5.9.3. Inspect all fall protection equipment prior to use and notify the competent person of any defects or damage.

3.6 Training Requirements. Before employees are exposed to a fall hazard, training shall be completed IAW 29 CFR 1910.30, *Training Requirements* (DAFMAN 91-203, 13.7).

3.6.1. Trainers conducting fall protection and rescue training shall meet the requirements of ANSI/ASSP Z490.1.

3.6.2. Authorized personnel will be trained by a Competent or Qualified person trainer IAW ANSI/ASSP Z359.2.

3.6.3. Program administrators shall be trained on all equipment and practices applicable to the scope of work IAW ANSI/ASSP Z359.2.

3.6.4. Retraining. IAW 29 CFR 1910.30(c), the employer must retrain an employee when the employer has reason to believe the employee does not have the understanding and skill required by 29 CFR 1910.30(a) and 1910.30(b). Situations requiring retraining include, but are not limited to, the following:

3.6.4.1. When changes in the workplace render previous training obsolete or inadequate.

3.6.4.2. When changes in the types of fall protection systems or equipment to be used render previous training obsolete or inadequate.

3.6.4.3. When inadequacies in an affected employee's knowledge or use of fall protection systems or equipment indicate that the employee no longer has the requisite understanding or skill necessary to use equipment or perform the job safely.

3.6.5. Recurring Training.

3.6.5.1. Recurring training shall be performed at least annually.

3.6.5.2. The training shall establish employee proficiency, include an in-depth review of current and previous procedures, and introduce a new or revised control methods and procedures, as necessary.

3.6.5.3. Personnel trained as Competent and Authorized persons shall be retrained at least every two years. Annual refresher training shall be conducted the year following attendance in the initial course.

3.6.5.4. Competent and Authorized persons who are also identified as rescuers must meet all Authorized Rescuers training requirements as identified in DAFMAN 91-203, 13.3.2.8.

3.6.6. Training Documentation. All training shall be documented in accordance with DAFI 91-202, with the required information detailed in OSHA Publication 2254, *Training Requirements in OSHA Standards*.

3.7. Fall Protection Plans. Fall protection plans will be used only in construction, for residential roofs, leading edge work and precast concrete erection work (DAFMAN 91-203, 13.6).

3.7.1. The written plan shall be coordinated with the installation Occupational Safety Office (or applicable tenant Safety office) before the plan and its procedural controls are used.

3.7.2. When it is determined to not be feasible to use fall protection systems while on residential roofs as identified in 29 CFR 1910.28(b)(1)(ii), a written fall protection plan, meeting the requirements of 29 CFR 1926.502(k) and coordinated with the installation Occupational Safety Office, shall be developed.

3.7.3. Training for the fall protection plan must meet the requirements of 29 CFR 1926.503(a) and 1926.503(c).

3.7.4. A corrective action plan will be accomplished describing planned upgrades (equipment, cost, and timetable, prioritized by the shop) and appropriate RAC, to eliminate need partially or totally for procedural controls.

3.7.5. Consistent with OSHA guidelines, cost shall not be a consideration for selecting the fall protection plan's procedural controls versus implementing fall protection.

3.8. Fall Mishap Reporting.

3.8.1. Falls from heights, regardless of whether an injury or damage has occurred, will be reported to the servicing Occupational Safety Office, and investigated by a competent person, and occupational safety personnel.

3.8.2. A mishap investigation will be accomplished to determine the cause of the fall and used to correct any issues found in procedures, equipment, or rescue, as applicable.

3.9. Visual Aids. These visual aids provide supplementary resources, including OSHA letters of interpretation, technical manual sections, and explanations of fall protection training requirements for both general industry and construction settings, as well as clarification on the definition of a "qualified trainer."

Visual Aid. OSHA Letter of Interpretation on “General Industry versus Construction”.
(<https://www.osha.gov/laws-regs/standardinterpretations/2003-11-18>)

Visual Aid. OSHA Technical Manual Section V: Chapter 4 (Fall Protection Requirements)
(<https://www.osha.gov/otm/section-5-construction-operations/chapter-4#appd>)

Visual Aid. OSHA Fall Protection Training Requirements- General Industry
(<https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.30>)

Visual Aid. OSHA Fall Protection Training Requirements- Construction
(<https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.503>)

Visual Aid. Explanation of “qualified trainer” OSHA Letter of Interpretation
(<https://www.osha.gov/laws-regs/standardinterpretations/2017-08-31>)

Chapter 4

FALL HAZARD SURVEY

4.1. Fall Hazard Survey. IAW DAFMAN 91-203, 13.4., a fall hazard survey will be conducted in all work areas where employees are exposed to fall hazards. The survey is designed to help employers and safety professionals identify potential fall hazards and determine the necessary steps to mitigate or eliminate them. This can include implementing engineering controls, such as guardrails or safety nets, as well as administrative controls, such as training and work practices, to reduce the risk of falls.

4.1.1. The survey team will be led by the unit competent/qualified person(s) and comprised of the work center supervisors, authorized persons, installation Occupational Safety Office and F&ES Flight. Refer to ANSI/ASSP Z359.2 for additional guidance about fall hazard surveys.

4.1.2. A fall hazard survey will include:

4.1.2.1. Identification of fall hazards and include details of each hazard such as means of access to the fall hazards, locations of the fall hazards, tasks that create exposure to fall hazards, and hidden fall hazards that are not always readily apparent.

4.1.2.2. Pertinent information about the fall hazards to include showing its basic configuration.

4.1.2.3. Identification of environmental factors that will affect the installation, use, inspection, maintenance and dismantling of any fall protection system.

4.1.2.4. A risk assessment to determine the level of risk for each fall hazard identified.

4.1.2.5. Appropriate abatement actions, as required by DAFI 91-202.

4.1.2.6. Selected fall protection method(s) for each identified hazard.

4.1.3. Competent or qualified person will prepare the fall hazard survey report and submit copies to the unit fall protection program administrator, F&ES Flight, and installation Occupational Safety Office.

4.1.4. Fall hazard surveys will be updated or re-accomplished when changes occur in the work center.

4.1.5. When fall hazards are identified resulting from item or equipment upgrades, modification or replacements, the DAF item managers (depot level) shall perform necessary functions (e.g., describing planned upgrades, costs, timetables, and prioritization), for DAF equipment not meeting fall protection standards.

4.2. Survey Components. The following points outline key aspects of a comprehensive Fall Hazard Survey, covering various elements to consider.

4.2.1. Means of access.

4.2.2. Locations.

4.2.3. Tasks creating fall hazard(s) exposure.

4.2.4. Hidden hazards not readily apparent.

4.2.5. Basic configuration information.

4.2.6. Environmental factors affecting the installation, use, inspection, maintenance, and dismantling of any fall protection system.

4.2.7. Risk assessment to determine the level of risk for each fall hazard identified.

4.2.8. If applicable, RAC(s).

4.2.9. Selected fall protection method(s) for each identified hazard. Note: If personal fall arrest systems are selected, the calculation of all clearances will be included in the written fall protection procedures. Employees shall not use PFAS until adequate clearances are available.

4.2.10. Secondary hazards to consider are electrical, thermal, chemical, sharp edges, abrasive surfaces, stability of structure, weather, unrelated operations, lighting, visibility, potential to hit mobile objects below, entanglement hazard, heat/fire hazards, corrosion of equipment due to environment, not having a two-person work policy, etc.

4.3. Application. Fall Hazard Surveys involve a systematic approach to identifying and mitigating fall hazards in the workplace. Below is guidance and a breakdown of key points:

4.3.1. Safety Professionals Evaluation. Safety professionals are tasked with assessing the placement of anchors concerning workers to determine potential hazards. They evaluate whether anchors are located above the head, at shoulder height, foot level, etc.

4.3.2. Verification of Edge Protection. Safety professionals ensure that edges are adequately protected from falls to lower levels, meeting trigger heights as per safety standards.

4.3.3. Inspection of Structure and Hardware. The integrity of the structure and hardware at the work location is inspected to ensure they are functional and free of defects that could compromise safety.

4.3.4. Assessment of Work Scope. Safety professionals assess the scope of work being undertaken to determine the specific fall protection measures required for each work process.

4.3.5. Identification of Equipment. Verification of the specific equipment needed to mitigate fall hazards is conducted. This includes determining whether fall arrest, fall restraint, or a combination of equipment is necessary.

4.3.6. Implementation of Control Measures. For each identified fall hazard in the work center, a corresponding fall protection control measure is assigned to mitigate the risk effectively.

4.3.7. Verification of Injury Prevention Processes. Safety professionals ensure that existing processes in place are sufficient to prevent serious injury or death in the event of a fall.

4.3.8. Consultation for Best Practices. Safety professionals consult with SMEs, other safety professionals, and relevant organizations to determine if best practices are being implemented and followed.

Chapter 5

FALL PROTECTION PROGRAM ASSESSMENT

5.1. Fall Protection Assessments. IAW DAFMAN 91-203, 13.3.3., the unit fall protection program administrator will assess the compliance of the fall protection program requirements, with assistance of the competent/qualified person, as needed.

5.1.1. Findings will be documented and corrected.

5.1.2. Final report will be routed to the unit commander for review and signature within 10 days of assessment completion.

5.1.3. The unit fall protection program administrator will maintain a minimum of three (3) years of completed assessments.

5.1.4. The installation or tenant unit's Occupational Safety Office will complete an annual assessment of fall protection program requirements for each unit and document results IAW DAFI 91-202.

5.2. Assessment Checklist. Table 5.1. incorporates assessment requirements described in DAFI 91-202 and DAFMAN 91-203. It is an example that can be used by both the Occupational Safety Office and fall protection program administrator.

Table 5.1. Fall Protection Program Assessment Checklist

Fall Protection Program Assessment Checklist	
Workplace:	Bldg.:
Inspection Item	Compliant?
Initial fall hazard survey date?	
Commander's Fall Protection Policy Letter current?	
Commander's appointment letter contains the following: Written documentation for who is identified as a trainer, administrator, competent, and/or qualified personnel whether they are within the organization or a contractor.	
Written fall protection training (how do they train and evaluated their personnel?) Training shall consist of lecture, demonstration, and hands-on application.	
If personal fall arrest systems are selected, the calculation of all clearances will be included in the written fall protection procedures.	
Manufacturer's Instructions for all equipment being utilized	
Written fall protection and Rescue procedures	
Fall protection self-assessment reviewed by the Commander	
Supervisor, who is a competent person, conduct, and document quarterly inspections of all organizational fall protection equipment	
Training documentation reflecting member roles and responsibilities for their unit's fall protection program	
Notes/Comments:	
Certifier/Signature:	Date:

Chapter 6

FALL PROTECTION AND RESCUE PROCEDURES

6.1. Overview. Fall protection and rescue procedures will be documented specifically for each workplace and task(s) they are applied to when the use of fall protection is required (DAFMAN 91-203, 13.5).

6.1.1. If a procedure can be effectively used in multiple workplaces/tasks, then the same procedure can be used.

6.1.2. Procedures shall be prepared and modified by a qualified or competent person.

6.1.3. Procedures shall be reviewed every two years for currency and accuracy.

6.1.4. When rescue by the F&ES Flight or contracted agencies is unavailable, then the unit shall ensure a unit rescue team is available (DAFMAN 91-203, 13.5.3.).

6.2. Fall Protection Written Procedures. IAW DAFMAN 91-203, 13.5.2., procedures shall include:

6.2.1. Purpose of the fall protection procedure.

6.2.2. Location and photographs/diagrams of the fall hazard(s) and fall protection system setup.

6.2.3. Appropriate standards, regulations or requirements for the task(s) conducted.

6.2.4. Training requirements for the fall protection procedure based on the fall protection equipment required.

6.2.5. Fall protection system design parameters. Note: Include fall calculations based on identified equipment and equipment design parameters, which include a detailed list of PPE and who developed the procedure, when it was developed, system certifications and inspection logs.

6.2.6. Equipment requirements.

6.2.7. Procedures documenting how to safely erect, use and dismantle the fall protection equipment.

6.2.8. Preparatory actions to be conducted by the supervisor to ensure authorized persons know the fall protection and rescue procedures.

6.2.9. Steps to take when work is completed, e.g., clean up, storage.

6.3. Rescue Plan. IAW DAFMAN 91-203, 13.5.2.10., a detailed rescue plan will include:

6.3.1. Coordination with outside rescue agencies (installation F&ES Flight, contracted rescue unit, etc.) to determine requirements to ensure prompt rescue of fallen personnel as part of preplanning.

6.3.2. Procedures to contact the rescue agency if a fall occurs.

6.3.3. Training on actions an authorized person can take to attempt self-rescue, when possible.

6.3.4. Actions to be taken by the organization to rescue fallen authorized personnel, when possible.

6.3.5. Location of rescue anchorage.

6.3.6. Equipment needed.

6.3.7. Location of attachment to fallen employee's harness.

6.3.8. Specific actions to achieve successful rescue.

6.3.9. Required training for rescuers.

6.4. Understanding Suspension Trauma: Risks and Prevention. Suspension trauma, also known as orthostatic intolerance, poses a significant hazard to workers suspended in full body harnesses after a fall.

6.4.1. Suspension Trauma/Orthostatic Intolerance Hazard.

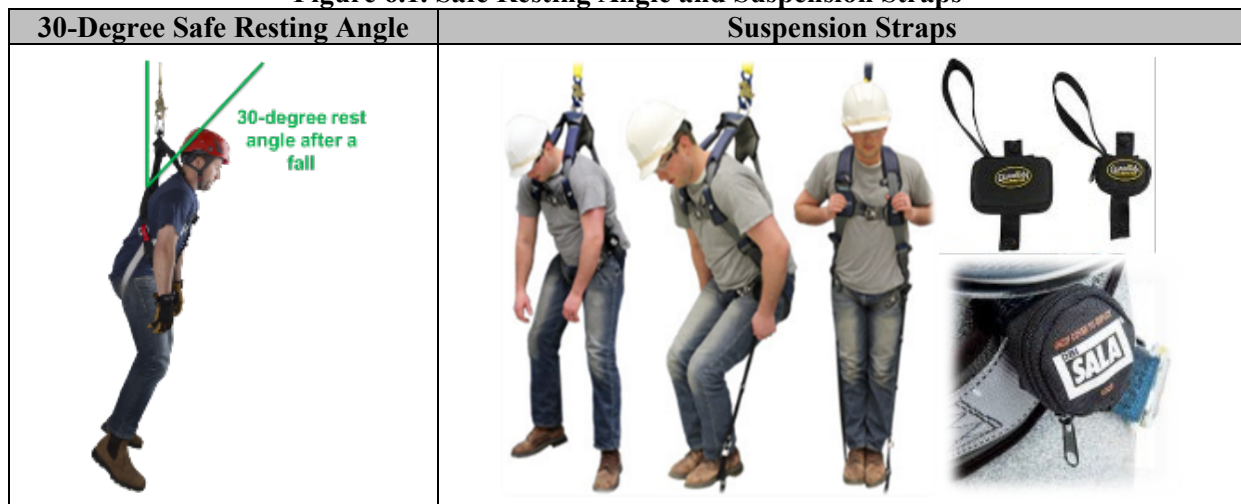
6.4.1.1. Effects of Suspension: Workers suspended in full-body harnesses may lose consciousness post-fall due to restricted blood flow, causing carbon dioxide buildup, cell damage, and sodium/potassium imbalances, risking heart issues or blood clots. Proper recovery procedures are vital to prevent severe harm or fatality.

6.4.1.2. Contributing Factors: Several factors, including worker age, overall health, additional injuries, and environmental stress like heat or cold, can contribute to the onset of suspension trauma.

6.4.1.3. Signs of Suspension Trauma: Within 2-3 minutes of suspension, workers may experience symptoms such as faintness, nausea, breathlessness, dizziness, sweating, low heart rate, low blood pressure, paleness, hot flashes, or a grey skin tone.

6.4.1.4. Prevention Measures: Ensuring a snug and properly placed dorsal D-ring, centered on the employee's back near shoulder level, maintains a safe rest angle within 30 degrees. Suspension straps are effective in reducing the risk of suspension trauma and improving circulation for the victim. **Figure 6.1.** illustrates these preventative measures.

Figure 6.1. Safe Resting Angle and Suspension Straps



6.5. Example - Fall Rescue Protocols. To ensure effective response to fall incidents, rescue procedures must be tailored to each work center, including pertinent phone numbers, necessary equipment, and location-specific guidelines. All workers must undergo training by a competent individual on these procedures, which should be designed to address worst-case scenarios, offering the best chance of saving a fallen worker's life. Below is an example of fall rescue protocols.

6.5.1. Immediately call 911 in case of a fall incident, followed by:

6.5.2. Employ the buddy system for rescue operations.

6.5.3. Gather essential rescue gear, including a rescue kit, extension ladder, aerial lift or scissor lift, regular ladder, and pulley kit.

6.5.4. Assess both location and worker-specific secondary hazards. **Table 6.1. Secondary Hazards** lists examples of location and fallen worker secondary hazards.

6.5.5. Execute the rescue plan as outlined, which may involve self-rescue, organizational rescue, or involving fire rescue teams.

6.5.6. Notify relevant emergency and command agencies promptly.

6.5.7. Follow post-rescue procedures, providing necessary treatment to the fallen worker. Keep the victim in a seated position with legs pulled to the chest until medical professionals can remove the harness and gear at the hospital.

6.5.8. Transfer rescue responsibilities to emergency responders upon their arrival.

6.5.9. Post-Rescue Protocol.

6.5.9.1. A personal fall protection system or its components subjected to impact loading must be removed from service immediately and not used again until a competent person inspects the system or components and determines that it is not damaged and safe for use (29 CFR 1910.140(c)(17)).

6.5.9.2. It is recommended that organizations regularly test their fall protection rescue plans to identify any deficiencies. This can be integrated into various inspections or exercises under the guidance of inspectors or unit commanders.

Table 6.1. Secondary Hazards

Secondary Hazards – Location		
Electrical	Thermal	Chemical
Sharp edges	Abrasive surfaces	Stability of structure
Weather	Unrelated operations in the area	Lighting
Visibility	Mobile objects in the area	Entanglement
Heat/fire hazards	Corrosion	Structure/equipment configuration
Secondary Hazards – Fallen Worker		
Loss of consciousness	Blood loss	Broken bones
Heat stress	Cold stress	Entanglement
Burns	Not breathing	No pulse
Shock	Spine injury	

Chapter 7

HIERARCHY OF CONTROLS

7.1. Initial Considerations. Fall Hazard Surveys are designed to help employers and safety professionals identify potential fall hazards and determine the necessary steps to mitigate or eliminate them. If hazards cannot be eliminated, they should be evaluated to help determine the appropriate fall protection systems for the work site. Consider the following:

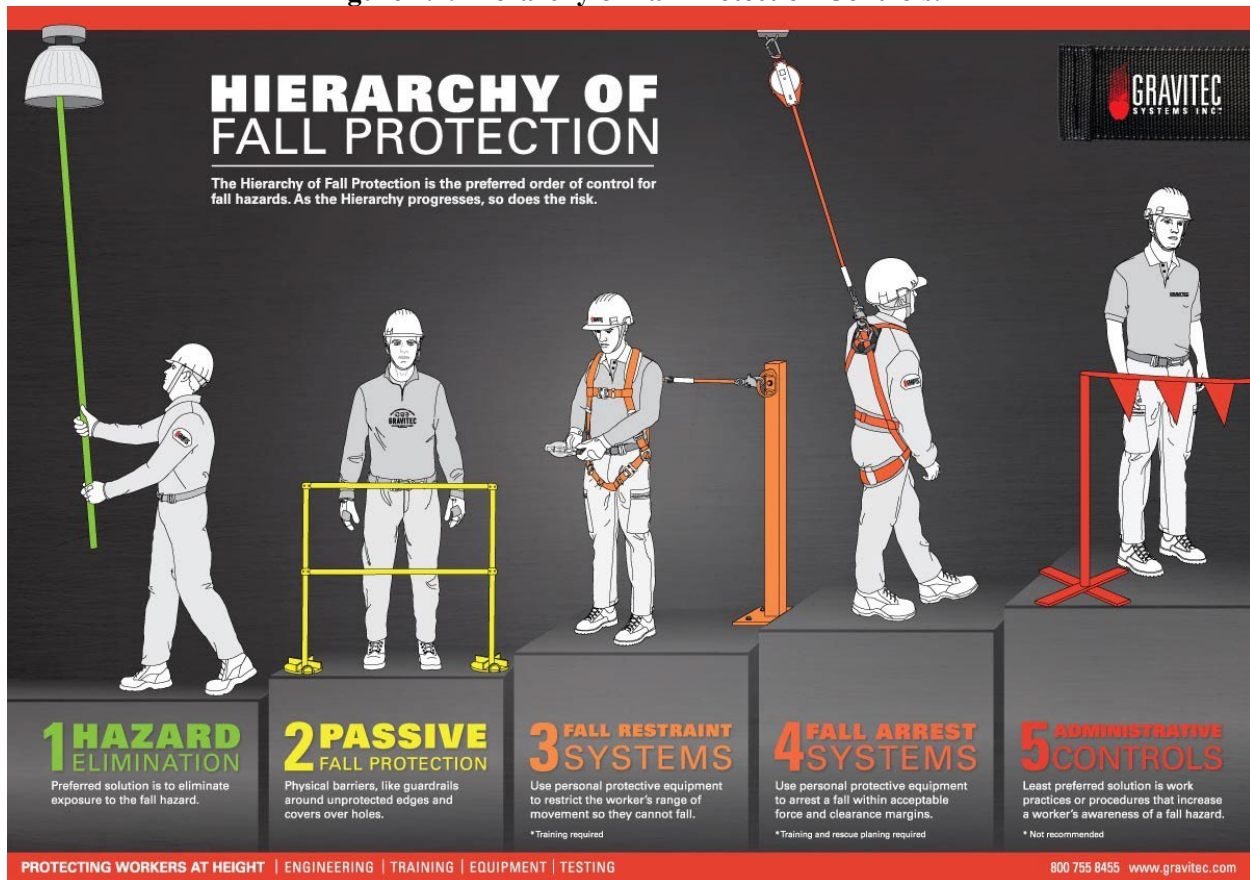
- 7.1.1. What is the fall distance from the working surface to the next level?
- 7.1.2. How many workers are exposed to the hazard?
- 7.1.3. What tasks and work areas are associated with the hazard?
- 7.1.4. How will the worker move to perform tasks (horizontally, vertically)?
- 7.1.5. Will the anchor placement create potential swing fall hazards, and are secure anchor points available or easily installed nearby?
- 7.1.6. Are there additional secondary hazards near the work area, such as overhead power lines?
- 7.1.7. How will prompt rescue be conducted if workers are suspended in a fall-arrest system, and what rescue equipment is accessible in the potential fall area?

7.2. Hierarchy of Fall Protection. The Hierarchy of Fall Protection outlines a preferred order of controls to mitigate fall hazards, starting with hazard elimination and progressing through passive fall protection, fall restraint systems, fall arrest systems, and administrative controls. **Figure 7.1.** illustrates the Hierarchy of Fall Protection Controls. Below is a description of each control:

- 7.2.1. Hazard Elimination: The primary approach to addressing fall hazards is by eliminating them altogether. This involves reassessing procedures, practices, locations, or equipment to eradicate exposure to the fall hazard. For instance, relocating HVAC equipment from the roof edge to the ground or an equipment room exemplifies hazard elimination.
- 7.2.2. Passive Fall Protection: Passive protection, such as guardrails and hole covers, creates physical barriers to prevent falls. This method is considered safer than relying solely on PPE due to reduced potential for errors. Although initial costs may be higher, passive protection often proves more cost-effective in the long run compared to ongoing PPE expenses. However, its necessity depends on the frequency and duration of exposure to fall hazards.
- 7.2.3. Fall Restraint Systems: Fall restraint systems prevent falls by restricting a worker's movement within safe boundaries. Despite being less commonly mentioned in regulations, they are favored over fall arrest systems.
- 7.2.4. Fall Arrest Systems: Fall arrest systems are designed to stop a fall once it occurs, within acceptable force and clearance parameters. However, they carry higher risks as they require stopping the falling worker with acceptable force and preventing contact with surrounding structures or the ground.

7.2.5. Administrative Controls: Administrative controls, such as safety monitors or warning lines, aim to increase worker awareness of fall hazards. However, they are considered the least preferred method as they lack physical or positive protection.

Figure 7.1. Hierarchy of Fall Protection Controls.



Chapter 8

TYPES OF FALL PROTECTION

8.1. Types of Fall Protection. (DAFMAN 91-203, 13.2.4.1.)

8.1.1. Passive Fall Protection. Passive fall protection, such as guardrails, work stands and platforms (aircraft maintenance stands, e.g., B-1, B-4, B-5), nets, ladder cages and other devices can prevent an employee from falling but are not directly connected to the employee. If passive fall protection is not feasible, active fall protection is the preferred option.

8.1.2. Active Fall Protection. Active fall protection devices include, but are not limited to, ladder climbing devices and personal fall arrest, positioning, and restraint systems (requiring employees to wear a harness and attach to an anchorage or lifeline).

8.1.2.1. Positioning and Restraint Systems. Fall restraint/positioning systems restrict an employee's range of movement preventing the individual from falling.

8.1.2.2. PFAS allow an employee to fall, but limits arresting loads to generally safe levels and prevents the employee from hitting the next level.

8.2.3. The four active fall protection systems are described in **Table 8.1**.

Table 8.1. Active Fall Protection Systems.

Systems	Application
Personal Fall Arrest System (PFAS) 29 CFR 1926.502(d)	Anchorage. According to OSHA, “anchorage means a secure point of attachment for equipment such as lifelines, lanyards, or deceleration devices.” Examples include I-beams and tie off straps, which must be able to support a minimum of 5,000 pounds per worker or at least twice the expected load of a person falling 6 feet. Body harness. Body harnesses must secure an employee in a way that would minimize the arresting force of a fall to 1,800 pounds or less. It must be capable of supporting 310 pounds of combined tool and body weight. Components. These include connectors, lanyards, deceleration devices, and self-retracting lifelines.
Suspension System 29 CFR 1926.452(o)	Suspension systems are commonly used by painters and window washers, as they allow employees to lift and lower themselves along a vertical surface while working hands-free. A fall arrest system must still be used alongside a suspension system.
Positioning System 29 CFR 1926.502(e)	Also called work-positioning equipment, a positioning system is a body belt or body harness system that allows a worker to be supported on an elevated vertical surface, such as a wall, windowsill, or ladder, and work with both hands free.
Retrieval System 29 CFR 1926.502(d)(20)	OSHA requires that “the employer shall provide for prompt rescue of employees in the event of a fall or shall assure that employees are able to rescue themselves.” Retrieving a worker who has fallen is essential to a fall protection plan. Although OSHA does not provide specific instructions as to how retrieval should be accomplished, it does outline some guidelines that should govern a rescue plan.

8.2. Fall Protection Exceptions.

8.2.1. General Industry. “When employers are inspecting, investigating, or assessing workplace conditions or work to be performed prior to the start of work or after all work has been completed. This exemption does not apply when fall protection systems or equipment meeting the requirements of 29 CFR 1910.29 have been installed and are available for workers to use for pre-work and post-work inspections, investigations, or assessments” (29 CFR 1910.28(a)(2)(ii)).

8.2.2. Construction. Does not apply when employees are inspecting, investigating, or assessing workplace conditions prior to the actual start of construction work or after all construction work has been completed (29 CFR 1926.500(a)(1)).

8.2.3. Research the task being accomplished, type of work, and applicable standards to decide if a task is exempt. If ever in doubt, contact the next higher safety authority in your chain of command.

Chapter 9

PERSONAL FALL PROTECTION SYSTEMS

9.1. Personal Fall Protection Systems. IAW 29 CFR 1910.140, This section establishes performance, care, and use criteria for all personal fall protection systems. The employer must ensure that each personal fall protection system used to comply with this part must meet the requirements of this section.

9.2. General Requirements. IAW 29 CFR 1910.140(c), the employer must ensure that personal fall protection systems meet the following requirements.

9.2.1. Connectors must be of durable steel or equivalent materials.

9.2.2. Connectors must be corrosion-resistant and smooth to prevent system damage.

9.2.3. Each employee using Vertical Lifelines (VLLs) must have their own.

9.2.4. Lanyards and VLLs must withstand a minimum breaking strength of 5,000 pounds (22.2 kN).

9.2.5. Self-retracting lifelines and lanyards limiting free fall to 2 feet (0.61 m) must handle a minimum tensile load of 3,000 pounds (13.3 kN).

9.2.6. A competent person must inspect each lanyard or lifeline knot before use.

9.2.7. D-rings, snaphooks, and carabiners must support at least 5,000 pounds (22.2 kN).

9.2.8. D-rings, snaphooks, and carabiners must pass a proof test of 3,600 pounds (16 kN) without damage.

9.2.9. Snaphooks and carabiners must be automatic locking, requiring two consecutive movements to open.

9.2.10. Horizontal lifelines must be supervised by a qualified person and part of a personal fall arrest system with a safety factor of at least two.

9.2.11. Anchorages for fall protection must be separate from those for suspending employees or platforms.

9.2.12. Anchorages must support 5,000 pounds (22.2 kN) for each employee with a safety factor of two.

9.2.13. Travel restraint lines must withstand a tensile load of 5,000 pounds (22.2 kN).

9.2.14. Lifelines must not be natural fiber and polypropylene rope must have UV protection.

9.2.15. Fall protection systems must be used only for employee safety.

9.2.16. Systems subjected to impact must be inspected and approved by a competent person before reuse.

9.2.17. Systems must be inspected for damage before each use and defective components replaced.

9.2.18. Components must be compatible with connectors used.

9.2.19. Equipment must be protected from damage.

9.2.20. Prompt rescue must be provided in case of a fall.

9.2.21. Harness attachment points must be at the center of the back or pre-sternal if free fall is limited to 2 feet (0.6 m).

9.3. Personal Fall Arrest System (PFAS). A system used to arrest an employee in a fall from a walking-working surface. It consists of a body harness, anchorage, and connector. The means of connection may include a lanyard, deceleration device, lifeline, or a suitable combination of these (29 CFR 1910.140(b), *Definitions*).

9.3.1. System Performance Criteria. IAW 29 CFR 1910.140(d)(1), the employer must ensure that personal fall arrest systems:

9.3.1.1. Limit the maximum arresting force on the employee to 1,800 pounds (8 kN).

9.3.1.2. Bring the employee to a complete stop and limit the maximum deceleration distance the employee travels to 3.5 feet (1.1 m).

9.3.1.3. Have sufficient strength to withstand twice the potential impact energy of the employee free falling a distance of 6 feet (1.8 m), or the free fall distance permitted by the system.

9.3.1.4. Sustain the employee within the system/strap configuration without contacting the employee's neck and chin area.

9.3.1.5. If a personal fall arrest system, meeting the criteria in Appendix D of 29 CFR 1910.140, is used by an employee weighing less than 310 pounds (140 kg), it complies with 29 CFR 1910.140(d)(1)(i) through (iii). For employees weighing 310 pounds (140 kg) or more, if the criteria in Appendix D are appropriately adjusted by the employer, the system also complies with 29 CFR 1910.140(d)(1)(i) through (iii).

9.3.2. System use criteria. IAW 29 CFR 1910.140(d)(2), The employer must ensure that:

9.3.2.1. On any horizontal lifeline that may become a VLL, the device used to connect to the horizontal lifeline is capable of locking in both directions on the lifeline.

9.3.2.2. Personal fall arrest systems are rigged in such a manner that the employee cannot free fall more than 6 feet (1.8 m) or contact a lower level. A free fall may be more than 6 feet (1.8 m) provided the employer can demonstrate the manufacturer designed the system to allow a free fall of more than 6 feet and tested the system to ensure a maximum arresting force of 1,800 pounds (8 kN) is not exceeded.

9.3.3. Body Belts. Body belts are prohibited as part of a PFAS.

9.3.4. PFAS Equipment Inspections and Maintenance. (DAFMAN 91-203, 13.8.)

9.3.4.1. PFAS users shall comply with TO 00-25-245, *Operations Instructions - Testing and Inspection procedures for Personnel Safety and Rescue Equipment*, and manufacturer's instructions for inspection, maintenance, cleaning, and storage.

9.3.4.2. Authorized person(s) shall inspect PFAS prior to use.

9.3.4.3. Supervisors shall ensure all PFAS components receive a thorough inspection at least quarterly. This inspection shall be documented and maintained for at least one year. Exception: Components of a PFAS that have been professionally installed and certified will be inspected in accordance with manufacturer's instructions, at the interval recommended by the manufacturer, and by a person qualified to perform the inspection. Inspection shall be documented and maintained.

9.3.4.4. Supervisors shall maintain manufacturer's instructions and performance testing information for PFAS used by their employees.

9.3.4.5. If defects or damage to equipment or inadequate maintenance of equipment is found, the equipment shall be immediately tagged unserviceable and removed from service.

9.3.4.6. Unserviceable PFAS will be destroyed to prevent further use. Inspections shall be documented in accordance with TO 00-25-245 or manufacturer's instructions, whichever is more restrictive.

9.3.4.7. For overseas locations, the use of anchorage points is authorized when the host country provides documentation of applicable testing and inspections.

9.4. Positioning Systems (Work-Positioning System). A system of equipment and connectors that, when used with a body harness or body belt, allows an employee to be supported on an elevated vertical surface, such as a wall or windowsill, and work with both hands free. Positioning systems also are called "positioning system devices" and "work-positioning equipment" (29 CFR 1910.140(b), *Definitions*). See **Figure 9.1.** for examples of Positioning Systems.

9.4.1. System performance requirements. IAW 29 CFR 1910.140(e)(1), the employer must ensure that each positioning system meets the following requirements:

9.4.1.1. All positioning systems, excluding window cleaners' positioning systems, shall demonstrate the capability to endure, without failure, a drop test involving a 4-foot (1.2-m) drop of a 250-pound (113-kg) weight.

9.4.1.2. Devices shall be rigged such that an employee cannot free fall more than 2 feet (.6 m).

9.4.1.3. Devices shall be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds (13.3 kN), whichever is greater.

9.4.1.4. Connectors shall be drop forged, pressed, or formed steel, or made of equivalent materials. Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of this system.

9.4.1.5. Unless the snaphook is a locking type and designed for the following connections, snaphooks shall not be engaged directly to webbing, rope, or wire rope, to each other, to a D-ring to which another snaphook or other connector is attached, to a horizontal lifeline. Or, to any object

which is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional disengagement could occur by the connected object being able to depress the snaphook keeper and release itself.

9.4.1.6. Positioning device systems shall be inspected prior to each use for wear, damage, and other deterioration, and defective components shall be removed from service.

9.4.1.7. Body belts, harnesses, and components shall be used only for employee protection (as part of a personal fall arrest system or positioning device system) and not to hoist materials.

9.4.2. Window Cleaners' Positioning Systems. A system which consists of a window cleaner's belt secured to window anchors (29 CFR 1910.140(b), *Definitions*). IAW 29 CFR 1910.140(e)(1)(ii), all window cleaners' positioning systems must:

9.4.2.1. Withstand, without failure, a drop test involving a 6-foot (1.8-m) drop of a 250-pound (113-kg) weight.

9.4.2.2. Limit the initial arresting force on the falling employee to not more than 2,000 pounds (8.9 kN), with a duration not exceeding 2 milliseconds, and subsequent arresting forces to not more than 1,000 pounds (4.5 kN).

9.4.3. Compliance Verification. Positioning systems, inclusive of window cleaners' positioning systems, complying with the test methods and procedures outlined in 29 CFR 1910.140, *Appendix D* shall be deemed in accordance with applicable regulations.

9.4.4. Lineman's Body Belt and Pole Strap Systems. Lineman's body belt and pole strap systems shall undergo the following tests:

9.4.4.1. A dielectric test of 819.7 volts, AC, per centimeter (25,000 volts per foot) for 3 minutes without visible deterioration.

9.4.4.2. A leakage test of 98.4 volts, AC, per centimeter (3,000 volts per foot) with a leakage current of no more than 1 mA.

9.4.4.3. A flammability test in accordance with 29 CFR 1910.140, *Table I-7*.

9.4.5. System Use Criteria for Window Cleaners' Positioning Systems.

9.4.5.1. Window cleaners' belts shall be designed and constructed to ensure belt terminals do not pass through their fastenings on the belt or harness if a terminal becomes dislodged from the window anchor. The length of the runner from terminal tip to terminal tip is 8 feet (2.44 m) or less.

9.4.5.2. Window anchors to which belts are affixed shall be installed in the side frames or mullions of the window at a height not less than 42 inches (106.7 cm) and not more than 51 inches (129.5 cm) above the windowsill.

9.4.5.3. Each window anchor shall be capable of supporting a minimum load of 6,000 pounds (26.5 kN).

9.4.5.4. The utilization of installed window anchors for any purpose other than attaching the window cleaner's belt is prohibited.

9.4.5.5. Damaged or deteriorated fastenings or supports of a window anchor shall result in either removal of the anchor or detachment of the anchor head to render it unusable.

9.4.5.6. Rope exhibiting wear or deterioration affecting its strength shall not be utilized.

9.4.5.7. Both terminals of the window cleaner's belt shall be attached to separate window anchors during any cleaning operation.

9.4.5.8. No employee shall work on a windowsill or ledge under conditions of snow, ice, or any other slippery substance, or on a weakened or rotted sill or ledge.

9.4.5.9. No employee shall work on a window sill or ledge unless the window sill or ledge is a minimum of 4 inches (10 cm) wide and slopes no more than 15 degrees below horizontal or the 4-inch minimum width of the window sill or ledge is increased by 0.4 inches (1 cm) for every degree the sill or ledge slopes beyond 15 degrees, up to a maximum slope of 30 degrees.

9.4.5.10. Before climbing through the window opening, an employee shall attach at least one belt terminal to a window anchor and keep at least one terminal attached until completely back inside the window opening.

9.4.5.11. Employees shall travel from one window to another by returning inside the window opening and repeating the belt terminal attachment procedure at each window.

9.4.5.12. An employee using a window cleaner's positioning system may travel from one window to another while outside of the building, provided: At least one belt terminal is always attached to a window anchor. The horizontal distance between window anchors does not exceed 4 feet (1.2 m). This distance may be increased up to 6 feet (1.8 m) horizontally if the windowsill or ledge is at least 1 foot (0.31 m) wide and the slope is less than 5 degrees. The sill or ledge between windows is continuous. The width of the windowsill or ledge in front of the mullions is at least 6 inches (15.2 cm) wide.

Figure 9.1. Positioning System Examples



9.5. Additional Personal Fall Protection Systems.

9.5.1. Personal Fall Protection System. A system (including all components) an employer uses to provide protection from falling or to safely arrest an employee's fall if one occurs. Examples of personal fall protection systems include personal fall arrest systems, positioning systems, and travel restraint systems (29 CFR 1910.140(b), *Definitions*).

9.5.2. Rope Descent System. A suspension system that allows an employee to descend in a controlled manner and, as needed, stop at any point during the descent. A rope descent system usually consists of a roof anchorage, support rope, a descent device, carabiner(s) or shackle(s), and a chair (seatboard). A rope descent system also is called controlled descent equipment or apparatus. Rope descent systems do not include industrial rope access systems. (29 CFR 1910.21, *Definitions*).

9.5.2.1. Rope Access System is a means of working at height using synthetic fiber kernmantle ropes and associated equipment to access, be supported, and used as a means of egress from a workplace that provides 100% fall protection coverage (ANSI-ASSP Z459.1 *Safety Requirements for Rope Access System*).

9.5.3. Travel Restraint Systems. A combination of an anchorage, anchorage connector, lanyard (or other means of connection), and body support that an employer uses to eliminate the possibility of an employee going over the edge of a walking-working surface (29 CFR 1910.140(b), *Definitions*). See **Figure 9.2.** for an illustration of a Travel Restraint System set-up.

Figure 9.2. Travel Restraint System.



9.6. Visual Aids. The visual aid shows the Guardian Fall Protection Anchor, Body Wear, and Connector. It illustrates the key components of a fall protection system used for worker safety at heights.

Visual Aid. Guardian Fall Protection Anchor, Body Wear, Connector
(<https://www.milsuite.mil/video/watch/video/57434>)

Chapter 10

LIFELINES

10.1. Lifeline Definition. A component of a personal fall protection system consisting of a flexible line for connection to an anchorage at one end so as to hang vertically (Vertical Lifeline), or for connection to anchorages at both ends so as to stretch horizontally (horizontal lifeline) and serves as a means for connecting other components of the system to the anchorage (29 CFR 1910.140(b), *Definitions*).

10.2. Vertical Lifeline (VLL). (ANSI/ASSP Z359.1-2020)

10.2.1. VLLs connect the employee's full-body harness to the anchorage/anchorage connector as part of the personal fall protection system. VLLs allow the employee to travel down and/or up the lifeline while conducting tasks. Determination of whether an employee may be able to travel in both directions will be determined by the type of fall arrestor used on the system which is used to stop a fall while on a VLL. **Figure 10.1.** illustrates a standard setup.

10.2.2. When VLLs are used, each employee must be attached to a separate lifeline.

10.2.3. VLLs must have a minimum breaking strength of 5,000 pounds (22.2 kN) (29 CFR 1910.140(c)(4)).

10.2.4. A competent person or qualified person must inspect each knot in a lanyard or VLL to ensure that it meets the requirements of paragraphs 29 CFR 1910.140(c)(4) and 1910.140(c)(5) before any employee uses the lanyard or lifeline.

10.3. Horizontal Lifeline.

10.3.1. Horizontal Lifelines shall be designed, installed, and used, under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two (29 CFR 1926.502(d)(8)).

10.3.2. Horizontal Lifeline Application and Requirements.

10.3.2.1. Application. The system must be designed for more than one employee if more than one is tied onto the lifeline (ANSI/ASSE Z359.6-2016).

10.3.2.2. Requirements. A full body harness. Connection "O" ring for Self-Retracting Lanyard (SRL), lanyard, shock absorbing lanyard, or device authorized by the qualified person to be utilized with the system. Two anchor points meeting requirements, which accommodate the number of workers intended to utilize the horizontal lifeline. The line must run from each anchor point installed by a qualified person. The line is typically made of kernmantle, webbing, or metal cabling. If a kit is used, reference the manufacturer's instructions.

10.3.3. On suspended scaffolds or similar work platforms with Horizontal Lifelines which may become VLLs, the devices used to connect to a Horizontal Lifeline shall be capable of locking in both directions on the lifeline (29 CFR 1926.502(d)(7)).

10.3.4. Horizontal Lifelines are typically installed on worksites where multiple workers are performing work from a great height or when free movement over an area is needed without having to constantly disconnect and reattach to different anchor points.

10.3.5. Horizontal Lifelines typically consists of a wire rope, or a synthetic fiber rope anchored and tensioned between two anchor points with intermediate anchor points on longer lengths. Workers attach themselves to the horizontal lifeline's slider or shuttle using a variety of fall arrest equipment such as a body harness, lanyard, and connectors. See **Figure 10.1.** for an illustration of typical set-up and **Figure 10.1.** for additional examples.

10.3.6. Horizontal Lifelines can be used for both fall arrest or fall restraint depending on how they are used. When used as a travel restraint system, such as on a roof top, protection can be achieved by ensuring that the lanyard does not allow the worker to reach the edge of the roof.

10.3.7. Roof Horizontal Lifeline systems are engineered to prevent falls when workers are accessing, inspecting, or repairing roofs. There are multiple things you need to consider when assessing roof lifelines, such as structure types, building strength, roofing material, and anchor point location. The building height and work required also determine the length of the roof lifeline system.

10.3.8. Horizontal Lifeline Sag. The amount of sag in the line and/or its elasticity can magnify the fall arrest forces at the anchorages. They must be taken into consideration when designing the fall arrest system. The greater the sag, the greater the forces during a fall arrest.

10.3.9. Inspection. When inspecting a horizontal lifeline system, consult the qualified person who designed and supervised the installation and use of the system.

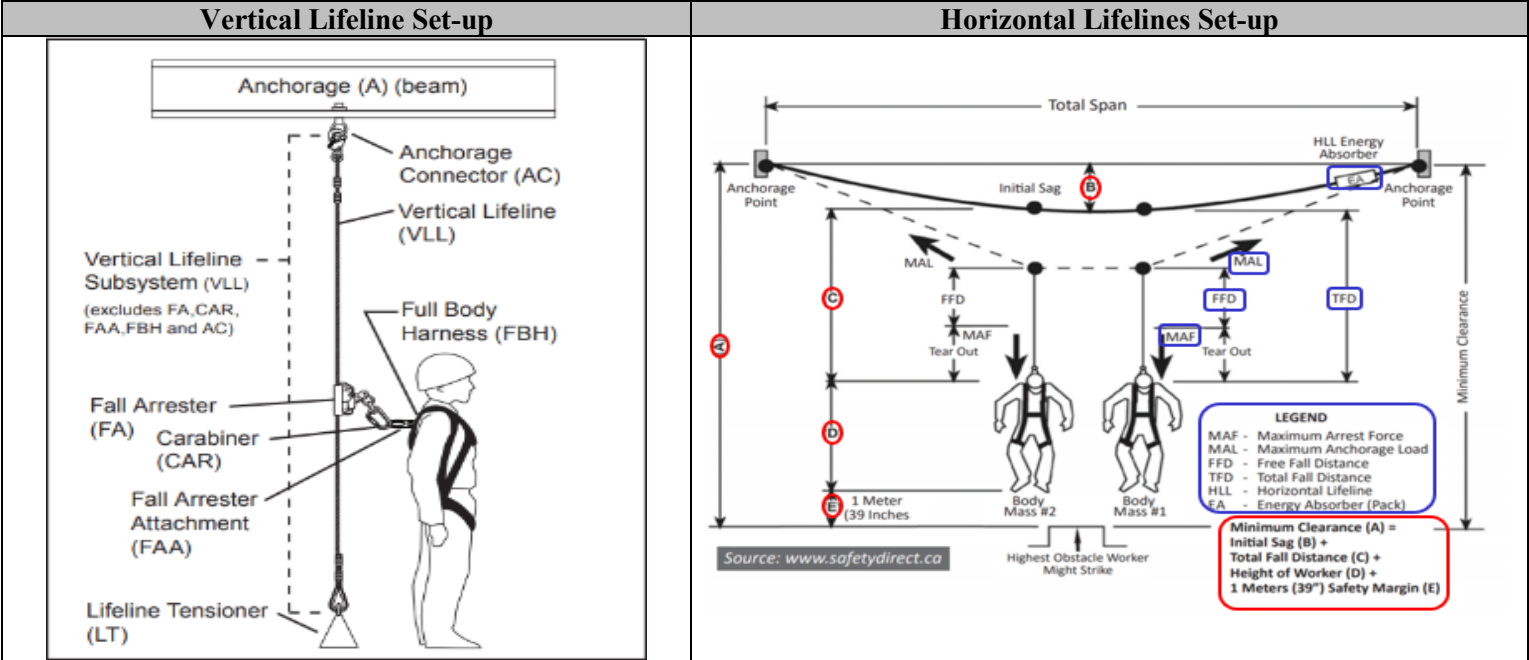
10.4. Rigid Rail System. A Rigid Rail System is an overhead track and trolley fall arrest system, paired with a self-retracting lanyard for workers, and provides fall arrest solutions in environments that require very short arrest distances. Rigid rail systems are perfect for warehouses, factories, aircraft hangars, transportation depots, and other facilities with various ceiling heights. See **Figure 10.1.** for an example.

10.5. Portable Gantry. Portable Gantry systems are ideal for applications where a permanent solution is not possible. It allows for single or multiple users to complete their required tasks and can then be moved out of the way when not needed. See **Figure 10.1.** for an example.

10.6. Visual Aids. The visual aid demonstrates a horizontal lifeline setup.

Visual Aid. [Horizontal Lifeline Demonstration](https://www.milsuite.mil/video/watch/video/57568)
(<https://www.milsuite.mil/video/watch/video/57568>)

Figure 10.1.



Horizontal Lifelines



Rigid Rail System	Portable Gantry
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Chapter 11

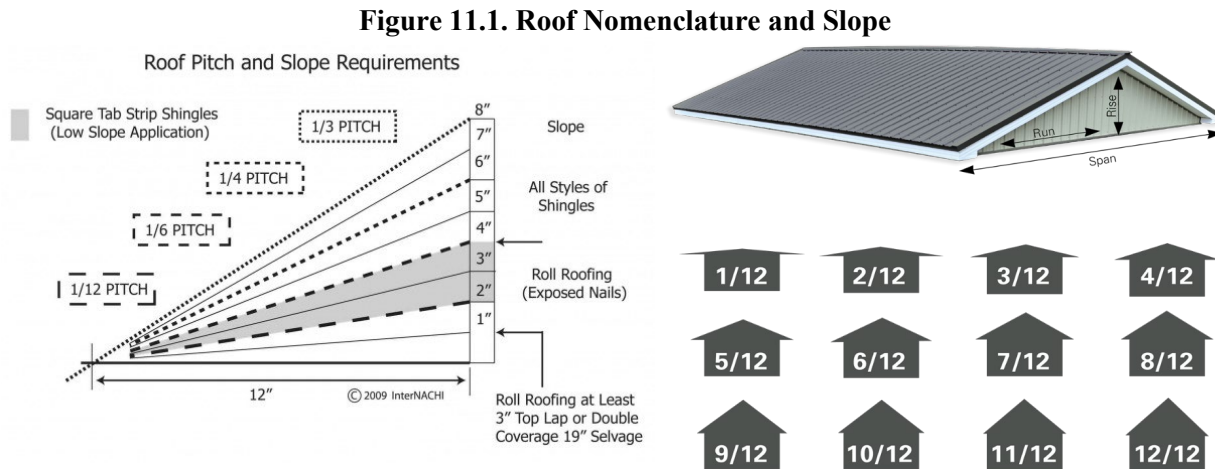
ROOF REQUIREMENTS

11.1. Definitions and Requirements.

11.1.1. Low-Slope Roof. Any roof that is flat or less than or equal to a ratio of 4-foot in 12-foot (vertical to horizontal) (29 CFR 1910.21(b), *Definitions*).

11.1.2. Steep Roofs. Any roof greater than a 4-foot in 12-foot slope roof. Each employee on a steep roof with unprotected sides and edges 6 feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems with toe boards, safety net systems, or PFAS (29 CFR 1926.501(b)(11)).

11.2. Roof Incline. Both pitch and slope indicate the incline of a roof, expressed as a proportion of the vertical to the horizontal. **Figure 11.1.** illustrates how roof incline is calculated and identified.



11.3. Roof Parapets. Roof Parapets is a protective wall along the edge of a roof are common on modern low sloped roofs; however, older facilities will have many fall hazards associated with their roof tops. Keep a keen eye for active-duty military, Air Force civilians, and Space Force civilians that are conducting operations on roof tops. Make sure they are utilizing fall protection equipment, are properly tied off, and have a means of rescue if a fall occurs.

Chapter 12

BODY HARNESS

12.1. Body Harness. Straps that secure about the employee in a manner to distribute the fall arrest forces over the thighs, pelvis, waist, chest, and shoulders, with a means for attaching the harness to other components of a personal fall protection system (29 CFR 1910.140(b), *Definitions*). **Figure 12.1** illustrates two different type of body harness.

Figure 12.1. Body Harness



12.2. Webbing Material.

12.2.1. Nylon is Soft and flexible and stretches with enough weight added to it. It absorbs water and can get moldy. Wet nylon is weaker.

12.2.2. Polyester is more durable and rigid than nylon. It resists water absorption.

12.2.3. Specialty harnesses such as ones that are flame retardant, chemical resistant, anti-static, high heat resistant, abrasion and cut resistant can be selected based on job specifications.

12.3. D-Ring Location and Application. In fall protection systems, various D-ring attachment points play crucial roles in ensuring the safety of personnel. **Figure 12.2.** illustrates D-ring locations and application.

12.3.1. Dorsal D-rings are at the center of the employee's back near shoulder level (29 CFR 1910.140(c)(20)). Air Force and Space Force personnel commonly use this D-ring as the primary connection point for fall arrest and fall restraint applications.

12.3.2. Sternal D-rings are uncommonly used in Air Force and Space Force application. Sternal is used primarily for specialized rescue, ladder safety systems, tower ascending/descending, and restraint applications.

12.3.3. Hip/Side D-rings are used for work positioning applications. These are uncommonly used by Air Force and Space Force personnel.

12.3.4. Shoulder D-rings are used for confined space rescue applications. These are uncommonly used by Air Force and Space Force personnel.

Figure 12.2. D-Ring Location and Application



12.4. Inspection. Equipment must be inspected prior to use. The inspection shall begin at one end of the harness working towards the other end. Never start in the middle as this increases the chance to miss defects. If any discrepancies are noted, DO NOT use the equipment, and remove from service. **Figure 12.3** illustrates items to look for and inspect.

12.4.1. Impact Indicator. Harnesses may have two types of impact indicators. The first is integrated into the harness D-ring, deploying upon a fall while retaining the D-ring. The second type involves a fold-over style indicator where the rear vertical webbing tears upon impact. These indicators signal to users and competent persons that the harness has been exposed to fall forces and should be retired. The integrity of the impact indicator is crucial, with variations depending on equipment style.

12.4.2. Check to ensure labels and tags are in place, legible, and within lifetime requirements per the manufacturer's instructions.

12.4.3. Check webbing for signs of excessive wear, cuts, ultraviolet damage, and burn marks. Check stitching for missing or loose threads. Check hardware for signs of pitting, corrosion, gouges, damage, and metal discoloration. D-rings, snap hooks, and carabiners must be capable of sustaining a minimum tensile load of 5,000 lbs. (22.2 kN).

12.4.4. Heat will start to degrade nylon and polyester webbing at approximately 180F (melting point approximately 450F). Check equipment for burns, warped material, and scorch marks.

12.4.5. Writing on the webbing of the harness is prohibited due to the unknown side effects that the marker will have on the webbing material.

Figure 12.3. Inspections



12.5. Sizing. The proper size of the body harness will be determined by the height and weight of the individual worker. There will be a sizing chart included in the manufacturer's instruction as well as online. These charts shall be consulted prior to purchasing body harnesses and prior to selecting one to perform work to determine the appropriate size for each worker on location.

12.6. Donning Procedures. To don the harness properly, begin by inspecting it thoroughly for any signs of damage or wear. Position the back D-ring between your shoulder blades to ensure optimal safety. Next, buckle up the leg straps securely, followed by buckling up the front of the harness. Once all buckles are secured, adjust the harness so that it fits snugly around your body while ensuring the D-ring remains in the correct position. This meticulous process guarantees that the harness is correctly fitted and ready for use, providing maximum protection during any activity. See **Figure 12.6.** for an illustration of each step.

Figure 12.6. Steps to Harness Donning

Inspect	Position back D-ring between shoulder blades	Buckle up legs	Buckle up Front	Adjust so the harness fits snugly, and D-ring remains in the correct position
				

12.7. Visual Aids. The visual aids showcase the inspection of SALA fall protection equipment, and the process of donning a body harness for fall protection.

Visual Aid. Fall Protection Equipment Inspection SALA
(<https://www.milsuite.mil/video/watch/video/57862>)

Visual Aid. Fall Protection, Donning a Body Harness
(<https://www.milsuite.mil/video/watch/video/57432>)

Chapter 13

LANYARDS

13.1. Lanyards. Within fall protection, lanyard means a flexible line of rope, wire rope, or strap that generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.

13.2. Common Types.

13.2.1. Shock Absorbing Lanyards. Utilized in fall arrest or fall restraint application. Shock absorbers require approximately 450 lbs. of force to deploy the shock absorber (based on manufacturer's instructions from several industry leading fall protection companies).

13.2.2. Non-Shock Absorbing Lanyards (Positioning Lanyards). Designed to keep the worker in place with a fixed length. These lanyards are used only in fall restraint application.

Figure 13.1. Shock Absorbing versus Non-Shock Absorbing Lanyard



Shock Absorbing Lanyard
(used for fall restraint or arrest)



Non-Shock Absorbing Lanyard
(used only for fall restraint)

13.3 Application.

13.3.1. The worker including tools/equipment must not exceed 310 lbs. on a standard shock absorbing lanyard. Workers/tools/equipment exceeding 311-420 lbs. will use Heavy Duty fall protection equipment (heavy duty lanyards have a freefall distance of 12' and must be tied off overhead).

13.3.2. Maximum freefall is 6 feet for a standard shock absorbing lanyard, or the freefall distance permitted by the system.

13.3.3. Max arresting force applied to the body is 1800 lbs.

13.3.4. Lanyards are web or cable of lengths 6 feet or less.

13.3.5. Lanyard maximum deceleration distance is 3.5 feet (42").

13.4. Inspection.

13.4.1. Prior to use, inspection begins at one end of the lanyard, rope, or rope grab working towards the other end and shall never start in the middle as this increases the chance to miss defects. If any discrepancies are noted, DO NOT use the equipment, and remove from service:

13.4.2. The impact indicator must be intact. Indicators will vary by equipment style.

13.4.3. Labels/Tags must be in place, legible, and within lifetime of date of first use. If no date of first use, refer to manufactured date (present, legible, current).

13.4.4. Check webbing for signs of excessive wear, cuts, and burns. Check stitches for missing or loose threads. Check hardware for signs of damage, rust, or corrosion.

13.4.5. Check to ensure connectors operate freely and secure properly.

13.4.6. D-rings, snap hooks, and carabiners must be capable of sustaining a minimum tensile load of 5,000 lbs. (22.2 kN).

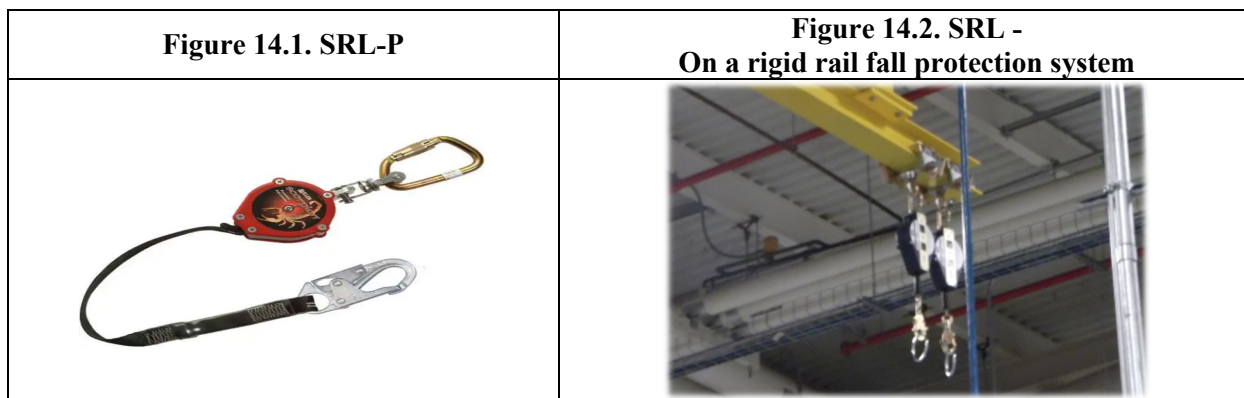
Chapter 14

SELF-RETRACTING DEVICES

14.1. Self-Retracting Lifeline/Lanyard. A deceleration device containing a drum-wound line that can be slowly extracted from, or retracted onto, the drum under slight tension during normal movement by the employee. At the onset of a fall, the device automatically locks the drum and arrests the fall (29 CFR 1910.140(b)).

14.1.1. Self-Retracting Devices come in various forms, including Self-Retracting Lanyards (SRLs), Self-Retracting Lanyards with integral rescue capability (SRL-Rs), and Self-Retracting Lanyards, personal (SRL-Ps). SRLs are commonly used in aircraft hangars or vehicle maintenance facilities with rigid rail overhead fall protection system tracks. On the other hand, SRL-Ps are smaller and portable, designed to be worn directly on the user's full-body harness and attached to an approved anchor (ANSI/ASSP Z359.14-2021). **Figure 14.1.** and **Figure 14.2.** show SRL-P and SRL on a rigid rail fall protection system.

14.1.2. Deceleration distance refers to the vertical distance between a worker's harness attachment point at the onset of a fall and their final resting position. It's crucial to consider deceleration distances when selecting fall protection equipment. SRLs play a vital role in minimizing fall distances and reducing the total force applied to the body by engaging immediately upon a fall. These devices are equipped with deceleration brake systems, allowing for effective fall protection.



14.2. Self-Retracting Devices Classes. Self-Retracting Devices are categorized into two classes:

14.2.1. Class 1: Class 1 devices are suitable for use only when anchored above the user's head and when the maximum freefall distance is restricted to 2 feet.

14.2.2. Class 2: Class 2 devices can be utilized when an overhead anchor point is unavailable or impractical, and there's a possibility of contact with a structural edge. The maximum allowable freefall distance should be limited to 6 feet. It's important to note that using a foot-level anchor point poses a higher risk of serious injury. Hence, users should opt for the highest possible anchor point and resort to attaching at foot level only as a last resort.

14.3. Application.

14.3.1. Adhere to weight limitations: Maximum weight allowed when using standard gear is 310 lbs. Heavier loads ranging from 311-420 lbs. require heavy-duty equipment.

14.3.2. Maximum force during fall arrest: Should not exceed 1800 lbs. Class 1 and 2 SRLs typically apply around 1350 lbs. of force.

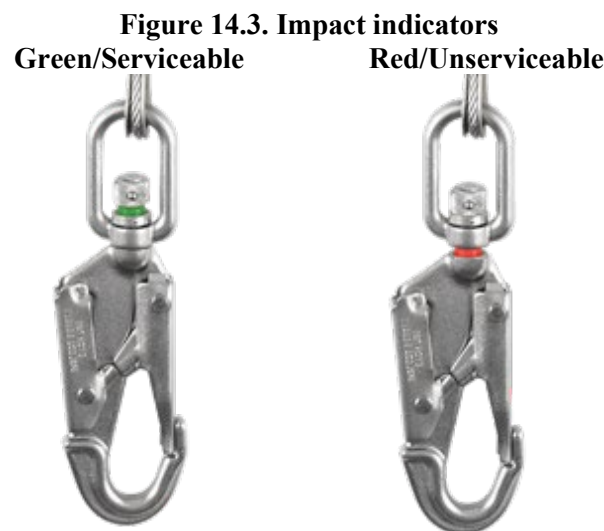
14.3.3. Maximum arresting distance: Set at 42 inches.

14.3.4. Lanyards: Available in various lengths and materials such as webbing or cable. Play a critical role in fall protection systems.

14.4. Inspection.

14.4.1. Begin inspecting the self-retracting lanyard from one end to the other to ensure thoroughness and reduce the risk of overlooking defects. Alongside a detailed examination following manufacturer instructions, a ground-level visual check of the anchor, drum, and lanyard suffices. Any noted discrepancies warrant immediate removal from service.

14.4.2. Ensure the impact indicator, such as snap hook or energy absorber, remains intact. Refer to Figure 14.3 for indications: Green denotes serviceability, while Red signifies unserviceability.



14.4.3. Verify that all labels and tags are present, legible, and adhere to guidelines, ensuring they provide accurate information about the equipment's status and specifications.

14.4.4. Thoroughly inspect all components, including webbing, cables, hardware, and housing, for signs of wear, damage, or deterioration. Ensure connectors operate smoothly, and test functionality by checking for smooth payout and retraction of webbing or cable with adequate tension. Conduct a quick pull test to verify brake functionality. The housing must have a minimum breaking strength of 5,000 lbs. (22.2 kN).

Chapter 15

ANCHORAGE AND ANCHOR POINT

15.1. Anchorage. A secure point of attachment for equipment such as lifelines, lanyards, or deceleration devices (29 CFR 1910.140(c), *Definitions*).

15.1.1. Anchorages used to attach to personal fall protection equipment must be independent of any anchorage used to suspend employees or platforms on which employees work. Anchorages used to attach to personal fall protection equipment on mobile work platforms on powered industrial trucks must be attached to an overhead member of the platform, at a point located above and near the center of the platform (29 CFR 1910.140(c)(12)).

15.1.2. IAW 29 CFR 1910.140(c)(13), anchorages, except window cleaners' belt anchors, must be capable of supporting at least 5,000 pounds (22.2 kN) for each employee attached; or designed, installed, and used, under the supervision of qualified person, as part of a complete personal fall protection system that maintains a safety factor of at least two.

15.1.2.1. Anchors rated below 5000 lbs. with a safety factor of 2 must be certified in writing by a qualified person. The certification document must be maintained by the organization.

15.1.2.2. For anchorage certified below 5000 lbs. a safety professional must verify the qualified person meets OSHA requirements and review the certification of the qualified person.

15.1.2.3. If both verifications are valid, a certified anchor point rated below 5000 lbs. can only be used for the operations it is certified for.

15.2. Inspection. During equipment inspection, it is crucial to thoroughly examine all hardware, checking for any signs of damage, rust, or corrosion. If any defects are noted, remove from service, and notify a competent person.

15.2.1. Check the impact indication (if a feature) or look for signs of impact loading.

15.2.2. Swages should be inspected for wear or slippage, while ensuring that all moving components operate freely and are securely fastened. Verify that the anchorage can support the designed or appropriate loads and installed correctly. Lastly, confirm that all attachment fasteners are in serviceable condition to ensure the safety and reliability of the equipment.

15.2.3. Ensure that the anchorage location is easily accessible. Ensure no hardware is missing. There must be no restricted visibility of the anchor while utilizing it.

15.3. Hazards. Critical hazards in anchorages encompass missing hardware, cracks, dents, chips, pitting, or deformation. Caution is warranted for temporary welding, requiring inspection by a qualified person. Proper installation is crucial, aligning connectors with anchor point D-rings to prevent unintended shear forces, with swiveling D-rings recommended for effective hazard mitigation.

15.4. Visual Aids. The visual aid provides a detailed list of anchors, and the typical use or purpose.

Visual Aid. [Examples of Anchors](#)

(<https://www.osha.gov/otm/section-5-construction-operations/chapter-4#appc>)

Chapter 16

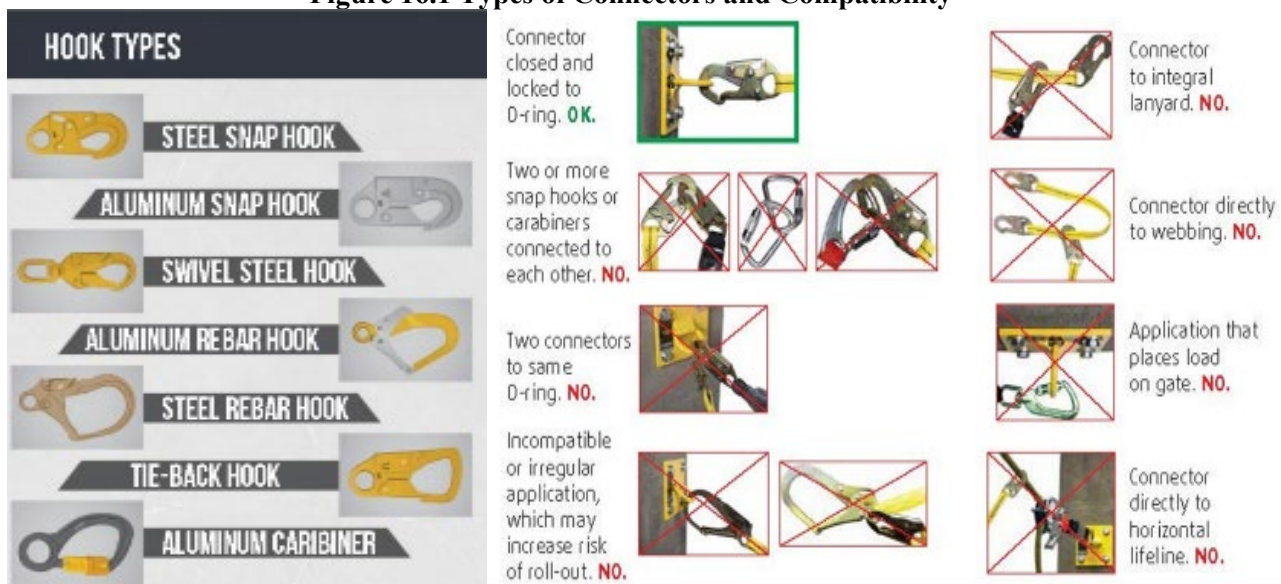
CONNECTORS

16.1. Connector. A device used to couple (connect) parts of the fall protection system together (29 CFR 1910.140(c), *Definitions*). See **Figure 16.1** for a depiction of connectors and their capability.

16.1.1. Connectors must be drop forged, pressed, or formed steel, or made of equivalent materials (29 CFR 1910.140(c)(1)).

16.1.1. Connectors must have a corrosion-resistant finish, and all surfaces and edges must be smooth to prevent damage to interfacing parts of the system (29 CFR 1910.140(c)(2)).

Figure 16.1 Types of Connectors and Compatibility



16.2. Connector Hook Requirements.

16.2.1. The gate must be rated at ≥ 3600 lbs. for both frontal and side loading.

16.2.2. Hooks should be sized appropriately to prevent unintentional disengagement when connected to equipment.

16.2.3. They must be self-closing and self-locking for enhanced safety.

16.2.4. Proof-testing to 3600 lbs. is necessary.

16.2.5. Hooks should have a minimum tensile strength of ≥ 5000 lbs.

16.2.6. They must be smooth and free of sharp or rough edges to prevent damage.

16.2.7. Double action gates are required, meaning the gate must undergo two separate consecutive movements to open.

16.3. Connector Failure and Hazards.

16.3.1. Forced Roll Out occurs when excessive force causes the gate of the connector to fail or roll out. To prevent this, the gate must be rated to handle a minimum of ≥ 3600 lbs. of force. Check the hardware for the gate's load rating, and if it's not specified, remove it from service immediately. See **Figure 16.2** for an example of what forced roll out looks like.

16.3.2. Side Loading occurs when the load is unintentionally applied to the connector from the side or at an angle, which can weaken the connector's strength when used incorrectly. To prevent side loading, connectors should always be used in line with anchor points and with connectors of similar size that are compatible with the anchor point. **Figure 16.3.** shows a rebar hook that is too large for the temporary anchor it is attached to creating a side loading hazard.

16.3.3. Rope grabs are connectors equipped with a deceleration device that moves along a lifeline. They engage the lifeline automatically through friction to stop an employee's fall. It's essential to refer to the manufacturer's instructions to ensure proper usage of rope grabs for tasks requiring fall protection. However, it's worth noting that Air Force and Space Force personnel rarely use these devices. **Figure 16.4.** shows a rope grab.

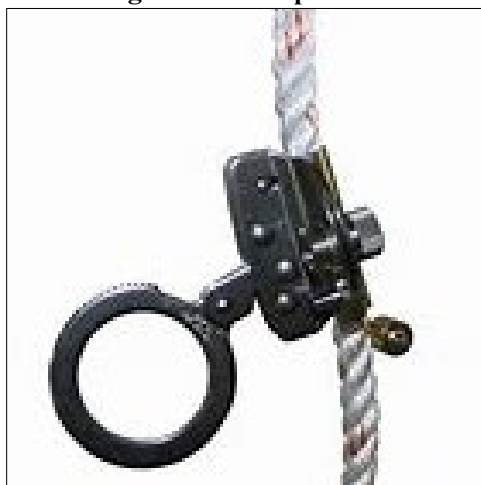
Figure 16.2. Forced Roll Out Damage.



Figure 16.3. Side Loading Hazard.



Figure 16.5. Rope Grab



Chapter 17

FALL CALCULATIONS

17.1. Guidelines for PFAS. IAW 29 CFR 1910.140(d)(2)(ii), personal fall arrest systems are rigged in such a manner that the employee cannot free fall more than 6 feet (1.8 m) or contact a lower level. A free fall may be more than 6 feet (1.8 m) provided the employer can demonstrate the manufacturer designed the system to allow a free fall of more than 6 feet and tested the system to ensure a maximum arresting force of 1,800 pounds (8 kN) is not exceeded.

17.1.1. A competent person and/or qualified person shall determine fall clearance minimum heights, determine the proper equipment, anchor points, and mitigate secondary hazards.

17.2. Fall Calculation. Fall calculation must be performed before any work is performed. See **Table 17.1.** for a breakdown of the calculation and example.

17.2.1. Maximum Arresting Force (MAF) refers to the highest force exerted on the body when stopping a fall. It's determined by multiplying the weight of the worker and equipment by the distance of the fall.

17.2.2. The MAF limit for a fallen worker's body is 1800 lbs. Exceeding this force without proper deceleration or shock absorption could result in severe injury or death.

Table 17.1. Fall Calculation

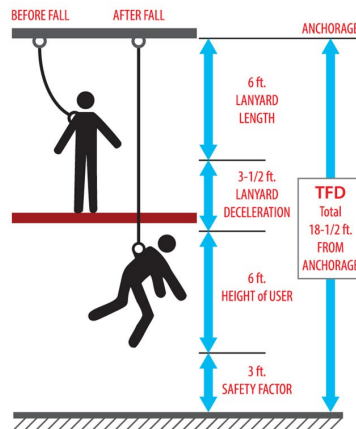
Fall Calculation W x D = Total Force to Body	
W	Body Weight + Equipment
D	Freefall distance
Total arresting force applied to the body	W x D = total force applied to body
Example: A 200 lbs. worker with 6 lbs. of tools who falls 6 feet can generate fall forces of 1,236 lbs. across a person's body. W: 200 lbs. worker + 6 lbs. of tools = 206 lbs. total D: 6-foot freefall distance 206 lbs. X 6 feet = 1236 lbs. of total arresting force	

17.3. Fall Clearance. Fall Clearance refers to the minimum vertical distance required between the worker's feet and a lower level, such as the ground or a lower working platform, to prevent contact with the lower level in case of a fall. It's crucial that the calculated fall clearance of a fall protection system is always less than the available clearance between the worker's level and any lower platform. To determine the fall clearance, certain factors need to be known. See **Table 17.2.** and **Figure 17.3.** for a breakdown of the Fall Clearance calculation.

Table 17.2. Fall Clearance Calculation

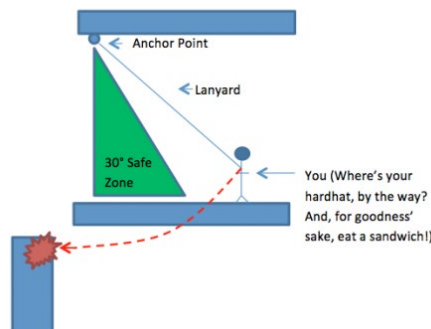
Fall Clearance Calculation
Fall Clearance = Length of the Lanyard (Freefall Distance) + Deceleration Distance + Height of Worker + Safety Factor + Swing Fall (As Required)

Figure 17.3. Determining Fall Clearance



17.4. Swing Fall. Swing fall happens when a worker moves horizontally away from the anchor point. This increases the total drop clearance needed to safely stop a fall. To prevent swing fall, it's recommended to limit it to a maximum of 4 feet (ANSI/ASSE Z359.6-2016). When anchors are not aligned with the worker or when the job requires moving away from the anchor, swing fall should be factored into the calculation. Neglecting to consider swing fall could lead to severe injury or even death. See **Figure 17.4.** for a breakdown of Swing Fall Clearance calculation.

Figure 17.4. Swing Fall Clearance



17.5. Application. Numerous fall protection companies offer online fall calculators to help determine the most suitable equipment for organizational requirements. When opting for personal fall arrest systems (PFAS), it's essential to incorporate clearance calculations into the written fall protection procedures. Employees must refrain from using PFAS until sufficient clearances are confirmed.

17.6. Hazards. Hazards associated with fall calculations include improper gear selection, calculation errors, failure to account for swing fall, and operational changes without re-evaluating the fall protection program.

17.6.1. To address inadequate clearance options, solutions may involve using a shorter lanyard, raising the anchorage point, opting for a self-retracting lanyard, considering alternatives to eliminate the need for active fall protection, or implementing a restraint system.

17.7. Visual Aids. The visual aid connects to an OSHA Technical Manual that describes measurements for assessing fall hazards and controls.

Visual Aid. [OSHA General Requirements for Fall Calculations](#)

Chapter 18

GUARDRAILS

18.1. Guardrail Systems. Guardrail Systems are erected to prevent employees from falling to lower levels. Specific guidance is described in DAFMAN 91-203, 29 CFR 1910.29(b), and 29 CFR 1926.500(b).

18.2. Requirements. Guardrails are mandated when working at or above fall protection trigger heights and when personal fall protection is not utilized. In addition, guardrails must be free of rough and sharp edges, and the use of steel or plastic banding is prohibited.

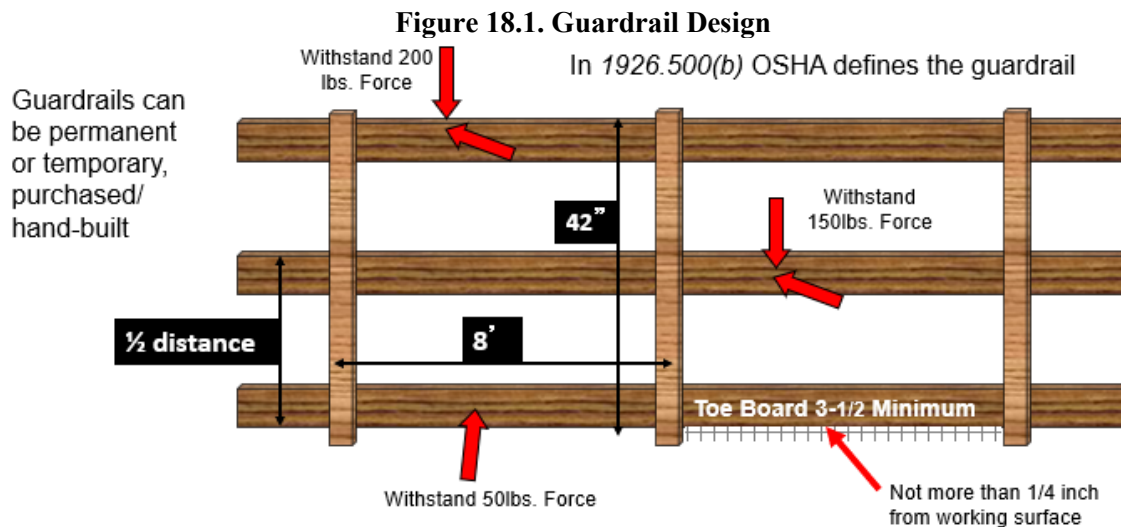
18.3. Design Specifications. See Figure 18.1. Guardrail Design.

18.3.1. The top rail should be 42" $\pm$ 3" tall with a strength rating of 200 lbs.

18.3.2. The mid rail should be half the height of the top rail and support a load of 150 lbs.

18.3.3. The toe board must have a minimum height of 3.5" and a maximum gap underneath of 0.25", with a load rating of 50 lbs.

18.3.4. Vertical posts should be spaced no more than 8 feet apart.



18.4. Application. Inspectors are tasked with evaluating unprotected edges leading to lower levels and must mitigate any hazards meeting the trigger height requiring fall protection. Verify that guardrails are sturdy, serviceable, and meet the specified height and load requirements.

18.4.1. Common guardrail hazards include inadequate height of the top rail or missing mid rail, absence of the toe board, guardrail instability or deflection when pressure is applied and degradation due to corrosion or weather damage.

Chapter 19

DESIGNATED AREAS AND WARNING LINE SYSTEMS

19.1. Designated Area. A distinct portion of a walking-working surface delineated by a warning line in which employees may perform work without additional fall protection (29 CFR 1910.21(b), *Definitions*). IAW 29 CFR 1910.29(d), the following requirements must be met:

19.1.1. Employees must remain within the designated area during work operations.

19.1.2. The perimeter of the designated area must be marked with a warning line, which can be a rope, wire, tape, or chain. This line must meet the following criteria:

19.1.2.1. Have a minimum breaking strength of 200 pounds (0.89 kN).

19.1.2.2. Be positioned with its lowest point, accounting for sag, between 34 inches (86 cm) and 39 inches (99 cm) above the walking-working surface.

19.1.2.3. Be supported to prevent slack from adjacent sections, ensuring it remains within the specified height range.

19.1.2.4. Be clearly visible from a distance of 25 feet (7.6 m) and from anywhere within the designated area.

19.1.2.5. Be erected as close to the work area as possible.

19.1.2.6. Be installed no less than 6 feet (1.8 m) from the roof edge for temporary and infrequent work or no less than 15 feet (4.6 m) for other work.

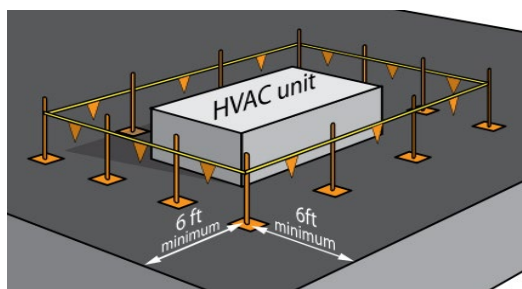
19.1.3. When mobile mechanical equipment is used for temporary and infrequent work within a designated area, the warning line must be positioned:

19.1.3.1. Not less than 6 feet (1.8 m) from the unprotected side or edge parallel to the equipment's operating direction.

19.1.3.2. Not less than 10 feet (3 m) from the unprotected side or edge perpendicular to the equipment's operating direction.

19.2. Warning Line. A barrier erected to warn employees that they are approaching an unprotected side or edge, and which designates an area in which work may take place without the use of other means of fall protection. (29 CFR 1910.21(b), *Definitions*). See **Figure 19.1.** for an illustration of a Warning Line setup. IAW 29 CFR 1926.502(f), the following requirements must be met:

Figure 19.1. Warning Line System



19.2.1. Erection of Warning Lines:

19.2.1.1. Warning lines must enclose all sides of the roof work area.

19.2.1.2. When mechanical equipment is not in use, Warning lines must be set up at least 6 feet (1.8 m) from the roof edge.

19.2.1.3. When mechanical equipment is in use, Warning lines must be placed at least 6 feet (1.8 m) from the roof edge parallel to the equipment's operation direction. Additionally, Warning lines must also be positioned at least 10 feet (3.1 m) from the roof edge perpendicular to the equipment's operation direction.

19.2.2. Connection to Work Area:

19.2.2.1. Points of access, material handling areas, storage areas, and hoisting areas must be linked to the work area by an access path bordered by two warning lines.

19.2.2.2. When access paths are not in use, barricades of equal strength and height to warning lines must block the path's intersection with the warning line around the work area.

19.2.3. Construction of Warning Lines. Warning lines consist of ropes, wires, or chains supported by stanchions, set up as follows:

19.2.3.1. Flagged at intervals of not more than 6 feet (1.8 m) with high-visibility material.

19.2.3.2. Positioned with the lowest point (including sag) no less than 34 inches (0.9 m) from the walking/working surface and the highest point no more than 39 inches (1.0 m) from the walking/working surface.

19.2.3.3. Stanchions must resist a horizontal force of at least 16 pounds (71 N) applied 30 inches (.8 m) above the walking/working surface, perpendicular to the warning line, without tipping over.

19.2.3.4. Ropes, wires, or chains must have a minimum tensile strength of 500 pounds (2.22 kN) and be capable of supporting loads as specified.

19.2.3.5. Lines must be attached to each stanchion to prevent slack when pulled.

19.2.4. Employees are not permitted between a roof edge and a warning line unless performing roofing work in that area.

19.2.5. Mechanical equipment on roofs can only be used or stored in areas protected by a warning line system, guardrail system, or personal fall arrest system.

19.3. Visual Aids. The visual aid connects to an OSHA Technical Manual that describes Regulation requirements and references.

Visual Aid. Regulation requirements and references on Warning Line Systems, Safety Monitoring Systems, and Controlled Access Zones (CAZs).

(<https://www.osha.gov/otm/section-5-construction-operations/chapter-4>)

Chapter 20

HOLE COVERS

20.1. Definition. Hole means a gap or open space in a floor, roof, horizontal walking-working surface, or similar surface that is at least 2 inches (5 cm) in its least dimension (29 CFR 1910.21(b), *Definitions*).

20.2. Cover. IAW 29 CFR 1926.502(i), covers for holes in floors, roofs, and other walking/working surfaces shall meet the following requirements:

20.2.1. Covers located in roadways and vehicular aisles shall be capable of supporting, without failure, at least twice the maximum axle load of the largest vehicle expected to cross over the cover.

20.2.2. All other covers shall be capable of supporting, without failure, at least twice the weight of employees, equipment, and materials that may be imposed on the cover at any one time.

20.2.3. All covers shall be secured when installed to prevent accidental displacement by the wind, equipment, or employees.

20.2.4. All covers shall be color coded, or they shall be marked with the word "HOLE" or "COVER" to provide warning of the hazard.

20.3. Application. Inspector shall evaluate holes in the floor or ground to see if they meet the definition of a floor opening that requires fall protection. If the hole meets the definition, then it is required to have some type of mitigation measure in place. If a hole cover is not adequate, the use of a guardrail system, fence, or barricade will mitigate the hazard where foot traffic occurs, especially if the hole is not readily seen due to vegetation or other visual barriers. (Examples include, pits, ditches, trenches, or shafts)

20.4. Hazards. Common areas for this hazard are raised flooring in facilities for communication lines (false flooring), catwalks, roof skylights, and construction areas that allow access through a floor opening to a lower level.

20.5. Visual Aids. The visual aid connects to an OSHA Technical Manual that describes requirements for hole covers.

Visual Aid. [OSHA Hole Cover General Requirements](https://www.osha.gov/otm/section-5-construction-operations/chapter-4#hole)

(<https://www.osha.gov/otm/section-5-construction-operations/chapter-4#hole>)

Chapter 21

WALL OPENINGS

21.1. Wall Opening. Each employee working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is 6 feet (1.8 m) or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches (1.0 m) above the walking/working surface, shall be protected from falling by the use of a guardrail system, a safety net system, or a personal fall arrest system (29 CFR 1926.501(b)(14)). See **Figure 21.1.** for a depiction of OSHA requirements.

21.2. Opening. A gap or open space in a wall, partition, vertical walking-working surface, or similar surface that is at least 30 inches (76 cm) high and at least 18 inches (46 cm) wide, through which an employee can fall to a lower level (29 CFR 1910.21(b), *Definitions*).

Figure 21.1. Wall Opening Criteria



Ref #1	The outside bottom edge of the wall opening MUST be 6 feet or more above a lower level
Ref #2	The inside bottom edge of the wall opening is less than 39" from the floor
Ref #3	Greater than or equal to 30" high and 18" or wider in any wall or partition

21.3. Application. Verify the wall opening meets all three criteria and abate the hazard.

21.4. Hazards. Common areas for wall opening hazards are construction sites, loading/unloading operations at facilities, elevator shaft, weather damaged facilities, facility renovations, and aging facilities.

Chapter 22

STAIRWAYS AND HANDRAILS

22.1. Stairway (Stairs). Risers and treads that connect one level with another and includes any landings and platforms in between those levels. Stairways include standard, spiral, alternating tread-type, and ship stairs (29 CFR 1910.21(b), *Definitions*).

22.1.1. A Stairrail system is a vertical barrier that runs along the unprotected side edge of a stairway to prevent workers from falling to lower levels. The top surface of the stairrail system may be used as the handrail (29 CFR 1926.1050(b); 29 CFR 1926.1052(c)(7)).

22.2. Handrail. A rail used to provide employees with a handhold for support (29 CFR 1910.21(b), *Definitions*). Effective handrails provide an adequate handhold for workers to grasp to prevent them from falling (29 CFR 1926.1052(c)(1) and 1926.1052(c)(9)).

22.3. Stairway and Handrail Compliance. IAW 29 CFR 1910.29(f), the employer must ensure the following:

22.3.1. Handrails are positioned between 30 inches (76 cm) and 38 inches (97 cm) from the leading edge of the stair tread to the top surface of the handrail.

22.3.2. Stair rail systems' height depends on installation date:

22.3.2.1. Installed before January 17, 2017: minimum 30 inches (76 cm) from the leading edge of the stair tread to the top surface of the top rail.

22.3.2.2. Installed on or after January 17, 2017: minimum 42 inches (107 cm) from the leading edge of the stair tread to the top surface of the top rail.

22.3.3. The top rail of a stair rail system can serve as a handrail if it meets specific height requirements and other handrail criteria.

22.3.4. There must be a minimum clearance of 2.25 inches (5.7 cm) between handrails and any other object.

22.3.5. Handrails and stair rail systems must have smooth surfaces to prevent employee injuries and clothing snagging.

22.3.6. No opening in a stair rail system can exceed 19 inches (48 cm) at its least dimension.

22.3.7. Handrails should be shaped and sized to allow employees to grasp them firmly.

22.3.8. The ends of handrails and stair rail systems should not present any projection hazards.

22.3.9. Handrails and top rails of stair rail systems must withstand a downward or outward force of at least 200 pounds (890 N) applied within 2 inches (5 cm) of any point along the top edge of the rail without failing.

Chapter 23

SAFETY NETS

23.1. Introduction. Safety nets are classified as a passive fall protection system which can be installed as either a barrier to prevent a fall, or beneath the work to catch a falling worker. Safety nets are designed to decrease the fall distance, to absorb the energy of a fall, and to reduce the likelihood or seriousness of an injury (29 CFR 1926.105; 29 CFR1926.502(c)).

23.1.1. Safety nets shall be provided when workplaces are more than 25 feet above the ground or water surface, or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical (29 CFR1926.105(a)). **Figure 23.1.** illustrates the net requirements at different heights.

23.2. Requirements. IAW 29 CFR1926.502(c), safety net systems and their use must adhere to the following guidelines:

23.2.1. Safety nets should be placed as close as possible beneath the working surface, not exceeding 30 feet (9.1 m) below. On bridges, the area between the working surface and the net must be clear.

23.2.2. The outer edge of safety nets must extend outward from the outermost projection of the work surface, with specific minimum distances depending on the vertical distance from the working level to the horizontal plane of the net.

23.2.3. Sufficient clearance must exist under safety nets to prevent contact with surfaces or structures below during an impact force equal to the drop test specified.

23.2.4. Safety nets and installations must withstand an impact force equivalent to a drop test using a specified weight and height. Drop tests should occur after installation, relocation, major repair, and at 6-month intervals if stationary.

23.2.5. Defective nets must not be used. Weekly inspections for wear, damage, and deterioration are required, with defective components promptly removed. Additionally, inspections are necessary after any event potentially affecting net integrity.

23.2.6. Materials, tools, or equipment fallen into safety nets must be promptly removed, preferably before the next work shift.

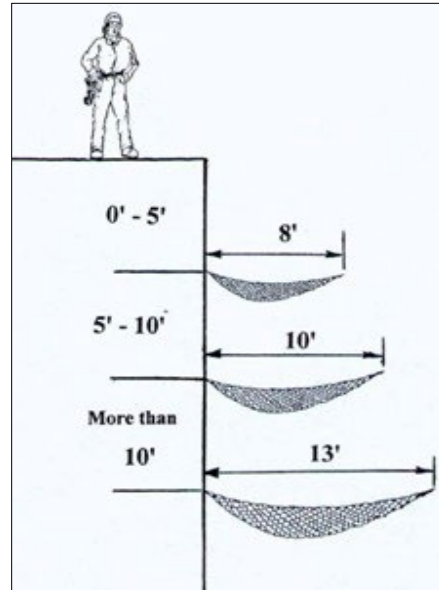
23.2.7. Safety net mesh openings must not exceed specific size limits, with mesh crossings securely fastened to prevent enlargement.

23.2.8. Each safety net section must have a border rope with a minimum breaking strength of 5,000 pounds (22.2 kN).

23.2.9. Connections between safety net panels must be as strong as integral net components and spaced no more than 6 inches (15 cm) apart.

23.3. Hazards. Common hazards include netting that does not meet the 6"x 6" or smaller mesh size, missing a label of proof testing, unserviceable netting, lack of prior to use inspections, and net not constructed to regulations.

Figure 22.1. Net Requirements for Working at Heights



23.4. Inflatable Fall Arrest Device. On March 15, 1995, Mr. Dan Dunn of 2368 Fairskies Dr., Spring Hill, Florida, received a response from OSHA regarding his inquiry about an inflatable fall arrest device. OSHA stated that the device would be evaluated based on criteria similar to safety nets. If the device meets the standards outlined in 29 CFR 1926.502(c) and effectively prevents the test weight from reaching the ground, it could be considered compliant. However, it must be installed within 30 feet of the working surface as specified in the net standards.

Chapter 24

MOBILE ELEVATED WORK PLATFORM

24.1. Scope. A Mobile Elevated Work Platform (MEWP) is a device designed to lift workers to elevated positions using platforms supported by scissors, masts, or booms.

24.2. References. Refer to DAFMAN 91-203, Chapter 16, *Mobile Elevating Work Platforms and Scaffolding* for additional guidance on MEWPs and scaffolding. Also, consult 29 CFR 1910 Subpart D, *Walking-Working Surfaces*, 29 CFR 1910 Subpart F, *Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms*, and 29 CFR 1910.27, *Scaffolds and Rope Descent Systems*. All fall prevention and protection measures must be evaluated and approved by a qualified person before use.

24.3. Requirements.

24.3.1. Compliance with Standards: Vehicle-mounted elevating and rotating aerial devices must meet the requirements of ANSI/SAIA A92.2-2021, *Vehicle Mounted Elevating and Rotating Aerial Devices*. Any modifications should conform to ANSI/SAIA A92.2-2021 and 29 CFR 1910.67, *Vehicle-Mounted Elevating and Rotating Work Platforms*, and documented appropriately. Note that removing or tampering with safety features is prohibited (DAFMAN 91-203, 16.5.1.).

24.3.1.1. An inspector should check the equipment status paperwork (Air Force Technical Order (AFTO) Form 244, *Industrial/Support Equipment Record* or equivalent) to ensure operability.

24.3.2. Visual Inspection: Before each shift or day's work, visually inspect the unit and test lift controls to ensure safe operation. Test the override feature as per ANSI/SAIA A92.2-2021 requirements and document any discrepancies found during the inspection (DAFMAN 91-203, 16.5.5.4).

24.3.3. Guardrail System: Platforms, excluding buckets or baskets, should have a guardrail system with a top rail 42 inches high and at least one rail midway between the top rail and platform surface. Both rails must withstand 300 pounds of force without failure (DAFMAN 91-203, 16.5.5.9.1.).

24.3.4. Safety Harness: Occupants of buckets or platforms must wear a full-body harness and lanyard, limiting free fall distance to six feet or less. Each lanyard should be attached to a designated anchor point on the boom or basket (DAFMAN 91-203, 16.5.5.10.).

24.4. Hazards.

24.4.1. While guardrails and buckets offer some fall protection, the catapulting tendency of mobile lift baskets poses a risk of workers being ejected from the lift, leading to severe injury or death.

24.4.2. During operation, there's a risk of workers coming into contact with live electrical components or getting entangled in rotating or moving equipment parts. Collisions with stationary objects like aircraft, vehicles, or poles are also potential hazards.

24.4.3. Adverse weather conditions such as high winds, rain, snow, ice, or hail can affect the stability and safety of the lift, posing risks to workers.

24.4.4. Equipment not properly maintained and regularly inspected may have issues like low hydraulic pressure, worn tread, rust, or damaged controls, increasing the likelihood of accidents and malfunctions.

Chapter 25

SCAFFOLDING

25.1. Definitions. Scaffold means any temporary elevated platform (supported or suspended) and its supporting structure (including points of anchorage), used for supporting employees or materials or both (29 CFR 1926.450, *Definitions*).

25.2. Fall Protection Requirements for Scaffolds. 29 CFR 1926.451(g) describes the requirements for fall protection, these include:

25.2.1. Fall Protection for Elevated Scaffolds: Employees on scaffolds over 10 feet above ground level must be protected from falls. Specific types of fall protection are outlined in subsections 29 CFR 1926.451(g)(i) through 1926.451(g)(vii).

25.2.2. Requirements for Scaffold Erectors and Dismantlers: Effective from September 2, 1997, a competent person must assess the feasibility and safety of providing fall protection during scaffold erection or dismantling. Fall protection is mandatory where feasible and does not pose additional hazards.

25.2.3. PFAS specifications: Personal fall arrest systems must be attached to vertical or horizontal lifelines or scaffold structural members, meeting specific anchorage and attachment criteria outlined in subsections 29 CFR 1926.451(g)(iii) and 1926.451(g)(iv). Additionally, guardrail systems must comply with various provisions regarding installation, height, strength, and surface properties, as detailed in subsections 29 CFR 1926.451(g)(i) through 1926.451(g)(xv).

25.3. Training. IAW 29 CFR 1926.454(a), the employer shall have each employee who performs work while on a scaffold trained by a person qualified in the subject matter to recognize the hazards associated with the type of scaffold being used and to understand the procedures to control or minimize those hazards. The training shall include the following areas, as applicable:

25.3.1. The nature of any electrical hazards, fall hazards and falling object hazards in the work area.

25.3.2. The correct procedures for dealing with electrical hazards and for erecting, maintaining, and disassembling the fall protection systems and falling object protection systems being used.

25.3.3. Retraining is required where changes in the types of scaffolds, fall protection, falling object protection, or other equipment present a hazard for which an employee has not been previously trained.

25.4. Visual Aids. The visual aids cover OSHA's general requirements for scaffolding and scissor lifts, as well as various applications of scaffolding.

Visual Aid. [OSHA Scaffolding General Requirements](https://www.osha.gov/etools/scaffolding/supported)
(<https://www.osha.gov/etools/scaffolding/supported>)

Visual Aid. [OSHA Scissor Lift General Requirements](https://www.osha.gov/etools/scaffolding/scissor-lifts)
(<https://www.osha.gov/etools/scaffolding/scissor-lifts>)

Visual Aid. [Scaffolding Applications](https://www.osha.gov/otm/section-5-construction-operations/chapter-4#appa)
(<https://www.osha.gov/otm/section-5-construction-operations/chapter-4#appa>)

Chapter 26

LADDERS

26.1. Portable Ladders. A ladder that can readily be moved or carried, and usually consists of side rails joined at intervals by steps, rungs, or cleats (29 CFR 1910.21, *Definitions*). **Figure 26.1.** illustrates portable ladder positioning requirements.

26.1.1. Requirements.

26.1.1.1. Ladder side rails must extend at least 3 feet above the upper landing surface for access.

26.1.1.2. While not mandatory, it's recommended to use fall protection with portable ladders.

26.1.1.3. The ladder should maintain a 4:1 pitch, meaning for every 4 feet vertically, the ladder should be 1 foot away from the structure.

26.1.1.4. Always maintain three points of contact while climbing or descending the ladder.

26.1.2. Inspection.

26.1.2.1. Check the ladder's load rating and ensure it's not exceeded.

26.1.2.2. Before each use, inspect the ladder. Check for tight joints, straight rungs, and intact side rails.

26.1.2.3. Metal components must be free from corrosion, with all bolts and rivets securely in place.

26.1.2.4. Ensure the ladder is appropriate for the intended task, such as using fiberglass ladders for electrical work.

26.1.2.5. For extension ladders, ensure movable parts operate smoothly, ropes are intact, and all components are in good condition.

26.1.3. Hazards. Common hazards include missing hardware, improper ladder setup, standing on the ladder's top, and using the wrong ladder for the job.

26.1.4. The NIOSH and CDC offer a "ladder safety" app to aid workers and inspectors in measuring ladder angles.

26.2. Fixed Ladders. A ladder with rails or individual rungs that is permanently attached to a structure, building, or equipment. Fixed ladders include individual-rung ladders, but not ship stairs, step bolts, or manhole steps (29 CFR 1910.21, *Definitions*). **Figure 26.1.** gives an example of a fixed ladder.

26.2.1. Requirements.

26.2.1.1. Refer to 29 CFR 1910.28(b)(9)(i) for detailed fixed ladder requirements, which vary depending on the ladder's installation date and accompanying safety equipment.

26.2.1.2. Depending on when the ladder was installed, it may require a personal fall arrest system, ladder safety system, cage, or well.

26.2.2. Application.

26.2.2.1. Determine the ladder's installation date to ensure compliance with the appropriate fall protection regulations.

26.2.2.2. Inspect fixed ladders for environmental damage, rust, sharp edges, and compliance with safety standards.

26.2.3. Hazards. Common hazards include corrosion, rust, sharp edges, and non-compliance with safety regulations, leading to ladder disrepair.

26.3. Ladder Safety Systems. A system designed to eliminate or reduce the possibility of falling from a ladder. A ladder safety system usually consists of a carrier, safety sleeve, lanyard, connectors, and body harness. Cages and wells are not ladder safety systems (29 CFR 1910.21, *Definitions*). **Figure 26.1.** gives examples of ladder safety systems.

26.3.1. Requirements.

26.3.1.1. Each ladder safety system enables climbing with both hands free and without continuously holding, pushing, or pulling any part of the system.

26.3.1.2. Systems may be cable or fixed rail types, permanently attached to the ladder or supporting structure.

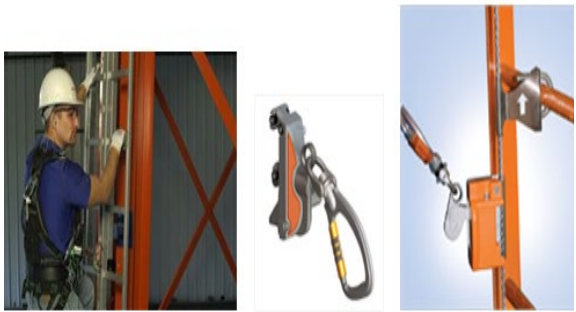
26.3.2. Application.

26.3.2.1. Inspect fixed ladders to determine if they require ladder safety systems, especially if they are 24 feet or higher.

26.3.2.2. Check ladder components for signs of damage, corrosion, or rust.

26.3.3. Hazards. Hazards include damaged components, corrosion, and failure to install safety systems despite regulatory requirements.

Figure 26.1. Ladder Specifications

Portable Ladder Positioning Requirements	Fixed Ladder Example	Ladder Safety Systems
		

Chapter 27

LEADING EDGES

27.1. Definition. Leading edge means the edge of a floor, roof, or formwork for a floor or other walking/working surface (such as the deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed, or constructed. A leading edge is considered to be an "unprotected side and edge" during periods when it is not actively and continuously under construction (29 CFR 1926.500(b), *Definitions*).

27.2. Requirements. IAW 29 CFR 1926.501(b)(2):

27.2.1. If workers are working on a leading edge that's 6 feet (1.8 meters) or higher above lower levels, they must be protected from falling. This can be done using guardrail systems, safety net systems, or personal fall arrest systems.

27.2.2.1. If the employer can show that using these systems is not practical or would make the situation more dangerous, they must create and follow a fall protection plan that meets the requirements outlined in 29 CFR 1926.502(k).

27.2.2.2. Note: There's an assumption that using at least one of the fall protection systems mentioned above is feasible and doesn't increase the risk. So, the employer needs to prove that using a fall protection plan complying with 29 CFR 1926.502(k) is more suitable for a specific workplace situation instead of using any of those systems.

27.2.2. If workers are on a surface that's 6 feet (1.8 meters) or higher above a lower level and leading edges are being constructed nearby, but they're not directly involved in the leading-edge work, they still need protection from falling.

27.2.2.1. This can be provided by a guardrail system, safety net system, or PFAS.

27.2.2.2. If a guardrail system is chosen and a controlled access zone has been set up for leading edge work, the control line can be used instead of a guardrail along the edge that runs parallel to the leading edge.

27.3. Hazards. Common hazards are workers not following written program requirements, unauthorized workers in the leading-edge area, and the area is improperly marked off.

Note: Leading edge work is usually contracted out. Air Force and Space Force Safety professionals will rarely deal with leading edge work operations. Research the scope of work and verify standards before consulting on these types of operations.

27.4. Visual Aids. The visual aids include demonstrations of drop tests for Leading Edge and Non-Leading Edge PFAS.

Visual Aid. Leading Edge PFAS Drop Test
(<https://www.milsuite.mil/video/watch/video/57513>)

Visual Aid. Non-Leading Edge PFAS Drop Test
(<https://www.milsuite.mil/video/watch/video/57511>)

Chapter 28

STEEL ERECTING

28.1. Overview. In steel erection, a new, very narrow working surface is constantly being created as skeletal steel is erected at various heights. For many steel erectors, especially connectors, the work starts at the top level of the structure. This means that anchor points above foot level are often limited or unavailable.

28.2. Requirements. IAW 29 CFR 1926.760(a):

28.2.1. Employees who are on a walking/working surface with an unprotected edge more than 15 feet above a lower level must be protected by conventional fall protection.

28.2.2. Perimeter safety cables must be installed at the final interior and exterior perimeters of multi-story structures as soon as the decking has been installed.

28.2.3. Connectors and employees working in controlled decking zones must be protected from fall hazards.

28.2.4. Install perimeter safety cables on multi-story structures after metal decking installation.

28.2.5. Protect connectors and workers in controlled decking zones from fall hazards.

28.2.6. Connectors must be protected from falls over two stories or 30 feet, complete connector training, and use fall protection systems above 15 feet.

28.2.7. Establish Controlled Decking Zone (CDZ) for initial metal decking installation, ensuring worker safety and limited access.

28.3. Visual Aids. The visual aid is a link to an OSHA eTool that helps educate employers and workers on the revised steel erection standards.

Visual Aid. [OSHA Steel Erecting General Requirements](https://www.osha.gov/etools/steel-erection)
(<https://www.osha.gov/etools/steel-erection>)

Chapter 29

FALL PROTECTION PPE MAINTENANCE AND STORAGE

29.1. Best Practices for Equipment Storage. This section outlines essential guidelines for storing fall protection equipment safely and effectively.

29.1.1. Safe Storage Practices: It is imperative to store fall protection equipment according to the manufacturer's guidelines. This not only ensures the equipment's longevity but also guarantees its safe use.

29.1.2. Tagging for Maintenance: Equipment requiring repairs or maintenance should be clearly tagged with an AFTO Form 244, *Industrial Support Equipment Record*, and removed from service until rectified.

29.1.3. Inspection Before Use: Equipment stored for an extended period should undergo inspection by a competent person before being used to ensure its integrity and functionality.

29.1.4. Proper Storage Conditions: When not in use, fall protection gear should be hung in a cool, dry place. Considerations for storage include avoiding contact with the ground or dirty environments, moisture, direct sunlight, chemical exposure, sharp objects, abrasive surfaces, and extreme temperatures.

29.1.5. Improper Storage Condition: Common pitfalls to avoid while storing PPE, include exposure to moisture, sunlight, chemicals, sharp objects, and extreme temperatures. **Note:** Common inspection findings identified during equipment inspections that necessitate immediate action include fabric deterioration, metal corrosion, webbing damage, and issues with hooks or gates.

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

ANSI/ASSE Z359.6-2016, *Specifications and Design Requirements for Active Fall Protection Systems*.

ANSI/ASSP Z359.0-2023, *Definitions and Nomenclature Used for Fall Protection and Fall Arrest*.

ANSI/ASSP Z359.1-2020, *The Fall Protection Code*.

ANSI/ASSP Z359.2-2017/2023, *Minimum Requirements for a Comprehensive Managed Fall Protection Program*.

ANSI/ASSP Z359.4, *Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components*.

ANSI/ASSP Z359.14-2021, *Safety Requirements for Self-Retracting Devices for PFAS and Rescue Systems*.

ANSI-ASSP Z459.1, *Safety Requirements for Rope Access System*.

ANSI/ASSP Z490.1, *Criteria for Accepted Practices in Safety, Health and Environmental Training*.

ANSI/SAIA A92.2-2021, *Vehicle-Mounted Elevating and Rotating Aerial Devices*.

DAFI 91-202, *The US Air Force Mishap Prevention Program*.

DAFMAN 91-203, *Air Force Occupational Safety, Fire, And Health Standards*.

OSHA Publication 2254, *Training Requirements in OSHA Standards*.

TO 00-25-245, *Operations Instructions - Testing and Inspection Procedures for Personnel Safety and Rescue Equipment*.

29 CFR 1910 Subpart D, *Walking-Working Surfaces*.

29 CFR 1910 Subpart F, *Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms*.

29 CFR 1910.21, *Scope and Definitions*.

29 CFR 1910.27, *Scaffolds and Rope Descent Systems*.

29 CFR 1910.28, *Duty to Have Fall Protection and Falling Object Protection*.

29 CFR 1910.29, *Fall Protection Systems and Falling Object Protection - Criteria and Practices*.

29 CFR 1910.30, *Training Requirements*.

29 CFR 1960.56, *Training of Safety and Health Specialists*.

29 CFR 1910.67, *Vehicle-Mounted Elevating and Rotating Work Platforms*.

29 CFR 1926.105, *Safety Nets*.

29 CFR 1910.140, *Personal Fall Protection Systems*.

29 CFR 1926.450, *Scope, Application and Definitions Applicable to this Subpart*.

29 CFR 1926.451, *General Requirements*.

29 CFR 1926.452, *Additional Requirements Applicable to Specific Types of Scaffolds*.

29 CFR 1926.454, *Training Requirements*.

29 CFR 1926.500, *Scope, Application, and Definitions Applicable to this Subpart*.

29 CFR 1926.501, *Duty to have fall protection*.

29 CFR 1926.502, *Fall Protection Systems Criteria and Practices*.

29 CFR 1926.503, *Training Requirements*.

29 CFR 1926.760, *Fall Protection*.

29 CFR 1926.1050, *Scope, Application, and Definitions Applicable to this Subpart*.

29 CFR 1926.1052, *Stairways*.

Acronyms

ANSI – American National Standards Institute

ASSE – American Society of Safety Engineers

CAZ – Controlled Access Zones

CDZ – Controlled Decking Zone

CFR – Code of Federal Regulations

F&ES – Fire & Emergency Services

HVAC – Heating, Ventilation, and Air Conditioning

MAF – Maximum Arresting Force

MEWP – Mobile Elevated Work Platform

OSHA – Occupational Safety and Health Administration

PFAS – Personal Fall Arrest System

PPE – Personal Protective Equipment

QTP – Qualification Training Package

RAC – Risk Assessment Code

SEG – Occupational Safety

SRL – Self-Retracting Lanyard

VLL – Vertical Lifeline

Forms

Air Force Technical Order (AFTO) Form 244, *Industrial/Support Equipment Record*.

DAF Form 847, *Recommendation for Change of Publication*.

Attachment 2

KNOWLEDGE CHECK

1. What is the primary purpose of fall protection equipment?
 - A. To enhance worker productivity.
 - B. To mitigate the effect of falls.
 - C. To protect employees from serious injury or death that need to work in elevated locations which meet the OSHA trigger heights.
2. IAW DAFMAN 91-203, what is the role of a Competent Person in the unit fall protection program?
 - A. Conducting fall hazard surveys.
 - B. Providing advice to the unit commander
 - C. Administer and Manage the Unit Fall Protection Program.
3. IAW DAFMAN 91-203, who is ultimately responsible for the development and implementation of the fall protection program that promotes a safe and healthful workplace?
 - A. Qualified Person
 - B. Competent Person
 - C. Unit Commander
4. True or False: Duties of the Installation Occupational Safety office include conducting thorough annual review of fall protection program elements.
 - A. True
 - B. False
5. Who assists in the fall hazard surveys and development of written fall protection and rescue procedures?
 - A. Fire & Emergency Services (F&ES) Flight
 - B. Unit Commander
 - C. Authorized Rescuer
6. IAW DAFMAN 91-203, supervisor responsibilities include?
 - A. Responsible for the procurement of fall protection/fall arrest systems.
 - B. Designation in writing by the Competent Person.
 - C. Delegates rescue team personnel.
7. What is a common requirement for Trainers, Qualified, and Competent persons?
 - A. Designated in writing by the unit commander.
 - B. Participate in the investigation of all incidents related to falls.
 - C. Implement a fall protection plan and rescue plan.
8. When is fall protection retraining required?
 - A. When changes in the workplace render previous training obsolete or inadequate.
 - B. Only if there is an injury.
 - C. Once every three years.

9. How often should recurring training be performed?
 - A. Quarterly
 - B. Every 2 years
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10. With what agency shall the Fall Protection Plan be coordinated?
 - A. Commander
 - B. Occupational Safety Office
 - C. F&ES Flight
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 - C. Only if damage to property occurs.
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 - A. To determine the basic configuration of fall hazards.
 - B. To identify environmental factors affecting fall protection systems.
 - C. To help employers and safety professionals identify potential fall hazards and determine the necessary steps to mitigate or eliminate them.
13. IAW DAFMAN 91-203 who typically leads the fall hazard survey team?
 - A. Competent or Qualified Person(s)
 - B. Work Center Supervisors
 - C. Installation Occupational Safety Office
14. True or False: A key aspects of a comprehensive Fall Hazard Survey is environmental factors affecting the installation, use, inspection, maintenance, and dismantling of any fall protection system.
 - A. True
 - B. False
15. The Fall Protection Program Assessment final report will be routed to the unit commander for review and signature within how many days of completion?
 - A. 5
 - B. 10
 - C. 30
16. IAW DAFI 91-202 how often will the installation or tenant unit's Occupational Safety Office complete an assessment of Fall Protection Program requirements for each unit?
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 - A. Procedures to contact the rescue agency if a fall occurs.
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 - C. Steps to take when work is completed, e.g., clean up, storage.

18. What are the SIGNS of suspension trauma?
 - A. Increased heart rate and high blood pressure.
 - B. Severe headache and muscle pain.
 - C. Faintness, nausea, breathlessness, and dizziness.
19. What are some examples of a fallen worker secondary hazards?
 - A. Broken bones, entanglement, shock.
 - B. Heartburn, nausea, indigestion.
 - C. Sore throat, runny nose, cough.
20. What is the primary approach outlined in the Hierarchy of Fall Protection for addressing fall hazards?
 - A. Fall Arrest Systems
 - B. Administrative Controls
 - C. Hazard Elimination
21. According to the Hierarchy of Fall Protection, which control method involves creating physical barriers to prevent falls?
 - A. Fall Restraint Systems
 - B. Passive Fall Protection
 - C. Administrative Controls
22. Which type of fall protection involves devices like guardrails and nets that prevent falls but are not directly connected to the employee?
 - A. Suspension System.
 - B. Passive Fall Protection.
 - C. Positioning System.
23. What is the purpose of a Retrieval System in fall protection?
 - A. To restrict an employee's range of movement.
 - B. To provide prompt rescue of employees in the event of a fall.
 - C. To allow employees to lift and lower themselves along a vertical surface.
24. True or False: There are NO exceptions to fall protection?
 - D. True
 - E. False
25. Which of the following materials is NOT suitable for connectors in personal fall protection systems?
 - A. Stainless Steel
 - B. Natural fiber
 - C. Steel
26. What system consists of a body harness, anchorage, and connector?
 - A. PFAS
 - B. Positioning Systems
 - C. Rope Descent System

27. IAW 29 CFR 1910.21 which of the following is NOT part of a Rope Descent System?
- A. Descent device
 - B. Horizontal lifeline
 - C. Chair (seatboard).
28. What is the purpose of a travel restraint system?
- A. To arrest an employee in a fall.
 - B. To eliminate the possibility of an employee going over the edge of a walking-working surface.
(pg. 30)
 - C. To provide support on an elevated vertical surface.
29. Which lifeline system is primarily used for tasks that require workers to move horizontally over a large area without constantly disconnecting and reattaching to different anchor points?
- A. Portable Gantry
 - B. Horizontal Lifeline
 - C. Rigid Rail System
30. Which lifeline system is typically used in environments like warehouses and factories, providing fall arrest solutions with short arrest distances?
- A. Horizontal Lifeline
 - B. Rigid Rail System
 - C. Portable Gantry
31. IAW 29 CFR 1910.21, what defines a low-slope roof?
- A. Any roof with a slope greater than 4-foot in 12-foot.
 - B. Any roof that is flat or less than or equal to a ratio of 4-foot in 12-foot.
 - C. Any roof with a slope greater than 6-foot in 12-foot.
32. In webbing material, which material is more durable and rigid than nylon, and resists water absorption?
- A. Polyester
 - B. Nylon
 - C. Chemical resistant
33. When inspecting a lanyard prior to use, where should the inspection begin?
- A. In the middle of the lanyard.
 - B. At one end of the lanyard working towards the other end.
 - C. From the hardware towards the rope or strap.
34. What is the primary purpose of the impact indicator on a self-retracting device?
- A. To determine the device's maximum allowable weight.
 - B. To signal whether the device has been exposed to fall forces and should be retired.
 - C. To identify the manufacturer of the device.
35. IAW 29 CFR 1910.140, anchorages used to attach personal fall protection equipment must be capable of supporting at least how many pounds for each attached employee?
- A. 5,000 pounds.
 - B. 7,500 pounds.
 - C. 10,000 pounds.

36. IAW 29 CFR 1910.140, connectors must have a finish that is?
- A. Painted.
 - B. Galvanized.
 - C. Corrosion-resistant.
37. True or False: Maximum Arresting Force (MAF) refers to the highest force exerted on the body when stopping a fall?
- A. True
 - B. False
38. What is the primary purpose of calculating fall clearance in a fall protection system?
- A. To assess the potential impact force on the worker's body.
 - B. To ensure the worker will not strike a lower level in the event of a fall.
 - C. To calculate the distance traveled during a fall.
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- A. Swing fall is the distance a worker can swing after falling.
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 - C. Swing fall is the distance a worker falls before the fall protection system engages.
40. What is the primary purpose of warning lines in designated areas?
- A. To prevent access to certain work areas.
 - B. To warn employees of an unprotected side or edge.
 - C. To guide the movement of mechanical equipment.
41. What is a requirement for hole covers located in roadways and vehicular aisles?
- A. Must be marked with the word "HOLE."
 - B. Should support at least twice the maximum axle load of the largest vehicle expected to cross.
 - C. Should be capable of supporting the weight of employees only.
42. What protective measures are mandated for employees working near wall openings?
- A. Wearing reflective vests.
 - B. Guardrail system, safety net system, or personal fall arrest system.
 - C. Using handrails for support.
43. Which of the following is true about handrails and stair rail systems?
- A. There must be a minimum clearance of 4 inches between handrails and any other object.
 - B. The ends of handrails and stair rail systems should not present any projection hazards.
 - C. Opening in a stair rail system can exceed 24 inches at its least dimension.
44. IAW 29 CFR 1926.105, when should safety nets be provided at workplaces?
- A. When workplaces are more than 25 feet above the ground or water surface.
 - B. When workplaces are more than 10 feet above the ground.
 - C. When workplaces are more than 30 feet above the ground or water surface.

45. IAW DAFMAN 91-203, what type of fall protection must occupants of buckets or platforms wear on Mobile Elevated Work Platforms (MEWPs)?
- A. Reflective vests.
 - B. Full-body harness and lanyard.
 - C. Hard hats.
46. IAW 29 CFR 1926.451, employees on scaffolds over how many feet above ground level must be protected from falls?
- A. 5 feet
 - B. 10 feet
 - C. 15 feet
47. What is a characteristic of ladder safety systems?
- A. They require continuous manual operation during climbing.
 - B. They include cages or wells as integral components.
 - C. They allow climbing with both hands free.
48. IAW 29 CFR 1926.501, what fall protection systems can be used to protect workers from falling when working on a leading edge?
- A. Safety lighting systems.
 - B. Guardrail systems, safety net systems, or personal fall arrest systems.
 - C. Emergency evacuation procedures.
49. True or False: For steel erecting, employees who are on a walking/working surface with an unprotected edge more than 5 feet above a lower level must be protected by conventional fall protection.
- A. True
 - B. False
50. For best practices for equipment storage, what are considerations for storing fall protection gear when not in use?
- A. Expose it to direct sunlight.
 - B. Store it in a moist environment.
 - C. Hang it in a cool, dry place.

KNOWLEDGE CHECK – ANSWERS KEY

1. What is the primary purpose of fall protection equipment?
 - A. To enhance worker productivity.
 - B. To mitigate the effect of falls.
 - C. To protect employees from serious injury or death that need to work in elevated locations which meet the OSHA trigger heights. (pg. 9)**
2. IAW DAFMAN 91-203, what is the role of a Competent Person in the unit fall protection program?
 - A. Conducting fall hazard surveys.
 - B. Providing advice to the unit commander
 - C. Administer and Manage the Unit Fall Protection Program. (pg. 9)**
3. IAW DAFMAN 91-203, who is ultimately responsible for the development and implementation of the fall protection program that promotes a safe and healthful workplace?
 - A. Qualified Person
 - B. Competent Person
 - C. Unit Commander (pg. 10)**
4. True or False: Duties of the Installation Occupational Safety office include conducting thorough annual review of fall protection program elements.
 - A. True (pg. 10)**
 - B. False
5. Who assists in the fall hazard surveys and development of written fall protection and rescue procedures?
 - A. Fire & Emergency Services (F&ES) Flight (pg. 10)**
 - B. Unit Commander
 - C. Authorized Rescuer
6. IAW DAFMAN 91-203, supervisor responsibilities include?
 - A. Responsible for the procurement of fall protection/fall arrest systems. (pg. 10)**
 - B. Designation in writing by the Competent Person.
 - C. Delegates rescue team personnel.
7. What is a common requirement for Trainers, Qualified, and Competent persons?
 - A. Designated in writing by the unit commander. (pg. 11)**
 - B. Participate in the investigation of all incidents related to falls.
 - C. Implement a fall protection plan and rescue plan.
8. When is fall protection retraining required?
 - A. When changes in the workplace render previous training obsolete or inadequate. (pg. 12)**
 - B. Only if there is an injury.
 - C. Once every three years.
9. How often should recurring training be performed?
 - A. Quarterly
 - B. Every 2 years
 - C. Annually (pg. 12)**

10. With what agency shall the Fall Protection Plan be coordinated?
 - A. Commander
 - B. Occupational Safety Office (pg. 13)**
 - C. F&ES Flight
11. In what situations should falls from heights be reported?
 - A. Only if there is an injury.
 - B. Regardless of whether an injury or damage has occurred. (pg. 13)**
 - C. Only if damage to property occurs.
12. What is the purpose of a Fall Hazard Survey?
 - A. To determine the basic configuration of fall hazards.
 - B. To identify environmental factors affecting fall protection systems.
 - C. To help employers and safety professionals identify potential fall hazards and determine the necessary steps to mitigate or eliminate them. (pg. 15)**
13. IAW DAFMAN 91-203 who typically leads the fall hazard survey team?
 - A. Competent or Qualified Person(s) (pg. 15)**
 - B. Work Center Supervisors
 - C. Installation Occupational Safety Office
14. True or False: A key aspects of a comprehensive Fall Hazard Survey is environmental factors affecting the installation, use, inspection, maintenance, and dismantling of any fall protection system.
 - A. True (pg. 16)**
 - B. False
15. The Fall Protection Program Assessment final report will be routed to the unit commander for review and signature within how many days of completion?
 - A. 5
 - B. 10 (pg. 17)**
 - C. 30
16. IAW DAFI 91-202 how often will the installation or tenant unit's Occupational Safety Office complete an assessment of Fall Protection Program requirements for each unit?
 - A. Annually (pg. 17)**
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17. IAW DAFMAN 91-203 a Rescue Plan will include all the following EXCEPT?
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 - C. Steps to take when work is completed, e.g., clean up, storage. (pg. 18-19)**
18. What are the SIGNS of suspension trauma?
 - A. Increased heart rate and high blood pressure.
 - B. Severe headache and muscle pain.
 - C. Faintness, nausea, breathlessness, and dizziness. (pg. 19)**

19. What are some examples of a fallen worker secondary hazards?
- A. Broken bones, entanglement, shock. (pg. 20)**
 - B. Heartburn, nausea, indigestion.
 - C. Sore throat, runny nose, cough.
20. What is the primary approach outlined in the Hierarchy of Fall Protection for addressing fall hazards?
- A. Fall Arrest Systems
 - B. Administrative Controls
 - C. Hazard Elimination (pg. 21)**
21. According to the Hierarchy of Fall Protection, which control method involves creating physical barriers to prevent falls?
- A. Fall Restraint Systems
 - B. Passive Fall Protection (pg. 21)**
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22. Which type of fall protection involves devices like guardrails and nets that prevent falls but are not directly connected to the employee?
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- A. To restrict an employee's range of movement.
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 - C. To allow employees to lift and lower themselves along a vertical surface.
24. True or False: There are NO exceptions to fall protection?
- A. True
 - B. False (pg. 24)**
25. Which of the following materials is NOT suitable for connectors in personal fall protection systems?
- A. Stainless Steel
 - B. Natural fiber (pg. 25)**
 - C. Steel
26. What system consists of a body harness, anchorage, and connector?
- A. PFAS (pg. 26)**
 - B. Positioning Systems
 - C. Rope Descent System
27. IAW 29 CFR 1910.21 which of the following is NOT part of a Rope Descent System?
- A. Descent device
 - B. Horizontal lifeline (pg. 30)**
 - C. Chair (seatboard).

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- A. Portable Gantry
 - B. Horizontal Lifeline (pg. 31-32)**
 - C. Rigid Rail System
30. Which lifeline system is typically used in environments like warehouses and factories, providing fall arrest solutions with short arrest distances?
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 - B. Rigid Rail System (pg. 32)**
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- A. Any roof with a slope greater than 4-foot in 12-foot.
 - B. Any roof that is flat or less than or equal to a ratio of 4-foot in 12-foot. (pg. 34)**
 - C. Any roof with a slope greater than 6-foot in 12-foot.
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 - B. Nylon
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- A. To determine the device's maximum allowable weight.
 - B. To signal whether the device has been exposed to fall forces and should be retired. (pg. 41)**
 - C. To identify the manufacturer of the device.
35. IAW 29 CFR 1910.140, anchorages used to attach personal fall protection equipment must be capable of supporting at least how many pounds for each attached employee?
- A. 5,000 pounds. (pg. 42)**
 - B. 7,500 pounds.
 - C. 10,000 pounds.
36. IAW 29 CFR 1910.140, connectors must have a finish that is?
- A. Painted.
 - B. Galvanized.
 - C. Corrosion-resistant. (pg. 43)**

37. True or False: Maximum Arresting Force (MAF) refers to the highest force exerted on the body when stopping a fall?
A. True (pg. 45)
B. False
38. What is the primary purpose of calculating fall clearance in a fall protection system?
A. To assess the potential impact force on the worker's body.
B. To ensure the worker will not strike a lower level in the event of a fall. (pg. 45)
C. To calculate the distance traveled during a fall.
39. What is swing fall, and why is it important to consider in fall protection calculations?
A. Swing fall is the distance a worker can swing after falling.
B. Swing fall occurs when a worker moves horizontally away from the anchor point, and it is important to consider it to ensure the worker won't strike obstacles or the ground. (pg. 46)
C. Swing fall is the distance a worker falls before the fall protection system engages.
40. What is the primary purpose of warning lines in designated areas?
A. To prevent access to certain work areas.
B. To warn employees of an unprotected side or edge. (pg. 48)
C. To guide the movement of mechanical equipment.
41. What is a requirement for hole covers located in roadways and vehicular aisles?
A. Must be marked with the word "HOLE."
B. Should support at least twice the maximum axle load of the largest vehicle expected to cross. (pg. 50)
C. Should be capable of supporting the weight of employees only.
42. What protective measures are mandated for employees working near wall openings?
A. Wearing reflective vests.
B. Guardrail system, safety net system, or personal fall arrest system. (pg. 51)
C. Using handrails for support.
43. Which of the following is true about handrails and stair rail systems?
A. There must be a minimum clearance of 4 inches between handrails and any other object.
B. The ends of handrails and stair rail systems should not present any projection hazards. (pg. 52)
C. Opening in a stair rail system can exceed 24 inches at its least dimension.
44. IAW 29 CFR 1926.105, when should safety nets be provided at workplaces?
A. When workplaces are more than 25 feet above the ground or water surface. (pg. 53)
B. When workplaces are more than 10 feet above the ground.
C. When workplaces are more than 30 feet above the ground or water surface.
45. IAW DAFMAN 91-203, what type of fall protection must occupants of buckets or platforms wear on Mobile Elevated Work Platforms (MEWPs)?
A. Reflective vests.
B. Full-body harness and lanyard. (pg. 55)
C. Hard hats.

46. IAW 29 CFR 1926.451, employees on scaffolds over how many feet above ground level must be protected from falls?
- A. 5 feet
 - B. 10 feet (pg. 56)**
 - C. 15 feet
47. What is a characteristic of ladder safety systems?
- A. They require continuous manual operation during climbing.
 - B. They include cages or wells as integral components.
 - C. They allow climbing with both hands free. (pg. 58)**
48. IAW 29 CFR 1926.501, what fall protection systems can be used to protect workers from falling when working on a leading edge?
- A. Safety lighting systems.
 - B. Guardrail systems, safety net systems, or personal fall arrest systems. (pg. 59)**
 - C. Emergency evacuation procedures.
49. True or False: For steel erecting, employees who are on a walking/working surface with an unprotected edge more than 5 feet above a lower level must be protected by conventional fall protection.
- A. True
 - B. False (pg. 60)**
50. For best practices for equipment storage, what are considerations for storing fall protection gear when not in use?
- A. Expose it to direct sunlight.
 - B. Store it in a moist environment.
 - C. Hang it in a cool, dry place. (pg. 61)**