PRISM SOLUTIONS

RESEARCH BRIEF

Research Request:

Fall Protection—Aircraft Maintenance

Research Response:

OSH Act of 1970

Section 5(a)(1), which is called the "General Duty Clause," serves as the catch-all section that OSHA uses to require all employers to provide a safe workplace for their employees. A quick layman's definition of this section is that if an action or situation looks unsafe and there are no OSHA rules that govern the act, then OSHA will cite it under this clause.

◊ Section 5. Duties:

(a): **Each employer:**

(1): "shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;"

(2): "shall comply with occupational safety and health standards promulgated under this Act."

*(b): "**Each employee** shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct."*

OSHA 1910 Regulations Governing General Industry

Choosing the proper PFP equipment for use with AWP equipment is only one of the requirements for providing proper and adequate PFP. If you elect a fall arrest system, for instance, you will be required to address fall rescues.

29 CFR 1910, Occupational Safety and Health Standards for General Industry

According to Subpart D of 29 CFR 1910, entitled "Walking-Working Surfaces," every person who is walking or working on a surface shall be protected from falling to a lower level. Paragraph 29 CFR 1910.23(c)(1) states that every open-sided floor or platform four feet high or more will require some form of fall protection.

1910 Subpart F covers fall protection as it pertains to powered platforms, manlifts and vehicle-mounted work platforms.

1910.67(c)(2)(v): "A body belt shall be worn and a lanyard attached to the boom or basket when working from an aerial lift."*

*The lanyard anchorage connector must be attached to the AWP equipment's anchor point.

1910.66 Appendix C Personal Fall Arrest Systems requires that the employer shall provide for prompt rescue of employees in the event of a fall or shall assure the self-rescue capability of employees, and before using a personal fall arrest system and after any component or system is changed, employees shall be trained in accordance with the requirements of paragraph 1910.66(i) (1), in the safe use of the system.

ANSI Standards

The ANSI/SIA A92.5-2006 Standard for boom-supported elevating work platforms establishes responsibilities of users, operators and owners. The standard requires users to ensure that their authorized operators follow proper guidelines and instructions. The user is also required to direct and monitor the operators to be in compliance with the provision set forth in the standard. Section 7.10 (1) defines the requirements for fall protection. The principal fall protection is provided by the guardrail system. The user shall direct the operator to ensure that all the components of the guardrail system are in place. **The user also must direct and monitor the operator(s)/occupant(s) of the AWP equipment to ensure that each person wears a personal fall arrest system to protect against the potential effects of ejection or a fall restraint system to prevent a free fall. The user may elect to use either a restraint or an arrest system.** The standard briefly describes a fall restraint and fall arrest system.

Responsibilities of the operators regarding fall protection are described in Section 8.6 (3), 8.8 (2) and (4), and 8.10 (1). Operators are required to ensure that guardrails are installed and positioned and that access gates, or openings, are properly closed. Additionally, operators must ensure that all occupants are wearing appropriate personal protective equipment. **Operators are required to wear fall restraint or fall arrest**

equipment – as directed by their employer – which is attached to the AWP equipment's anchor point.

ANSI/ASSE A10.32-2004 Standard for fall protection systems defines requirements for the selection, inspection, use, care and maintenance of the equipment and for training and supervision of the users of the equipment. Once the equipment is selected, training must be provided to the employee regarding the inspection, safe use, care and maintenance, plus training and annual drills regarding rescue.

ANSI/ASSE Z359 Standards require employers to have a comprehensive fall protection program that includes: 1) drafting a policy statement that includes goals and guidance for a managed program 2) appointing a program administrator 3) eliminating or controlling fall hazards 4) developing and maintaining fall protection and rescue procedures and 5) providing PFP equipment, knowledge and training.

Fall Protection Information

All fall protection products fit into four functional categories.

1. Fall Arrest; 2. Positioning; 3. Suspension; 4. Retrieval.

Fall Arrest
A fall arrest system is required if any risk exists that a worker may fall from an elevated position, as a general rule, the fall arrest system should be used anytime a working height of six feet or more is reached. Working height is the distance from the walking/working surface to a grade or lower level. A fall arrest system will only come into service should a fall occur. A full-body harness with a shock-absorbing lanyard or a retractable lifeline is the only product recommended. A full-body harness distributes the forces throughout the body, and the shock-absorbing lanyard decreases the total fall arresting forces.

Positioning
This system holds the worker in place while keeping his/her hands free to work. Whenever the worker leans back, the system is activated. However, the personal positioning system is not specifically designed for fall arrest purposes.

Suspension
This equipment lowers and supports the worker while allowing a hands-free work environment, and is widely used in window washing and painting industries. This suspension system components are not designed to arrest a free fall, a backup fall arrest system should be used in conjunction with the suspension system.

Retrieval
Preplanning for retrieval in the event of a fall should be taken into consideration when developing a proactive fall management program.

Listed below are different types of fall safety equipment and their recommended usage.

- **Class 1**—Body belts (single or double D-ring) are designed to restrain a person in a hazardous work position and to reduce the possibility of falls. They should not be used when fall potential exists; positioning only.
- **Class 2**—Chest harnesses are used when there are only limited fall hazards (no vertical free fall hazard), or for retrieving persons such as removal of persons from a tank or a bin.
- **Class 3—**Full body harnesses are designed to arrest the most severe free falls.
- **Class 4**—Suspension belts are independent work supports used to suspend a worker, such as boatswain's chairs or raising or lowering harnesses.
- **Rope Lanyard—**Offers some elastic properties for all arrest; used for restraint purpose.
- **Web Lanyard—**Ideal for restraint purposes where fall hazards are less than 2 feet.
- **Cable Positioning Lanyards—**Designed for corrosive or excess heat environments and must be used in conjunction with shock absorbing devices.
- **Shock Absorbers—**When used, the fall arresting force will be greatly reduced if a fall occurs.
- **Rope Grabs—**A deceleration device which travels on a lifeline, used to safely ascend or descend ladders or sloped surfaces and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee.
- **Retractable Lifeline Systems—**Gives fall protection and mobility to the user when working at height or in areas where there is a danger of falling.
- **Safety Nets—**Can be used to lesson the fall exposure when working where temporary floors and scaffolds are not used and the fall distance exceeds 25 feet.
- **Rail Systems—**When climbing a ladder, rail systems can be used on any fixed ladder as well as curved surfaces as a reliable method of fall prevention.

U.S. Navy Recommended Procedures—Fall Protection

Fall Protection Systems and Equipment

Aircraft maintenance stands/work platforms;

- When using maintenance stands/work platforms they shall be equipped with standard guardrail or other fall protection system.
- Towing and operation of work stands and platforms shall be in accordance with the local Command requirement.

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Mobile work platforms/aerial lift equipment;

- When using mobile work platform/aerial lift equipment, which has a manufacturer-installed/OSHA compliant anchorage, a full body harness and a shock absorber shall be used.
- When mobile work platforms do not have an OSHA compliant anchorage point, they shall be equipped with a standard guardrail system installed on all open sides, except the side facing the aircraft when it is very close to the working surface. Personnel shall not stand on railings to perform work and shall not use the platform rails as a ladder.

Restraint system

Ladders

Fall arrest system:

- Self retracting lanyard
- Horizontal lifeline system

Procedural controls.

- This is the least preferred method of providing fall protection.

Aircraft Fall Hazard Prevention and Control

Maintenance work

When maintenance procedures require workers to walk or perform tasks where they can fall four feet or more to a lower level, the following will apply:

- Personnel shall be trained to recognize the hazards of falling and the use of fall protection equipment;
- Refresher training on the safe use of fall protection equipment for personnel working on aircraft and exposed to fall hazards should be conducted every two years;
- Designated walkways should be identified and used wherever possible;
- Personnel working on aircraft surfaces should wear shoes with non-slip soles;
- Personnel shall be provided with fall protection equipment;
- The use of fall protection equipment and systems shall be required when maintenance work is conducted at the flight line;
- Good housekeeping practices are paramount and should be enforced and implemented. All aircraft surfaces shall be Immediately cleaned when hydraulic fluids, oils or other fluids leak;
- When winds preclude the safe performance of maintenance work outside the hangars, work on elevated surfaces of the aircraft, other than those required to safeguard the aircraft, shall be avoided.

Cleaning and washing of aircraft

- To protect against falls when cleaning and washing aircraft, personnel should not be allowed to climb or walk on wet surfaces while the aircraft is being washed;
- When washing or cleaning aircraft, separate elevated work platforms or work stands and long-handled brushes should be used to the maximum extent possible. The maximum use of maintenance stands and work platforms will reduce the risk and exposure to fall hazards.
- If it is necessary to walk on aircraft wings or other surfaces during washing, extreme care shall be exercised and other control measures may be utilized such as horizontal life lines or self retracting lanyards to which a full body harness can be attached.

Fall Protection Hierarchy of Controls

The hierarchy or the preferred order of control measures for fall hazards is:

⇒ Elimination - Removing the hazard from a workplace. This is the most effective control measure (e.g., lower various devices or instruments, such as meters or valves to the height level of the individual, instead of servicing such devices or instruments at heights).

⇒ Prevention - Isolating or separating the hazard from the general work areas (e.g., same level barriers such as guardrails, walls, or covers.)

⇒ Engineering Controls - If the hazard cannot be eliminated, isolated, or separated, engineering control is the next-preferred measure to control the risk (e.g., design change or use of different equipment or techniques such as aerial lift equipment).

⇒ Administrative Controls - This includes introducing new work practices that reduce the risk of a person falling (e.g., erecting warning signs or restricting access to certain areas).

⇒ Personal Protective Systems and Equipment (PPE) - These shall be used after other control measures (such as eliminating or preventing a fall hazard) are determined not to be practical, or when a secondary system or equipment is needed (e.g., when it is necessary to increase protection by employing a backup system). Additionally, the use of cranial protection should also be required any time when working on aircraft elevated surfaces.

Fall-protection Equipment Safeguards Maintenance Personnel Working at Height—Flight Safety Foundation

Rails, Walls Safeguard Work Platforms

Specialists in fall protection say that when maintenance tasks are performed from work platforms (including aircraft docking systems, scissor lifts or mobile elevating work plat-

forms), the equipment should be positioned to ensure that there are no gaps between the platforms and the aircraft.

Rails and/or walls around the edges usually are the preferred method of fall protection on work platforms, but sometimes safety nets are positioned beneath the work surface to catch a worker in the event of a fall. The ATA said that, although safety nets may be effective, they are "not preferred, as individuals may be injured during the impact with the net itself."

Personal fall-arrest systems and fall-restraint systems also may be used by maintenance personnel on work platforms, "when engineering controls are either ineffective or impractical," the ATA said.

In work-platform situations in which engineering controls, fall-restraint systems and fall-arrest systems all are considered ineffective, a controlled-access zone (CAZ) can be imposed to restrict access to the work surface to personnel participating in a specific maintenance task. Compliance with strict safety rules is then required to limit the fall-exposure risk. Nevertheless, the ATA said, "These [CAZs] are very seldom used in aircraft maintenance for work from platforms."

Different Risks Accompany Work From Aircraft Surfaces

Different risks are involved when maintenance personnel perform tasks from aircraft surfaces — wings, horizontal stabilizers, fuselages or engines.

When a fall-arrest system is in use for workers on an aircraft surface, operators must have plans for the recovery of a worker who falls. The ATA said that other cautions for fall-arrest systems include their possible interference with the maintenance process and their possible damage to the aircraft. In addition, fall-arrest systems often must be aircraft-specific, and systems with components at foot level may create trip hazards.

When a fall-restraint system is in use for workers on an aircraft surface, similar cautions apply: The fall-restraint system may interfere with maintenance, may damage the aircraft, may be required to be aircraft-specific and — if there are components at foot level — they may create trip hazards. The fall-restraint system also may be difficult to implement while still allowing access for leading-edge work, the ATA said. Because a fall-restraint system restricts the wearer's range of movement to prevent him or her from moving beyond the edge of the work surface, however, the system eliminates the need for fall-recovery plans.

In some situations involving workers on an aircraft surface, nets are positioned around the surface to catch a worker in the event of a fall. Nevertheless — as in situations involving work platforms — nets often are not appropriate. When the work is being done from an aircraft surface, there often is no surrounding structure to be used to mount a net; in addition, the placement of a net may interfere with other maintenance tasks. Like nets, guardrails also are often inappropriate when work is being performed from

an aircraft surface because the guardrails may interfere with the maintenance task being performed or may damage the aircraft.

In situations in which other fall-protection methods would be ineffective for work being performed from an aircraft surface, a CAZ could be imposed. (CAZs are used more frequently in these situations than in situations involving work platforms.) The ATA's recommendation for developing a CAZ for work performed from aircraft surfaces includes assessing — before work begins — all fall hazards that could be encountered during a maintenance task. Each fall hazard must "either be addressed so that it cannot contribute to a fall, or protection must be supplied to arrest a fall in progress"; if this is not possible, "surface access must be denied, and the [maintenance] process rescheduled until one of the controls [is] instituted," the ATA said.

All workers entering the CAZ must review the assessment before entering to ensure that they understand which aircraft surface they have access to, what hazards could be encountered and what protective measures should be taken, what distractions might arise and how to express concerns about the situation.

Correct Use of Equipment Depends on Adequate Training

Simply having fall-protection equipment is not enough to eliminate fall risks; training is essential to ensure that the equipment is used correctly.

"People often aren't trained properly," Duden said. "In some cases, fall-protection equipment is being provided, but the user is not familiar with how to use the equipment.

"It wasn't too long ago that I walked into an aircraft hangar where a gentleman was working on the rear stabilizer of a plane. He was roughly seven [feet] or eight feet [slightly more than two meters] off the ground. He had a lanyard, and the lanyard was tied off to the horizontal stabilizer. It was a six-foot [slightly less than two meters] lanyard, so he could stand up and do his work. But he was only eight feet off the ground, so a six-foot lanyard wasn't going to do much. He was going to hit the ground before that line became taut."

Companies that design fall-protection systems typically provide training on how to use it.

"When we design a system," Kavia said, "we go on site, ask specific questions about how they're working, and tailor our training to reflect that."

In addition to providing instruction on how to use the fall-protection system and how to wear and maintain safety harnesses, other topics include how to access the fall-protection system safely, so that workers are protected before they step onto the work surface.

As recently as 10 years ago, there typically was no fall protection in aircraft maintenance hangars. Today, equipment is increasingly available but is sometimes misused, primarily because of inadequate training, Duden said.

Nevertheless, when appropriate fall-protection equipment — and appropriate training — are available, many fall injuries can be prevented.

A Mechanic's Guide to Fall Protection Systems

Fall protection may not be the first thought when climbing atop an aircraft to perform a minor repair. If a task will only take five minutes, the risk of falling may be seen as a lesser evil than the additional time it would take to set up a fall protection system. This is a dangerous risk. With more than 100,000 reported incidents per year, falls from heights often result in serious injury.

Depending on the application, OSHA mandates fall protection when working on surfaces elevated by more than four to six feet. Within the aviation industry, there are multiple methods to control fall hazards, but selection of any given method is dependent on a variety of considerations.

Regardless of the type of aircraft a mechanic is working on — private jet, narrow- or wide-bodied plane — fall hazards are magnified by the fact that the work surfaces are slippery and sloped. This makes the potential for a fall much greater than in other industries. Unfortunately, no single system for controlling falls will work on all aircraft or in every situation. Variables such as location of the airplane, location of the maintenance task on the plane, type of task, fall clearance beneath the work surface and turnaround time all dictate the type of system selected.

Location of the airplane is one of the most important considerations when selecting a system. Unless an aircraft is parked directly under a permanent system in a hangar, a portable system or powered lift outfitted with fall protection is required. Even when parked in a hangar, access to a permanent overhead system may not be feasible. The system may be in use or the hangar, particularly at leased facilities, may not have a system installed. Unless the task can wait, a mobile fall protection system is needed.

Where the work is performed will also help determine which system to specify. If the task is close to the edge of a wing or near a window, for example, an aerial lift such as a scissor lift or cherry picker device could be used. If, however, the work is on the middle of a wing or the crown of the aircraft, a lift may be impractical.

The type of work the mechanic is performing will dictate the amount of mobility required and in turn will determine the most practical fall protection system. If a mechanic is performing stationary work such as an antenna change or damage repair, he or she

does not require a great deal of horizontal mobility on the work surface. If, on the other hand, the work involves inspections, cleaning or painting, a great deal of mobility will be required along the wings and fuselage.

In terms of fall clearance, smaller aircraft often don't have the clearance for a mechanic to use a fall protection anchor at foot level, which can mean a 12-foot free-fall in the event of a fall. He or she will need to tie off to an overhead anchorage point. On larger aircraft, with enough clearance between the work surface and the ground, tie-off at foot level is allowable, and in some cases, far more convenient than connecting to an overhead anchorage. When tied off at foot level, a shock-absorbing lanyard capable of keeping fall arrest forces below the OSHA limit of 1,800 pounds must be used.

In the competitive field of commercial aviation, time is of the essence. For quick, unscheduled repairs, a portable system that a mechanic can easily carry to the plane's site can greatly reduce headaches. When it's not feasible to wait for an overhead fall protection system to become available, a portable system as a backup is a necessity.

Aerial Lifts

Aerial lifts such as cherry pickers and scissor lifts are an option when performing stationary work, readily accessible on the side or edge of the aircraft. However, lifts can damage the aircraft if they come into contact with the fuselage or wing. Additionally, awkward positioning in the bucket or cage of a lift device can quickly cause mechanics to become uncomfortable. The freedom of movement that each of the following systems offer are much better suited for aircraft maintenance.

Permanent Systems

Tying off to an overhead permanent engineered system is the best solution for all kinds of aircraft maintenance work. An overhead anchorage point is preferable as it limits free-fall distance in the event of a fall, and therefore reduces the forces that will be exerted on the falling worker. These systems are convenient for stationary work as well as situations in which mobility along the fuselage or wing is needed. Most systems allow the user to bypass the brackets hands-free, so the mechanic never has to disconnect from the line. Some systems available can support up to five users at once. The disadvantage of these systems is that they cannot be moved. An airplane must be located directly underneath it for a mechanic to utilize the system.

There are two basic types of overhead permanent engineered systems: a cable system and a horizontal rail system. A cable system is strung horizontally across hangar roof beams and supported by intermediate brackets spaced evenly to help distribute the forces of a fall. The shuttle, the element that moves along the line, can navigate angles allowing the system to be engineered in a limitless array of configurations. A cable system can be limited to large aircraft. In the event of a fall, the cable, which is not rigid, will dip slightly where the weight of the user is deflected on the line, requiring increased fall clearance.

Horizontal rail systems are ideal for large and small aircraft. These rigid systems are also fixed to overhead support structures. Instead of a cable, however, a partially sealed steel beam with a trolley that moves within it serves as the anchor. Like the cable system, the rail system can span any length.

Free-Standing Systems

Free-standing systems are an ideal alternative to permanent engineered systems. Free-standing systems provide an overhead anchorage point that limits the free-fall distance. The free-standing system has one major advantage over permanent systems: it is mobile. Most systems, which are height adjustable for work on small or large aircraft, can be maneuvered into place by hand, forklift or maintenance vehicle. The drawback to a free-standing system is that mobility is limited to a safe working range, which varies based on the system. There are two types of free-standing systems commonly used in the aviation industry: ladder access systems and horizontal rail systems.

A ladder access system combines easy access to an elevated work area with fall protection from the ground up for the duration of the work being performed, meaning that at no point would a worker be unprotected from a fall. At the top of the ladder is a semi-enclosed platform from which a mechanic can access the wing or fuselage or perform a quick task on the edge or side of the aircraft. One or two fall arrest anchorages are also located at the top of the platform for attachment of a personal fall arrest system. Ladder access systems are ideal for reaching extreme heights, such as the tail of a large commercial jet.

Free-standing horizontal rail systems are essentially the same as the permanent engineered version, with the exception that they are mobile and height-adjustable, but limited to a certain length. They provide anchorages for one or two mechanics either on the same or separate rails. A rail system can be a better option than the ladder access system as it avoids contact with the aircraft, but the vertical reach is more limited and does not provide for fall protection from the ground up.

Vacuum Anchors

A vacuum anchor is a relatively new technology. These systems attach directly to the wing or crown of an aircraft without penetrating or damaging the surface. An optionally included compressed air bottle or connection to an independent air supply provides the vacuum power that holds the anchor to the surface. A fall arrest or restraint lanyard, depending on what the anchor is rated for, can be attached to the anchor and connected to the mechanic's full body harness. Two anchors can also be set up with a horizontal lifeline running between them for increased mobility along the fuselage or wing. This configuration allows one or two mechanics to tie off to the system.

The vacuum anchor is ideal for quick maintenance tasks such as light or antenna replacements. With some systems weighing in at less than 20 pounds, portability is a

major advantage. Additionally, it is quick to set up and is not limited by a specific "safe working area" as freestanding systems are. Due to the fall clearance required when tying off at foot level, the system should only be used on larger aircraft.

When climbing atop an aircraft, there's no excuse for lack of fall protection, especially when technological advances have made connecting to a pre-engineered system quick and efficient. Saving a minute or two is not worth the risk of serious injury or worse.