



**DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING
COMMAND**

**FALL PROTECTION
GUIDE/INSTRUCTIONS**

21 September 2000

TABLE OF CONTENTS

<u>SECTION #</u>		<u>PAGE #</u>
	TABLE OF CONTENTS -----	2
1.0	INTRODUCTION -----	5
1.1	PURPOSE -----	5
1.2	BACKGROUND -----	5
1.3	APPLICATION -----	5
1.4	SCOPE -----	6
1.5	REGULATIONS/STANDARDS -----	6
2.0	DEFINITIONS -----	8
3.0	TRAINING REQUIREMENTS -----	13
4.0	FALL PROTECTION SYSTEMS & GUIDELINES ---	16
4.1	FALL PROTECTION SYSTEMS -----	16
4.2	FALL PROTECTION GUIDELINES -----	17
4.2.1	COMMUNICATION TOWERS -----	17
4.2.2	CLIMBING FIXED LADDERS OVER 20 FT LONG --	17
4.2.3	ROOF WORK -----	18
4.2.4	LEADING EDGE WORK -----	18
4.2.5	SCAFFOLD WORK -----	18
4.2.7	AERIAL LIFTING EQUIPMENT -----	18
4.2.8	CONFINED SPACE ENTRY -----	18
4.2.9	EXCAVATED TRENCHES OR HOLES MORE ----- THAN SIX FEET DEEP	18
4.2.10	COVERS -----	19
5.0	DUTIES AND RESPONSIBILITIES OF ----- QUALIFIED AND COMPETENT PERSONS	20
5.1	QUALIFIED PERSON -----	20
5.2	COMPETENT PERSON -----	20
6.0	INSPECTION, MAINTENANCE, STORAGE ----- AND CARE PROCEDURES FOR FALL PROTECTION	21

6.1	ANCHORAGE SYSTEMS -----	21
6.2	SNAPHOOKS AND CARABINERS -----	21
6.3	LANYARD AND ENERGY ABSORBERS -----	22
6.4	FALL ARRESTOR -----	22
6.5	SELF RETRACTING LIFELINES -----	22
6.6	BODY SUPPORT -----	22
6.7	ROPES -----	23
6.8	VERTICAL LIFELINES -----	23
6.9	LADDER CLIMBING SYSTEMS -----	23
6.10	RAISING/LOWERING DEVICES -----	24
7.0	TIE OFF CONSIDERATIONS -----	25
8.0	FALL PROTECTION & PREVENTION PLAN/ RESCUE AND EVACUATION PLAN -----	27
9.0	FALL PROTECTION SYSTEM DESIGN ----- REQUIREMENTS	30
10.0	IDENTIFICATION, USE, CERTIFICATION AND ----- RE-CERTIFICATION OF ANCHOR POINTS	35
11.0	RESPONSIBILITIES DURING CONSTRUCTION ----- OPERATIONS, DESIGN AND MAINTENANCE ACTIVITIES	37
12.0	FALL PREVENTION CONSIDERATIONS ----- DURING PLANNING AND DESIGN PHASE	39
13.0	EXAMPLES/PROBLEMS AND SOLUTIONS TO ----- FALL HAZARDS	43
14.0	AMERICAN NATIONAL STANDARD INSTITUTE ----- FALL PROTECTION STANDARDS UPDATE	50
15.0	FALL PROTECTION TRAINING ROSTER -----	52
16.0	REFERENCES/HOW TO ACQUIRE INFORMATION --	53

APPENDIX "A"	-----	55
PART I	INSTRUCTIONS FOR USING FALL PROTECTION WORK PLAN MATRIX	56
PART II	HOW TO IDENTIFY FALL HAZARDS IN THE WORK PLACE UTILIZING WORK PLAN MATRIX	58
SECTION 1:	FALL PROTECTION PLANNING	58
SECTION 2:	DESCRIPTION OF FALL ARREST/ RESTRAINT METHODS	62
SECTION 3:	INSPECTION AND INSTRUCTIONS FOR ASSEMBLY/DISASSEMBLY AND STORAGE	66
SECTION 4:	WARNING SYSTEMS AND FALLING OBJECT PROTECTION	68
APPENDIX "B"	-----	72
B.1	MATHEMATICAL PROBLEMS FOR LIFELINES AND ENERGY ABSORBERS	73
FORMS	-----	75
1-1	EMERGENCY RESCUE PLAN FORM	76
1-2	FALL PROTECTION TRAINING ROSTER	77
WORK PLAN MATRIX	-----	78
(Separate file)		
FIGURES	-----	79
(Separate file)		

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

FALL PROTECTION GUIDE/INSTRUCTIONS

1.0 INTRODUCTION

1.1 PURPOSE:

This Fall Protection Guide/Instructions discusses the criteria to protect people from falling at heights.

1.2 BACKGROUND:

Falls are the leading cause of injuries and fatalities in the work place. They are number one cause in construction and fourth in general industry. It is a duty of every employer to provide fall protection to all workers exposed to fall hazards. According to Bureau of Labor Statistics (BLS), most work related injuries and fatalities are on the decline. In contrast, the number of injuries and fatalities from falls continued to rise, accounting for approximately twelve percent of total fatal work injuries. Falls increased from 684 in 1996 to 717 in 1999. Furthermore, thousands of workers suffered injuries due to falls with lost time from work. In the United States, approximately three fall fatalities occurs each working day. Half of the fatalities occurred in the construction industry. BLS data shows that fall fatalities from roofs are the most common, followed by fatal falls from scaffolds, ladders and other surfaces. Aside from tragic loss of life and suffering to victims and their families, workers are very expensive to train and to perform work efficiently. On the average, a single fall fatality costs approximately between \$800,000 to \$2,400,000. The average cost of a single injury due to fall is over \$30,000. In 1998, the most cited violations by OSHA, was for fall protection, leading edge and scaffolds. The intent of the guide is to heighten awareness to the dangers of falling from heights, and to protect all workers exposed to fall hazards in the work place.

1.3 APPLICATION:

This guide/instructions applies to Naval Facilities Engineering Commands, Engineering Field Divisions, Engineering Field Activities, Public Works Centers,

Resident Officers In Charge of Construction, Seabee Designee, Navy Crane Center, Engineers/On-Site Representatives/Audit Teams, Shore Facilities, Safety Managers, Other Navy Activities, Contractor's and Subcontractor's. The guide provides information for the protection of personnel and workers exposed to fall hazards.

1.4 SCOPE:

The scope of this guide/instructions is to develop a program designed to protect government workers and contractor's employees from falling off, onto, or through walking/working surfaces and to protect employees from being struck by falling objects. The guide identifies locations and situations where fall protection is required. These include but not limited to ramps, runways and other walkways, excavations, hoist areas, holes, reinforcing steel and form work, leading edge work, unprotected sides and edges, overhand bricklaying and related work, roofing work, pre-cast concrete erection, wall openings, maintenance and construction of communication towers, and other walking/working surfaces. **US Army Corps of Engineers (USACE), Safety and Health Requirements Manual EM 385-1-1, and 29 CFR 1926.500, Subpart M, the Construction Industry Standards sets a uniform threshold height of 6 feet (1.8 meters) where protection from falls is required for all employees.**

According to the general industry standards, 29 CFR 1910, the height limit for providing fall protection to employee's exposed to fall hazards is four (4) feet. The 29 CFR 1915 sets the height limit at five (5) feet.

All regulations and standards for fall protection and health and safety contain minimum requirements. "DoD 6055.1" Instructions does not preclude DoD components from prescribing supplementary requirements for special conditions over which the DoD component itself, or in coordination with other Federal agencies, exercise statutory authority for safety and health matters. Generally DoD Instructions 6055.1 does not apply to DoD contractors, except for inspection requirements.

The 29 CFR 1960 prescribes requirements for Federal employment occupational safety and health programs and contains provisions to assure safe and healthful working conditions for federal employees.

1.5 REGULATIONS/STANDARDS:

- **US Army Corps of Engineers (USACE), Safety and Health Requirements Manual, EM 385-1-1, current edition, Shall be included and enforced on all DoD contracts involving construction, dismantling, demolition or removal work. Contractors performing such work shall comply with all pertinent provisions of the latest version of the manual (FAR 52.236-13);**

- 29 CFR, PART 1926, Subpart M Requirements, Fall Protection Requirements in the Construction Industry;
- 29 CFR, PART 1910, Occupational Safety and Health Standards;
- 29 CFR PART 1915, Occupational Safety and Health Standards for Shipyard Employment.
- 29 CFR PART 1960, Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters.
- Department of Defense Directive 6055.1, Occupational Safety and Health Program;
- American National Standard Institute, ANSI Z359.1 (R 1999) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components;
- American National Standard Institute (ANSI) A10.32, Standards for Personal Fall Protection used in Construction and Demolition Operations;
- Navy Federal Guide Specification, NFGS-01525, Safety Requirements;
- OPNAVINST. 5100.23E, Shore Facilities;
- NAVFACINST 5100.11J.

End of Section

2.0 DEFINITIONS

Anchorage: A secured structure that can safely withstand forces exerted by fall arrest and rescue equipment. The structure can be in the form of a beam, girder, column or floor. Anchorage is either engineered or improvised. The anchorage must be capable of withstanding a minimum force of 5,000 pounds per person.

Anchorage Connector: The means by which fall arrest system is secured to the anchorage. This could be a steel cable sling, anchor strap, load rated eye bolt, tripod, davit arm or any other device designed to suspend human loads and capable of withstanding forces generated by a fall, **(See figure 1 and 2).**

Arresting Distance: Total vertical distance required to arrest falls; including deceleration and activation distance.

Arresting Force: Force exerted on a worker or test weight when a fall protection system stops a fall. The amount usually expresses the peak force experienced during a fall.

Body Belt: A strap with means both for securing it about the waist and attaching it to a lanyard, lifeline or deceleration device. **(Use in fall arrest system prohibited after January 1998)**

Body Harness: Means of configuration of connected straps to distribute fall arresting force over at least the upper thighs, waist, shoulders, chest and pelvis, with means for attaching a lanyard to other components of the personnel fall arrest system, **(See figure 3).**

Body Restraint System: A strap device, such as chest harness or full body harness, that can be secured around a worker and attached to a load-bearing anchorage in order to restrict travel and limit fall hazards. The strap can be single or multiple, **(See figure 4).**

Buckle: A connector used for attaching the strap or webbing segments together or to themselves, **(See figure 5 and 6).**

Cable Grab: A fall arrest device that locks by either a cam lock (Locking arm) or inertia when a free fall is sensed. It is attached to a worker directly or by a lanyard that slides up or down a fixed or vertical cable or rope lifeline, **(See figure 7).**

Carabiner: An oblong ring snap-hook. Also a connector component generally comprised of an oval or trapezoidal shaped body with a closed gate or similar arrangement. **Only self-locking carabiners are accepted or used. (See figure 8).**

Competent Person (CP) for Fall Protection: A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as in their application and use with related equipment (29 CFR 1910.66 Appendix C). Note: The OSHA CP definition {29 CFR 1926.450 and 1926.32(f)} also requires that a CP have the authority to take prompt corrective measures to eliminate the hazards of falling (**See Qualified person for design knowledge**).

Connecting Means: A lanyard or a device used to connect a body support (Harness) to an anchorage, so that it provides protected mobility for an elevated work task.

Controlled Access Zone (CAZ): A zone to restrict access to leading edge work. CAZ is bound by a control line and should run the full length of the leading edge and connected on each side to a guardrail or wall. The control line can be made of rope, wire, tape or equivalent material and shall be supported by posts and marked with a highly visible material. **CAZ is used when guardrail system, fall arrest systems or safety nets can not be used or installed.**

Conventional Fall Protection Systems: Guardrail systems, personal fall arrest devices, or safety nets.

Critical Sag: Is the deflection of the HLL where the arresting force exactly equals the weight of the worker. The worker's speed of fall does not decrease until the sag of the line is greater than the critical sag. Critical Sag is very important consideration for long span HLL with inline energy absorber.

Deceleration Distance: The vertical distance traveled between the user's fall arrest attachment at the onset of arrest forces during a fall, and after the fall arrest attachment comes to a complete stop.

D-ring: A connector used in a harness as an attachment element or fall arrest attachment and in lanyards, energy absorbers, lifelines and anchorage connectors as an integral connector [ANSI Z359.1-1992 (R1999)].

Energy (Shock) Absorber: A component whose primary function is to dissipate energy and limit deceleration forces, which the system imposes on the body during fall arrest, (**See figure 9**).

Fall Prevention: Is defined as the elimination and minimization of potential fall hazards and therefore, lessens the chance of employee exposure to falls. Any same-level means used to reasonably prevent exposure to a fall hazard; examples of fall prevention are guardrails, walls, floors and area isolation.

Fall Protection: What is done to effectively protect a worker from experiencing accidental falls from elevations.

Fall-Restraint System: Lanyard or device designed to restrain a worker from reaching a leading edge in order to prevent a fall from occurring, **(See figure 4).**

Force Factor: The ratio of peak arresting force using rigid weight compared to a human body having the same weight, both falling under identical conditions. For comparison between rigid weight and human body weight, multiply the rigid weight by 1.4 to allow for body comparison **(ANSI A10.32).**

Horizontal Lifeline (HLL): A component consisting of a flexible line composed of a rail, rope, wire or synthetic cable and having connectors or other coupling means at both ends for securing it horizontally, between the two anchorages. HLL is used for attachment of worker's lanyard or lifeline device while moving horizontally. HLL shall be designed, installed and used under the supervision of a qualified person, **(See figure 10 and 11).**

Ladder Climbing (Safety) Device: A device or climbing sleeve **connected to the front D-ring on the climber's full body harness** that slides up or down a rigid rail or cable. Should fall occur, the device is designed to lock by inertia or cam action to arrest the fall, **(See figure 12).**

Lanyard: A flexible line or rope, wire rope, or strap used to secure full body harness to a deceleration device, lifeline, or anchorage, **(See figure 9).**

Leading Edge: Unprotected side and edge, means the edge of a floor, roof or form-work for a floor or other walking/working surfaces.

Lifeline (LL): A flexible line for connecting to an anchorage at one end, to hang vertically (vertical LL), or for connection to anchorage at both ends to stretch horizontally (HLL), and which serves as a mean for connecting other components of a personal fall arrest system to the anchorage.

Personal Fall Protection System: A system used to arrest an employee in a fall from a working level. It consists of an anchorage system, connecting means, body harness, and may include a lanyard, deceleration device, or lifeline.

Positioning Belt: A single or multiple straps that can be secured around a worker's body to hold the user in a work position.

Positioning Device System: A combination of equipment that permits the user to have both hands free while being supported on an elevated vertical surface (ANSI A10.32), **(See figure 13).**

Qualified Person (QP) for Fall Protection: A person with recognized degree or professional certificate and with extensive knowledge and experience in the subject

field, who is **capable of design, analysis, evaluation and specifications in the subject work, project, or product** (29 CFR 1910.66 Appendix C). Note: for additional qualifications see section 3.8.

Restraint (Tether) System: A combination of equipment to prevent a user from reaching a point where a fall could occur from an elevated work surface (ANSI A10.32) **(See figure 4).**

Retracting Lifeline: Same as Self-Retracting Lanyard.

Rollout: An action by which a snap-hook or Carabiner unintentionally disengages from another connector or subject to which it is coupled.

Rope Grab: A deceleration device, which travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of a worker. The rope grab device will lock onto the compatible rope, **(See figure 7).**

Self-Retracting Lanyard (SRL): A deceleration device, which contains a drum-wound line that may be slowly extracted from, or retracted onto. The drum-wound line is under slight tension during normal worker movement. After onset of a fall, the drum automatically locks, within half a second, preventing further release of line, **(See figure 14).**

Shock Absorber: A component of a fall protection system that dissipates energy by creating or extending the deceleration distance, **(See figure 9).**

Snap Hooks: A connector comprised of a hook-shaped body with a normally closed gate or similar arrangement which may be opened to permit the hook to receive an object and when released automatically, closes to retain the object. **Only self- locking (single or double locking) snap hooks are accepted or used, (29 CFR 1926.500, Subpart M), (See figure 15).**

Swing fall: A pendulum-like motion that can result from moving horizontally away from a fixed anchorage and falling. Swing falls generate the same amount of energy as a fall through the same distance vertically but with additional hazard of colliding with an obstruction or the ground.

Toe-board: A low protective barrier that will prevent the fall of materials and equipment to lower levels.

Warning Line System: A barrier erected on a roof to warn workers that they are approaching an unprotected roof, side or edge and which designate an area which roofing work may take place without the use of guardrail, body harness or safety nets systems to protect workers in the area. Work performed outside barriers will require fall protection systems. **The difference between CAZ and Warning Line system is that**

in the CAZ, approved anchorages can not be provided to tie off the worker, (See figure 16).

End of Section

3.0 TRAINING REQUIREMENTS

- 3.1** In accordance with 29 CFR 1926.503, every employer shall establish and provide a training program for each employee who might be exposed to fall hazards.
- 3.1.1 The training program shall enable the employee (end user) to recognize the hazards of falling in the work place and how to minimize such hazards.
 - 3.1.2 Every employee shall be trained prior to start of work, by a competent person, in the following areas:
 - 3.1.2.1 Nature of fall hazards;
 - 3.1.2.2 Fall protection systems;
 - 3.1.2.3 Use and operation of fall protection/prevention systems;
 - 3.1.2.4 Inspection of fall protection equipment;
 - 3.1.2.5 Role of each employee in the safety monitoring systems;
 - 3.1.2.6 Handling, storage, care and maintenance of fall protection systems.
- 3.2** As per 29 CFR 1910.66, Appendix C, Section III (d), thorough employee training in the selection and use of personal fall arrest system is imperative. Prior to the use of fall protection equipment, the employee must be trained in the safe use of the system. This should include the following:
- 3.2.1 Application limits;
 - 3.2.2 Proper anchoring and tie-off techniques;
 - 3.2.3 Estimation of free fall distance, including determination of deceleration distance, and total fall distance;
 - 3.2.4 Methods of use, inspection, and storage of the system;
 - 3.2.5 Employers and employees should become familiar with applicable regulations and total fall distance;
 - 3.2.6 Limitation of equipment;
 - 3.2.7 Specific lifelines which may be used.
- 3.3** As per USACE Manual 385-1-1, Section 21.A.16, each employee who might be exposed to fall hazards shall be trained by a competent person qualified in the safe use of fall protection systems and the recognition of hazards related to their use, including:
- 3.3.1 Nature of fall hazards in the work area;
 - 3.3.2 Correct procedures for constructing, erecting, maintaining, using and dismantling fall protection systems;
 - 3.3.3 The maximum intended load-carrying capacities of fall protection systems;
 - 3.3.4 Applicable requirements for the USACE Manual 385-1-1;
 - 3.3.5 Limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs;

3.3.6 Retraining shall be provided as necessary for employees to maintain an understanding of these subjects.

- 3.4** In accordance with USACE Manual 385-1-1 and 29 CFR 1926, a written certification of training is required and shall be maintained at the job site for the duration of the work. The certificate shall identify the employee trained, date of training and the signature of the trainer.
- 3.5** All contractors and subcontractor's personnel exposed to fall hazards shall be trained on the use of fall protection equipment and systems and be familiar with NFGS 05125 Safety and Health Requirements. It is highly recommended that daily tailgate meetings be conducted prior to start of work, to discuss fall hazards for that day, and to remind workers to comply with the established fall protection procedures. Tailgate meetings will document the workers receiving ample training in fall protection.
- 3.6** All Navy personnel exposed to fall hazards shall be trained in accordance with paragraph 3.1 through 3.4 above. It is recommended that all employees exposed to fall hazards receive a minimum of 16 hours, or as appropriate, End User Training in fall protection. For Navy personnel who may be in a situation requiring climbing involving the use of fall arrest systems, the End User Training shall also include, practical climbing in a controlled situation, in the presence of a competent person.
- 3.7** All Resident Officers In Charge of Construction (ROICC) and Government Quality Assurance (QA) personnel, administering Construction and Maintenance Contracts, Multi Award Contracts (MAC), Task Order Contracts (TOC), Job Order Contracts (JOC), and Facilities Support Contracts (FSC), shall receive at a minimum 16 hours of hands-on training in fall protection systems, procedures and end-user training. The ROICCs and Government QA personnel shall be able to recognize fall hazard, deficiencies and fall risks at a work site. Hands-on training is also required for investigation and inspection work
- 3.8** Every Engineering Field Division, Engineering Field Activity, Public Works Center and Seabee Battalion shall designate in writing an engineer as their expert for fall protection design and construction issues (NAVFACINST 5100.11J). The designated representative shall possess an engineering degree as a civil/structural, working in the design department and have construction knowledge. The designated engineer shall be trained as a qualified/competent person [40 hours, or as appropriate]. The following are the anticipated duties of the designated engineer:

- Design of fall protection systems for Navy personnel, when required, including anchor systems, connecting means and body support and other fall protection systems;
- Prepare, update, review and approve fall protection and prevention (FP&P) plans and rescue and evacuation plans;
- Be the point of contact between NAVFAC fall protection engineer and his or her command or activity (EFD, EFA, PWC and SEABEE Battalion);
- Participate and assist in the investigation and inspection of fall accidents and mishaps within the EFD, EFA, PWC, ACOS, Facilities and Safety; and prepare **lessons learned** reports for fall mishaps;
- Be knowledgeable and proficient with all fall protection regulations, standards, products, equipment and systems;
- Review and approve plans and specifications of various design, construction and maintenance projects including Title I and Title II construction work for fall protection and prevention issues.

End of Section

4.0 FALL PROTECTION SYSTEMS AND GUIDELINES

(For design requirements of fall protection systems see Chapter 9.0)

It is very important for fall protection qualified person to plan, evaluate, design and select the most appropriate, safe and efficient fall protection systems. There are many fall protection systems that are available or can be used and it is of the utmost important to select the right system for a specific work application.

In every fall hazard situation it is always advisable to have two protective systems, primary and secondary systems. If the primary system fails the secondary system will be activated to protect the employee from falling. As an example, when approaching a leading edge work, the employee's primary protective system is the feet. Therefore, a secondary protective system is required, as a backup' such as a fall arrest/restraining system or guardrails. When climbing a ladder or a pole, the employee's primary fall protective system is the hands and feet. Ladder climbing device is required as a secondary backup system.

4.1 Fall Protection Systems

Every employee exposed to fall hazard shall be protected from falling to lower level by the use of fall protection systems. The main fall protection systems are:

- ◆ **Guardrails Systems**
- ◆ **Safety Nets**
- ◆ **Fall arrest System**

4.1.1 Guardrail System is a conventional method for the prevention of falls from heights. Guardrail is composed of top rail, mid rail, posts and toe boards.

4.1.2 Safety Nets are installed below the leading edge for employee protection.

4.1.3 Fall Arrest System is composed of the following subsystems and components:

- **Anchorage System** - include anchorage point and anchorage connection
- **Connecting Means** - include lanyard (may include shock absorber, snap hooks and carabiners)
- **Body Support**
- **Rescue and escape** - self rescue or assisted rescue

4.1.4 Other fall protection systems include:

- **Horizontal Lifelines**
- **Vertical Lifelines**
- **Ladder Climbing Devices**
- **Positioning Device Systems**
- **Restraining Systems**
- **Controlled Access Zone**
- **Warning Line System**
- **Arial Lifting Equipment, Working Platforms, and Catwalks**
- **Falling Object Protection**
- **Covers**

Note: Fall Arrest system is a passive system. The system will become active when a fall is arrested. Fall arrest system is also considered a secondary system if there is a primary system.

4.2 Fall Protection Guidelines

4.2.1 Communication Towers:

Less than 200 Feet High:

- To secure permanent anchorage on the tower, the first worker up requires a portable anchor, full body harness, use of self retracting lanyard (SRL), ladder climbing device or rope grab;
- After permanent anchorage is secured in place, workers that follow the first person up will require full body harness, SRL, vertical lifeline, ladder climbing device and/or rope grab
- When working on towers, workers will require fall protection at all times.

More than 200 Feet High, (OSHA CPL-2-1.29):

- Tower access to above 200 feet; workers can be hoisted using the Gin Pole or other hoisting mechanism;
- When working on towers, 100% fall protection is required at all times;
- Maximum three (3) people can ride the gin pole at the same time to gain access to the tower above 200 feet.

4.2.2 Climbing Fixed Ladders Over 20 Feet in Length:

- Use full body harness and short lanyard connection, chest “D” ring attached to ladder climbing device; SRL, vertical lifeline or rope grab attached to the back “D” ring. For general safety code and use of fixed ladders see ANSI

A14.3-1956 Safety Code for Fixed Ladders and 29 CFR1926 Subpart X for construction.

4.2.3 Roof Work:

- On sloped roofs use full body harness, SRL, roof brackets to be used as anchorage points (single or multiple connections designed for 5000 pounds per person), also use lifelines;
- On flat roofs with no parapet or guardrails; use full body harness, restraining system and or lanyard/SRL. Establish 6 feet warning line system from the leading edge or temporary guardrails for workers without fall arrest system.

4.2.4 Leading Edge Work:

- Horizontal lifeline, full body harness, lanyard/SRL, roof anchors, use guardrail system, restraining system and or slide guards.

4.2.5 Scaffold Work:

- Use guardrails, cross bracing or full body harness and lifelines.

4.2.6 Suspended Scaffolds, Work Platforms:

- Guardrails, independent vertical lifeline connected to full body harness, **(See figure 17).**

4.2.7 Aerial Lifting Equipment:

- Use full body harness, lanyards connected to approved anchorage;
- Workers will require fall arrest system if the lifting equipment is positioned outside the wheel-base even if the equipment is has guardrail system;
- When using scissors lift, it is highly recommended to tie off to an approved anchorage connection using full body harness at all times.
- **Aerial Lifting equipment can be modified by the manufacturer to install approved anchorage connections for fall arrest system. Usually guardrails in the aerial lifting equipment are not designed to arrest a fall.**

4.2.8 Confined Space Entry:

- When entering a confined area, and if there is a hazard of exposure to vertical fall, the person entering such space shall be tied to lifeline or SRL and rescue and retrieval equipment. A co-worker should be able to retrieve the victim utilizing the retrieval mechanism without any difficulty, **(See figure 18).**

4.2.9 Excavated Trenches or holes more than 6 feet deep:

- Provide temporary guardrail systems on both sides of the trench or around holes or establish a warning line system. Any person crossing this line or guardrails is required to have fall protection.

4.2.10 Covers

- Covers shall be capable of supporting without failure at least twice the weight of employee, equipment and material.
- Covers shall be secured when installed, color-coded and marked with the word 'HOLE, or COVER".

End of Section

5.0 DUTIES AND REONSIBILITIES OF QUALIFIED AND COMPETENT PERSON

5.1 Qualified Person (QP):

The qualified person duties and responsibilities includes the following:

- Prepare, Review, Approve and Modify:
 - Fall Protection and Prevention (FP&P) Plans;
 - Rescue and Evacuation Plans (REP);
- Design, Select, Certify, Evaluate and Analyze Fall Protection Systems and Equipment;
- Review, prepare and approve FP Specifications;
- Prepare Contract Documents for Fall Protection Systems.

5.2 Competent Person (CP):

The competent person duties and responsibilities include the following:

- Implementation of:
 - FP&P Plans
 - Rescue and Evacuation Plans (REP);
- Identify Hazardous and Dangerous Conditions in the Work Place;
- Inspection and installation of approved fall protection systems ;
- Compliance with FP&P Plans, Rescue and Evacuation Plans;
- Training of all workers exposed to Fall Hazards;
- Understanding and knowledge of fall protection systems and equipment;
- Conduct Inspection and Accident Investigations;
- Have full responsibility and authority to implement the FP&P Plans, REP at work place;
- Have only one task, which is to monitor employee compliance with FP&P Plans, REP requirements.

End of Section

6.0 INSPECTION, MAINTENANCE, STORAGE AND CARE PROCEDURES FOR FALL PROTECTION EQUIPMENT

As stated in 29 CFR 1910.66 Appendix C, Section I, Paragraph (f), personal arrest systems must be regularly inspected. Any component of the system with significant defects such as: cuts, tears, abrasions, mold, undue stretching, alterations or additions, which will affect its efficiency, and damage due to deterioration, contact with fire, acids or corrosives, distorted hooks or faulty springs, tongues unfitted to the shoulder buckles, loose or damaged mountings, non functional parts and any wearing or internal deterioration of the ropes must be taken out of service immediately and should be tagged or marked as unusable or destroyed. All FP equipment shall be inspected prior to each use by the user and by a competent person at intervals of no more than one year, (ANSI Z359.1 [6.1.1]). Inspection of the equipment by the competent person should be documented. **As a general rule, always consult equipment manufacturer's recommendations for Use, Inspection, Care and Maintenance.**

6.1 Anchorage Systems:

- Inspect all components of the anchorage systems;
- Observe any abrasions wear points, damaged threads or swags in the sling material before use;
- For synthetic slings and anchor straps, inspect all sewing and loops for wear, chemical damage, burn damage, and/or ultraviolet deterioration;
- Refer to the anchorage attached tags to determine when the sling should be retired
- Inspect cable slings for excessive damage to the steel fibers

6.2 Snap-hooks and Carabiners:

- Inspect on regular basis and before each use;
- Retire snap-hooks and carabiners and all integral components, if any discoloration, deformation, cracks or abrasions are detected;
- Retire immediately if it has sustained any fall, or if the spring brake and gate are bent, or if the gate keeper no longer engages the slot cleanly;
- Damaged snap-hook and carabiners shall be tagged and removed from service and inventory list;
- Dirty snap-hooks and carabiners shall be cleaned with kerosene, WD-40 or similar solvent, immerse in boiling water for 30 seconds to remove cleaning agent and dry with soft cloth, insure gate and gatekeeper operate properly;
- Carabiners shall not be loaded along the gate side;
- Snap-hooks shall not be side-loaded.

6.3 Lanyards and Energy Absorbers:

- Inspect lanyards regularly under slight tension;
- Check all components for abrasion, discoloration, cracks, and torn stitching;
- Wash on regular basis to remove dirt and grit that can abrade the fibers;
- Lanyards and energy absorbers shall have a permanently attached label indicating the manufacture's name, serial number/lot number, manufacture date, maximum elongation, maximum arresting force, maximum free fall, capacity, and that it meets OSHA & ANSI Z359.1 requirements and or ANSI A10.32 (ANSI A10.14 will be replaced with ANSI A10.32)
- Use and review manufacturer's log book provided with the equipment to determine the age of the lanyard and energy absorber;
- Lanyards and energy absorbers shall be inspected by the user prior to each use and by a competent person other than the user at least once a year;
- Maximum usage of a lanyard shall not be more than 5 years; retire the lanyard:
 - ✓ After a hard fall;
 - ✓ When the shock absorber has been even slightly impacted;
 - ✓ If lanyard has been used for any other purpose other than fall protection;
 - ✓ If the equipment show excessive wear, chemical damage, burn damage, and/or ultraviolet deterioration.

6.4 Fall Arrester

- Inspect regularly;
- Check for signs of wear, corrosion, rust and other anomalies;
- If any sign of wear or malfunction, remove device from service immediately.

6.5 Self Retracting Lifelines (SRL):

- Inspect prior to each use;
- Inspected by a competent person regularly;
- SRL shall be returned to the manufacturer for servicing and re-certification once a year;
- If SRL housing becomes yellow, gathers condensation, or the indicator has been engaged, remove from service immediately and return it to the manufacturer for repair and re-certification.

6.6 Body Support:

- Inspect on a daily basis or prior to each use for frayed threads, cuts, tears or loose connections;

- Inspect the stitched areas thoroughly;
- look for burn holes from welding or other heat sources;
- Ensure harnesses are not painted or marked;
- Store harnesses in a cool dry safe environment; ideally in a locked storage area;
- A Competent person other than the user shall inspect the harness periodically or at least once a year;
- Wash the harness in a mild soap and rinse multiple times to remove any soap residue and hang to dry out of direct sunlight in a cool dry environment;
- **Maintain a log book indicating the date of entry into service, the nature of the work Performed, washing or other details;**
- Retire harnesses from service after 5 years even if it is not used;
- Shall have a permanently attached label indicating manufacture's name, serial number/ lot number, manufacture date, capacity, and that it meets OSHA & ANSI Z359.1 requirements and or ANSI A10.32.

6.7 Ropes:

- Inspect Rope periodically for broken fibers, severely worn areas or change in the consistency of the core, inspect under slight tension and check for soft areas, bulges or excessive stiffness;
- Avoid exposing rope to hazardous chemicals, moisture, acids or oils;
- Don't use the rope after it is impacted or damaged;
- Wash the rope, on regular basis to remove dirt or grit, with lukewarm water and mild detergent, rinse several times to remove soap residue and hang in a dry, cool, dark area;
- Store rope in a strong weather proof bag and should always be dry prior to storage;
- Shall have a permanently attached label indicating manufacture's name, serial number/ lot number, manufacture date, capacity, and that it meets OSHA & ANSI Z359.1 requirements and or ANSI A10.32.
- Retire rope after 5 years of service. If it is damaged, impacted or exposed to chemicals, remove from service immediately.

6.8 Vertical Lifelines:

- Refer to section 6.7 above, and manufacturer's recommendations regarding inspection, care and maintenance.

6.9 Ladder Climbing Systems:

- Inspect on a regular basis;
- The sleeve should run freely without hand operations or guidance;
- Check cable and rails for abrasions, wear and cracks;
- Before climbing check integrity of cable, systems and ground level.

Note: when climbing fixed ladders under 20 feet in length ladder climbing devices are not required. Furthermore, portable ladders are not designed and constructed for the installation of ladder climbing devices. Therefore, using ladder-climbing devices on portable ladders is not required.

6.10 Raising/Lowering Devices (Rescue):

- Inspect visually before each use;
- Check for wear, and corrosion;
- Refer to the rope section for additional information.

End of Section

7.0 TIE-OFF CONSIDERATIONS

One of the most important aspects of personal fall arrest is fully planning the system “before” it is put in use. Probably the most overlooked component of the fall arrest system is planning for suitable anchorage points. Such planning should ideally be done during design stage and before a structure or a building is constructed so that anchor points can be incorporated, and identified during construction for use later for future maintenance work. If properly planned and designed, these anchorage points may be used during construction, as well as afterwards during the maintenance phase.

- 7.1** The strength of a personal fall arrest system depends on its subsystems and components as well as the anchorage point and how strongly such system is attached to the anchor point. Such attachment should not significantly reduce the strength of the system including the structural members, such as beams or columns, being attached to. If a mean of attachment is used that will reduce the strength of the system, such component should be replaced with a stronger one in order to maintain the appropriate maximum characteristics.
- 7.2** All components and sub-components of the selected fall arrest system shall be compatible.
- 7.3** No knots shall be tied in lanyards, lifelines or anchorage connectors (i.e. anchor strap). Tie-off using a knot in a lanyard, lifelines or anchorage connectors can reduce the strength by 50% or more.
- 7.4** Tie-off of a rope lanyard or lifeline around an “H” or “I” beam or similar support can reduce the strength drastically due to cutting action of a sharp edges of the beam. Therefore, use should be made of webbing lanyard or wire core lifeline around the beam; or the lanyard or lifeline should be protected from the edge.
- 7.5** Tie-off around rough or sharp surfaces reduces the strength of the line drastically. Such tie-off should be avoided or an alternate tie-off rigging should be used such as snap hook/D-ring connection, wire rope tie-off, an effective padding of the surfaces, or an abrasion-resistance strap around or over the sharp or rough surfaces.
- 7.6** The anchor point location should be located as high as possible to minimize the free fall distance and prevent any contact with an obstruction or the ground below if a worker falls.
- 7.7** Tie-off point(s) shall be located in such a way to minimize swinging of the worker (pendulum like motion) that can occur during a fall. The farther away in a horizontal direction a worker moves from a fixed tie-off point, the greater is the swinging angle if a fall occur. If any obstruction exists in the path of the swing

fall, the force generated by such fall is the same as the force in a vertical fall. The maximum angle of swing away from the tie-off point should not be more than 30 degrees.

- 7.8** Sliding hitch knots shall not be used in lieu of fall arresters (ANSI Z359.1). The hitch knot reduces the strength of lifeline/lanyard in some cases by as much as 50 percent.
- 7.9** The strength of an eyebolt is rated along the axis of the bolt and its strength is greatly reduced if the force is applied at an angle to this axis. Also, the diameter of the eyebolt should be compatible to snap-hook or carabiner attachment.
- 7.10** Horizontal lifelines, depending on their geometry and angle of sag, may be subjected to greater loads than the impact load imposed by an attached component. When the angle of sag for the horizontal lifeline is less than 30 degrees, the impact force generated is greatly amplified. For example, with a sag angle of 15 degrees, the force amplification is about 2:1 and at 5 degrees sag, it is about 6:1. Depending on the angle of sag, and the line's elasticity, the strength of the horizontal lifeline and the anchorages to which it is attached should be increased a number of times over that of the lanyard. Extreme care should be taken in considering horizontal lifeline for multiple tie-off. The reason for this is that in multiple tie-off to a horizontal lifeline, if one employee falls, the movement of the falling worker may cause other employees to also fall. Horizontal lifeline and anchorage strength should be calculated for each additional employee to be tied-off. For these and other reasons, horizontal lifelines shall only be designed and selected and certified by qualified persons. Testing of installed horizontal lifelines and anchors prior to use is recommended. **(See figures 10 and 11 for HLL and 19 thru 22 for anchorage connection).**

End of Section

8.0 FALL PROTECTION & PREVENTION (FP&P) PLAN/RESCUE AND EVACUATION PLAN (REP)

The FP&P Plans/REP are documents prepared by contractors, subcontractors or other Navy entities for the purpose of planning, designing, installing, monitoring and rescue of workers exposed to fall hazards and prevent fall accidents from occurring in the work place. The FP&P Plan/REP is a dynamic document that will require modification due to changes of different phases of work, procedures or methods of construction. A qualified person shall be responsible for preparing FP&P Plans/REP, as well as making any required changes, designing, updating or approving various methods and requirements of fall protection systems. It is of utmost importance that a FP&P Plan/REP be prepared and approved prior to start of work. The plans shall be kept at the work site at all times with any changes noted. **On NAVFAC contracts, contractors are required to submit FP&P Plan as required by "NAVFAC Guide Specification Section 01525 Health and Safety Requirements".**

8.1 FALL PROTECTION AND PREVENTION PLAN REQUIREMENTS:

FP&P Plan is different from Fall Protection Plan stated in 29 CFR 1926.503(k). A Fall Protection Plan is available only to employees who can demonstrate that it is infeasible or it creates greater hazard to use conventional fall protection systems; (i.e. guardrail, safety nets, or personal fall arrest system).

The FP&P Plan shall include the following:

- 8.1.1** Description of the fall hazards that will be encountered at the work place by the users during performance of their work;
- 8.1.2** Type of fall protection/fall prevention methods or systems used for every phase of work;
- 8.1.3** Training requirements for every employee exposed to fall hazards;
- 8.1.4** Type of fall protection equipment and systems provided to the employees that might be exposed to fall hazards;
- 8.1.5** The names of qualified and competent persons shall be included in the plan;
- 8.1.6** Indicate fall protection equipment and instructions for assembly/disassembly, storage maintenance and care;
- 8.1.7** Description of training requirements;
- 8.1.8** FP&P Plan must be prepared and signed by a qualified person. A competent person will implement the plan.

- 8.1.9** All employees working at heights at a job site shall understand and agree to use the P&P Plan and REP.

8.2 RESCUE AND EVACUATION PLAN REQUIREMENTS (REP) **(Refer to Form 1-1)**

As required by 29 CFR 1910.66 Appendix C, Section I, Paragraph (e)(8), when personal fall arrest systems are used, the employer must assure the employee they can be promptly rescued, or can rescue themselves, should a fall occur. The REP shall include emergency procedures, methods of rescue, equipment used, and training requirements.

The REP should include the following information as part of FP&P Plan:

8.2.1 Detailed location of the work site with any information that will help find the location, building number, floor number; etc. Post written directions that can be read over the phone to an ambulance driver/police/fire department or their dispatchers on how to get to the site from the main gate of a facility. Give complete information to the rescue responder. Post a map at the job site and highlight with yellow marker the route one should take from the site to the nearest hospital that someone can use to drive an employee with minor injuries. [29 CFR 1926.50(e)];

8.2.2 Indicate location of the lift or other equipment that will be used in case of emergency and the location of the key.

8.2.3 Detailed location of the closest first aid kit. To assure that during an emergency there is no time lost looking for first aid kits; post a site map marking the location of the first aid kits;

8.2.4 Listing of emergency phone numbers. In the event of an emergency rescue is required, call the phone numbers in the order that they are listed 1st, - 2nd, -3rd. Post written directions can be read over the phone to an ambulance driver/police/fire department or their dispatchers on how to get to the site from the main gate of a facility. Give complete information to the rescue responder;

8.2.5 Send escort to help the fire department or the rescuer to find location of an accident;

8.2.6 Indicate who is the person responsible to make the phone call in case of emergency;

8.2.7 Indicate names of personnel that will require rescue during the course of performing their jobs;

8.2.8 If self rescue is used indicate the type of self rescue equipment that are available at the job site or will be utilized during rescue operations;

8.2.9 Indicate the type of rescue training requirement on the use of self-rescue equipment the rescuer should receive in order to become a qualified rescuer.

End of Section

9.0 FALL PROTECTION SYSTEM DESIGN REQUIREMENTS

In order to plan and design a safe fall protection program, Navy personnel as well as contractors and subcontractors shall be trained and have the knowledge, understanding and commitment to implement a comprehensive fall protection requirements for the safety of all employees exposed to fall hazards.

Planners and designers should be striving to achieve 100% fall protection for all employees exposed to hazards of falling during construction work as well as maintenance and repair work, after construction is complete.

With regard to the order of control measures and solutions to fall hazards and project hierarchy and desirability, planners and designers should consider the following order of control measures and solutions when dealing with fall hazards (FH):

- **Elimination of FH**
- **Substitution and Replacement of FH**
- **Isolation and Separation of FH**
- **Engineering Controls**
- **Administrative Controls**

9.1 Design Requirements for Fall Protection Systems:

(For other specific design criteria see other regulations, standards and references); for additional information see Navy Guide Specification Section 01525 Safety Requirements.

The following design information can be inserted into contracts or used by the in-house design group.

9.1.1 Fall Protection System Requirements:

In accordance with 29CFR 1926, each employee on a walking/working surface with unprotected side or edge which is 6 feet or more above a lower level shall be protected from falling by use of guard rail systems, safety nets or personal fall arrest systems. If working/walking near or above chemicals, liquids or obstructions, fall protection systems are required, even on same level exposure. **As per 29CFR 1910, the threshold limit is 4 feet and per 29CFR 1915 is 5 feet.**

9.1.2 Guard Rails (See figure 23):

- 42 inches high plus or minus 3 inches above walking/working level;
- Shall be made of posts, top rail, mid-rails and toe boards;
- Posts shall be made a minimum of 2X4 inches lumber and a maximum spacing of 8 feet;
- Top rail shall withstand a force not less than 200 pounds if applied to the top rail in outward or downward direction, mid-rails shall withstand a force of 150 pounds and toe board shall withstand a force of 50 pounds;
- Top rail shall made of 2X4 inches lumber, ¼ inch diameter steel cable, 1.5 inches nominal diameter schedule 40 pipe, or 2 inches by 2 inches by 3/8 inch structural steel;
- Top rail shall not deflect lower than 39 inches;
- Mid-rail shall be at least 1X6 inch lumber;
- Toe-board shall be a minimum of 3½ inches high lumber.

9.1.3 Stairs Rails and Handrails:

- 36-37 inches high, (29 CFR 1926.500, Subpart M) for construction;
- 30-34 inches high, (COE EM 385-1-1 and 29 CFR 1910).

9.1.4 Safety Nets (See figure 25):

- Minimum breaking strength of 5,000 pounds;
- Safety net mesh opening should not be larger than 36 square inches or longer than 6 inches on any side opening;
- In any case the net shall not be installed lower than 30 feet from the working surface;
- Safety Nets must extend out from the working surface as follows:

<u>Distance from working level to Net</u>	<u>Distance Net should Extend from working surface</u>
Up to 5 feet	8 feet
Over 5 feet up to 10 feet	10 feet
Over 10 feet	3 feet

- Safety nets shall be tested and certified by a qualified person once every six months using a drop test of 400 pounds, dropped from the same elevation a worker might fall.

9.1.5 Personal Fall Arrest Systems:

- The system must withstand a minimum force of 5,000 pounds;
- Free fall distance generally ranges between 4-6 feet.

9.1.5.1 Anchor Systems:

- Shall withstand a minimum force (breaking strength) of 5,000 pounds;
- Many manufacturers require 5,400 pounds minimum anchorage strength for their equipment;
- No knots shall be tied in anchorage connectors;

9.1.5.2 Snap-hooks and Carabiners:

- Minimum Strength 5,000 pounds, must be self locking type;
- Must withstand a side loading force of 350 pounds and the gate should withstand a force of 220 pounds.

9.1.5.3 Lanyards:

- Strength of 5,000 pounds;
- Length: varies from 2 to 6 feet;
- Synthetic rope lanyard minimum diameter is 1/2 inch;
- Provide energy absorber with lanyards;
- Dynamic performance test, maximum arresting force on the body is 1,800 pounds;
- No knots shall be tied off in lanyards;
- Depending on special or specific applications, dual shock absorbing lanyards may be required;
- A lanyard strap shall not be wrapped around a tie-off point and then attached back to itself, unless it is a tie-back lanyard where the lanyard straps have been designed accordingly;
- A tie-back lanyard's snap-hook shall not be snapped directly back to the lanyard strap (roll-out or gate loading might occur); the snap-hook shall only be snapped to an attached D-ring (incorporated into the body harness by the manufacturer);
- When using a separate anchor connector strap or tie-back lanyard around a beam as an example, protect the strap or the lanyard from abrasion or cutting action by the beam;
- Shall have permanently attached label indicating manufacturer's name, serial number/lot number, manufacture date, capacity, and that it meets OSHA & ANSI Z359.1 requirements and ANSI A10.32.

9.1.5.4 Ropes:

- Synthetic rope lifelines, minimum strength of 5,600 pounds
- Wire rope lifeline, minimum strength of 6,000 pounds
- Vertical lifelines minimum strength of 5,000 pounds

9.1.5.5 Energy Absorbers:

- Shall not elongate more than 42 inches;

- Maximum arresting force of 1800 pounds, minimum operating or activation force of 450 pounds;
- Shall have a permanently attached label indicating the manufacturer's name, serial number/lot number, manufacture date, maximum elongation force, maximum free fall distance, capacity, and that it meets OSHA, ANSI Z359.1 and ANSI A10.32 requirements.

9.1.5.6 Self Retracting Lanyards;

- Shall withstand a minimum tensile load of 5,000 pounds if free fall distance is more than 2 feet;
- Shall withstand a minimum tensile load of 3,000 pounds if the free fall distance is 2 feet and less;
- Maximum arresting force shall not exceed 1,800 pounds.

9.1.5.7 Full Body Harness:

- Maximum arresting force of 1,800 pounds;
- D-ring should be incorporated into the full body harness;
- Shall have a permanently attached label indicating manufacturer's name, serial number/lot number, manufacture date, capacity, and it meets OSHA & ANSI Z359.1 requirements and ANSI A10.32;
- Manufacturers test the harness with a rigid weight of 220 pounds. The conversion factor of rigid weight to the human body is **1.4**. A 220 pounds rigid weight is equivalent to 310 pounds of human body weight.

9.1.5.8 Warning Line:

- Installed six to ten feet away from a leading **edge**, and flagged every 6 feet; provide signage indicating "warning line";
- The height of the warning line should be between 34-39 inches;
- Shall consist of a rope, wire or chain and supporting stanchions.

9.1.5.9 Horizontal lifelines (HLL)

According to ANSI Z359.1 Paragraph 1.3.2, HLL are out of scope and therefore are excluded from the standards. HLL do require special design for every specific application. According to 29CFR 1926.500 appendix C,(ii)(h)(6), HLL shall be designed, installed, certified and used under the supervision of a qualified person, as part of a complete fall arrest system, which maintains a safety factor of 2. However, for identification, use, certification and re-certification of **anchor points** as part of the HLL, a registered engineer is required. ANSI Z359.1 addresses all the sub-components of the HLL. It excludes the anchorage points, design, testing and certification of the system. HLL follows catenary design

(See appendix B for a mathematical problem how to calculate the anchorage strength requirements). HLL can be either permanent or temporary systems and either flexible or rigid such as the trolley system.

Certain parameters should be taken into consideration when designing horizontal lifelines, such as:

- Initial and maximum deflection or sag of the line;
- Clear span between supports or anchorages;
- Design of anchor points and anchorage connectors;
- Number of workers attached to the system;
- Free fall distance and total fall distance;
- Minimum clearance below HLL system;
- Unit weight of the cable;
- Unit weight of the line;
- Total weight of all workers attached to HLL.

The components of typical HLL sub-system may include the following:

- Anchorage, Anchorage Connectors;
- Lifeline Tensioner;
- Cable or rope;
- May include shock or energy absorber.

Presently there are no U.S. standards that identify HLL verification and testing requirements. However, verification testing requirements may include the following tests:

- **Dynamic Performance Test;**
- **Static Residual Strength Test;**
- **Line Fittings Static Strength Test;**
- **Intermediate Anchor Strength Test;**
- **Corrosion Test.**

End of Section

10.0 IDENTIFICATION, USE, CERTIFICATION AND RE-CERTIFICATION OF ANCHOR POINTS

Anchorage can either be engineered or improvised. An anchorage system is a combination of anchorage point and anchorage connector(s). Both anchorage points and anchorage connectors shall withstand a force of 5,000 pounds for every person attached to the system. Anchorage connectors are usually designed and prefabricated by a manufacturer under the supervision of a qualified person and meets OSHA and ANSI standards. The certification and re-certification of anchorage connectors can be done by the manufacturer or qualified person **(for math problem how to calculate anchorage strength requirements, see appendix B)**.

10.1 Responsibility of Anchor Point Identification, Design and Certification:

As stated in 29 CFR 1926, Subpart M, Appendix "C", Personal Fall Arrest System II(h)(i), **"if anchorages are installed, prior to use, a registered professional engineer with experience in designing fall protection systems, or another qualified person with appropriate education and experience should design the anchor point to be installed"**. Section II(h)(ii) of the same appendix states: **"if there is a need to devise an anchor point from existing structures such as beams, or eye-bolt, a qualified person should be used to evaluate the anchorages"**.

Under 29 CFR 1910.66 Appendix "C", Section I(10), states: **"Anchorages shall be capable of supporting 5,000 pounds per employee attached or shall be designed, installed and used under the supervision of a qualified person as part of a complete fall arrest system"**. According to 29 CFR 1910.66, Appendix "C", Section I(b), **"Qualified person means one with recognized degree or professional certificate and extensive knowledge and experience in the subject field, who is capable of design, analysis, evaluation and specifications in the subject work, project or product"**.

As derived from the above regulations, a qualified person should be able to calculate the forces generated by arresting a fall, total loading, deflection of HLL, impact on the structural members the line is attached to, and determine the optimal and safe location where and how to tie-off. The qualified person should have the knowledge, and is capable of designing, certifying, supervising, approving and rating the anchor points and tie-off points.

10.2 Inspection, Certification and Re-certification of Anchor Points:

- **Inspection:** According to ANSI Z359.1, Section 6.1 fall arrest equipment shall be inspected by the user prior to each use and by a competent person annually and in accordance with the manufacturer's instructions. End users are not qualified to inspect anchor points, however, they could be trained to pay special attention to any cracks around the anchor points or if the anchor points are unstable or loose. End users should refrain from tying-off to unsafe anchor points and they should bring it to the attention of the competent person if such situation exists.
- **Certification and Re-certification of Anchor Points:** Anchor points should be field-verified by a qualified person. ANSI Z359.1 addresses certification of anchorage connections. It does not address certification of anchor points. A registered professional engineer or a qualified person can certify the structural integrity of the anchor points. Depending on the design, type, location, size of structural member the anchorage is connected to, the environment and weather conditions, dictates how often such points should be inspected and re-certified by a qualified person.

End of Section

11.0 RESPONSIBILITIES DURING CONSTRUCTION OPERATIONS, DESIGN AND MAINTANANCE ACTIVITIES

11.1 Resident Officer In Charge Of Construction (ROICC)

The ROICC shall ensure all construction contracts, prior to start of construction, includes specification sections dealing with fall protection and that the contractors comply with the USACE manual 385-1-1 (FAR 52.236-13). It should be the contractor's responsibility to provide fall protection to all employees exposed to fall hazards and the they should be properly trained. The contractor shall submit a written FP&P Plan as per "NFGS 01525 Safety Requirements" and as part of the contract including training requirements for the employees and subcontractor's work force, to the ROICC, for review and approval. The ROICCs shall ensure that the contractor will not commence with any construction activities without prior approval of the FP&P Plan. **Fall protection should be one of the main topics discussed during the Pre-Construction Conference.**

11.2 In-house Design:

Navy designers should strive to eliminate fall hazards in the new design of new buildings and facilities by engineering various systems and modifying the design to eliminate the need to use fall protection systems. Navy designers shall ensure all design effort that require fall protection, whether it is during construction phase or future maintenance and repair work, to have fall protection requirement built into the design effort. If feasible, fall protection systems shall be permanently installed for future maintenance and repair work. The designer shall identify the required location of the safe points of connection (anchor points) for future work.

11.3 Navy Design Managers:

The Navy Design Managers shall ensure that A/Es incorporate the following requirements in the design effort:

- "Occupational Safety and Health Planning and Design Guide";
- Fall Protection is built into the design work and added to the specification sections of the contract;
- Utilize Activity Hazard Analysis system.

11.4 Maintenance Work:

The ROICCs and Navy Safety personnel shall ensure that all maintenance contract work by contractors to include fall protection and to ensure the contractors comply with USACE manual, 29 CFR 1910 & 1926 and applicable ANSI standards. If exposed to fall hazards. Navy maintenance workers shall be trained to recognize the hazards of falling in the work place and the use of fall protection equipment.

End of Section

12.0 FALL PREVENTION CONSIDERATIONS DURING PLANNING AND DESIGN PHASE

12.1 INTRODUCTION:

When planning and designing new buildings or facilities, Navy planners and designers including the owner/managers of such facilities, are responsible for providing safe design, for the protection of all workers and users exposed to the hazards of fall from heights during performance of their work. Navy architects and engineers or any other entity planning or designing a building, structure or facility have the general duty of care and responsibility to have a safe design for preventing falls throughout the facility. This duty of care extends to any person who may be involved in the construction, demolition, modification, renovation, maintenance or normal work operation of the building, structure or facility.

12.2 PLANNING AND DESIGNING CONSIDERATIONS:

It is very important at the design and planning phase to give consideration to the prevention of falls, not only during construction, but subsequent use, or maintenance of the building, structure or facility. Consideration during various phases include the following:

12.2.1 Construction Phase:

- Reducing the risk when working at heights(e.g. Installation of guardrails to the perimeter structural members prior to erection;
- Reducing the need to work at heights as much as possible by prefabricating modules on the ground before lifting them into position;
- The siting and condition of access road leading to the building or facility during construction, for example to enable a crane to place building material in the most appropriate and accessible location;
- Preparation and or clearing of debris of the ground or floor below the work area. The ground should be compacted and leveled in order to prevent equipment from tilting or being unstable (e.g. cranes or scissors lifts);
- Provision of temporary safety mesh as much as possible to prevent objects from falling down to lower level;

12.2.2 Maintenance and Occupancy phase:

- Safe access to or egress from any work area;
- Provision of permanent guardrails or edge protection such as parapets;

- Selection of material that can withstand harsh environment (e.g. special wood planks such as particle boards can weaken because it absorbs moisture and thus will not be able to support the weight of the worker during future roofing inspection or maintenance work);
- Use of temporary work platforms whenever possible such as scaffolds, and elevating work platforms;
- Identification and location of services (e.g. location of power lines, water);
- Location and operations of type of equipment selected and devices used (e.g. using adjustable light fixtures that can be lowered to the ground for replacement);
- Use of fall arrest systems and devices, including the provision of suitably located temporary or permanent anchor points and field identification of all required anchorage points;
- Provisions of safety nets, when required;
- Location of and access to equipment for maintenance purposes;
- Location of amenities such as plants;
- First aid facilities and trained personnel where necessary.

12.3 FALL HAZARD IDENTIFICATION:

Navy planners and designers and **system safety engineers** should identify any hazards that involve an employee falling while at workplace or using means of access to or egress from a building or facility. In order to assist in identifying fall hazards, special considerations should be given to:

- Consultation, communication and coordination with safety and health professionals;
- Knowledge of injuries arising from falls that have occurred at a workplace or at similar work places;
- Communication with various A/Es and contractors to find out if end users are having or likely to have problems while performing their jobs;
- Accidents or near miss incidents related to falls at the workplace or similar workplaces; Review Safety web page for various accidents that occurred at similar workplaces;
- Review relevant fall protection standards, regulations and guidance documents;
- Communications with employees of similar facilities to determine what type of risks an employee would face during the performance of their duties;
- Conduct a walk through inspections of the facility or similar facilities to be familiar with various risk situations;
- Compile statistical records indicating potentially unsafe work practices.

12.4 RISK ASSESSMENT:

It is the responsibility of the planner or the designer to assess risk of injury to employees resulting from each hazard that involves falling while at workplace during performance of their work.

Risk in relation to any injury or harm, means the probability of that injury or harm occurring. If a hazard is identified, the risks associated with such hazard can be assessed. Assessment of risks will help planners, designers and system safety engineers determine the potential injury and thus help identify methods to reduce risks. The necessary steps in a risk assessment process may include the following:

- Identify the specific hazardous/situation which might occur in a workplace;
- Identify the nature of the decisions to be made about hazards and who is responsible for making these decisions;
- Define the information needed by those personnel to make the decisions and how such information needs to be presented.

The required information may include the determination and assessment of the following;

- Size, height and layout of a work place;
- Material handling methods or accessing all material or equipment at different locations of the facility;
- Location and condition of all equipment and or material used in a workplace;
- The number, type of work and movement of all employees in a work place, planned facility or building.

12.5 RISK CONTROL:

Planners and designers should consider the means by which risk may be eliminated or reduced. Once risks have been assessed, measures should be taken to control the hazards of falling. There is a hierarchy or the preferred order of control measures. These range from eliminating the hazards as being the most effective to the other methods that reduce risks.

Specific Control Measures

Specific control measures may include the following:

- Planning and designing of new or modification of existing buildings, structures or facilities should take into consideration the prevention of falls;
- Evaluating methods or the way jobs or work tasks can be performed safely to eliminate or reduce the likelihood of a fall;

- Organizing and scheduling of work so that, employees do not interfere or increase the risk of a fall for themselves or others;
- Identifying the information and knowledge required by contractors to enable them to work safely;
- Collection, assembly and presentation of the information required to eliminate or reduce hazards;
- Identifying the training or knowledge requirement to work safely if there is the risk of a fall.

12.6 HIERARCHY OF CONTROL MEASURES

The hierarchy or preferred order of control is:

- **Elimination** - Removing the hazard or hazardous work practices from a workplace. This is the most effective control measure (e.g. lowering various devices or instruments such as meters or valves to the person's level instead of being high when servicing such devices or instruments)
- **Substitution** - Substituting or replacing the hazard or hazardous work practice with a less hazardous one (e.g. prefabricating of structures on the ground instead of erecting the component at heights);
- **Isolation** - Isolating or separating the hazard or hazardous work practice from employees or others from the general work area (e.g. install guardrail at an opening or leading edge);
- **Engineering Controls** - If the hazard can not be eliminated, substituted or isolated this is the next preferred measure to control the risk (e.g. Pre-drilled holes for fall arrest systems and devices to attach anchorage connections);
- **Administrative Controls** - This include introducing new work practices that reduce the risk of a person falling (e.g. erecting warning signs or restricting access to certain areas);
- **Personnel Protective Equipment** - This should be considered only when other control measures are not practical or to increase protection as a backup system or as a secondary system.

Note: Control measures are not mutually exclusive, there may be occasions or situations when more than one control measure should be used to reduce the risk of a fall.

End of Section

13.0 EXAMPLES/PROBLEMS AND SOLUTIONS TO FALL HAZARDS

The following examples/problems, questions and solutions to fall hazards are included to help safety personnel, ROICCs, design engineers, Contractors and Subcontractors to address fall hazards issues and concerns in the work place, especially during the performance of work.

13.1 Product or Material Delivery to a Construction Site:

Question: Are vendors delivering products or materials to a construction site covered under 29 CFR 1926.500 Subpart M, if the products and material are delivered to a location that is 6 feet or more above lower level?

Answer: Yes, they are required to comply with Subpart M. Vendors and others are considered engaged in construction activities when they deliver products or materials to a construction site that are used during construction work or when they are engaged in an activity that completes the construction work, such as final cleanup of buildings and structures. If the construction contractors picked up the products or materials at the vendor's outlet (store, warehouse, etc) the vendor, depending upon the type of facility, may not be regulated by 29 CFR 1926.500 Subpart M.

13.2 Delivery and Placement of Roofing Materials:

Question: What are the obligations of suppliers of roofing materials when they deliver roofing materials to a construction site and place the material on the roof?

Answer: Because the products will be used during construction activities, the suppliers will be required under Subpart M, to protect their employees from falls of 6 feet or more to lower levels when possible. Therefore, employees shall be provided with personal fall arrest equipment to attach to an anchor point if available, **(See figure 24)**. In case of delivering roofing materials, the following is required:

- **Gaining Access to the Roof: When gaining access to the roof, a handhold (rope, chain or other railing) shall be attached to the conveyor belt so that vendor or supplier's employee will have something to steady himself/herself with, or ladder shall be used to gain access to the roof.**

- **Distribution of Roofing Materials:** Once on the roof, the vendor's employee will receive roofing products from a conveyor belt (lift truck or similar equipment) and then distribute the products onto the roof at various locations. During this distribution, OSHA will not require the vendor's employees to install anchorage point for fall protection equipment regardless of the slope of the roof or the fall distance. The construction contractor shall establish/identify properly designed anchorages, to be used by vendor's employee.

Additional Discussion: It is recommended that the employee be tied to an anchorage point to be established at the ridge or the highest point on the roof. The anchorage point can have a post 4 to 5 feet high attached to it, so that a self-retracting lanyard or lifeline attachment to the "D" ring will be high enough and won't become a tripping hazard.

13.3 Performing Work from Elevated Scissors Lift:

Question: When working above 6 feet high and performing work from scissors lift, does a worker require fall protection equipment, even if the scissors lift is equipped with 42" guardrails?

Answer: According to OSHA, if scissors lift is equipped with standard guardrail on all sides, this would be in compliance with ANSI A92.2 "Self Propelled Elevating Work Platforms". However, most of the time, workers performing work, while in elevated scissors lift, lean over the guardrails and perform work outreaching beyond the limits of the guardrails. Furthermore, if the scissors lift, while in motion, collides with other equipment or stops abruptly, the worker might be ejected or thrown out. Therefore, additional fall protection equipment (fall arresting/restraining equipment) will be required for workers in a scissors lift.

Additional Discussion:

All other self propelled elevating work platforms will require worker to be tied-off to a properly designed anchorage point in the lift at all times as per 29CFR 1926.453.

According to OSHA Standard interpretation and compliance letters dated 7 July, 1998, for aerial lifting equipment; fall protection for scissors lifts, OSHA recognizes that there is confusion regarding scissors lift and appropriate standards governing such equipment. Furthermore, the interpretation letters states that working from elevated scissors lift (ANSI A92.6), a worker need only be protected from falling by a properly designed and maintained guardrail system.

13.4 Fall Protection Requirement for Scaffolds:

Question: What type of fall protection equipment will be required while working on scaffolds?

Answer: Fall Arrest System, vertical lifeline and guardrail system will be required on movable or suspended scaffolds. If scaffold is attached to a building or structure (stationary) workers will require guardrail systems. However, it is recommended to use fall arrest system, horizontal or vertical lifelines on stationary scaffolds. Warning line system is required at the lower level, (**See figure 17**).

13.5 Roofing Work:

Question: If a roofing contractor performs new work as well as re-roofing or recovering roofing equipment, What type of fall protection system is required?

Answer: When working on sloped roofs, use horizontal lifeline with a lanyard and full body harness, or use roofing anchor brackets with rope grab. If working on flat roofs use fall restraining system with full body harness and lanyard or construct temporary guardrails. On flat roofs, utilize warning line system to prevent workers from approaching the leading edge of the roof.

13.6 How to Calculate Total Fall Distance:

Question: How to calculate total fall distance from the anchor point location elevated surface to the ground below to determine if a worker exposed to fall hazard will not come in contact with the ground below?

Answer: To calculate total fall distance for worker exposed to a fall, determine the location where the tie off point is, including lanyard length, deceleration distance which is not more than 42 inches, height of the worker and clearance distance from the foot of the worker to the ground below. If the tie off point location is below the D-ring of the harness, this will increase total fall distance. (**See figure 26**).

13.7 Third Party Certification:

Question: Is third party certification required for fall arrest systems?

Answer: Existing regulations and standards do not address third party certification. Major fall protection equipment manufacturers felt that there is a need to certify their equipment or products by a third party entity, independent from the manufacturers themselves. The need for the third party certification is highly recommended because although there are regulations and standards governing fall protection equipment manufacturers, the industry itself is not regulated. The market is being flooded with new fall protection equipment manufactures and products and some of these products are not safe or are manufactured for mountaineering industry but being used for fall arrest.

Note: Anchor points do not require third party certification as long as the structural engineer has designed/verified/approved and certified the system and was installed under his or her authority.

13.8 Requirements for Inspection and Certification Processes for horizontal Lifeline System

Question: What is the difference between Inspection and Certification process?

Answer:

Inspection: According to ANSI Z359.1 Paragraph 6.1 Inspection: equipment shall be inspected by the user before each use and by the competent person annually. Inspection criteria shall be equal or exceed manufacturer's instructions or ANSI standards. The end user and the competent person shall have the proper training to detect and control against the use of damaged, defective and improperly maintained equipment. Although the component and sub-component of HLL systems is part of ANSI Z359.1; the HLL system and sub-systems as a whole is excluded from the standards. Every HLL is unique and require special design. The inspection process for HLL components include anchorage connectors, lifeline tensioner, thimble, cable, fittings, snap-hooks, self retracting lanyard shock absorber, lanyards, full body harness, etc. should follow ANSI Z359.1 standards inspection process and manufacturer's instructions. Furthermore, HLL tensioner should be inspected and checked once prior to each use and at least once a week.

Certification: Is the act or process resulting in documentation that determines and attests to criteria that meet the design

requirements and the standards. Certifying HLL system is carried out by testing or applying proven analytical method, under the supervision of a qualified person or entity. However, according to ANSI Z359.1, Paragraph 3.1.4, Personal Fall Arrest System (PFAS) incorporating a HLL (outside the scope of the standard).

13.9 Personal Fall Arrest Equipment Consideration As Personal Protective Equipment (PPE)

Question: Is Personal Fall Arrest Equipment Considered personal protective equipment (PPE)?

Answer: PPE is supposed to protect a person using the equipment. Full body harness by itself will not protect the user from falling. Other components of the system are required such as lanyard, connecting means and anchorage system. In other words fall arrest system will protect the person from falling only and only if the system is complete and connected. The fall arrest system, as a whole will protect the user from falling, not the components. The most logical designation of PFAS should be personal protective systems (PPS).

Additional Discussion:

Under 29 CFR 1910.132(a) Application states that protective equipment include PPE for eyes, face, head, extremities, protective clothing, respiratory devices and protective shields and barriers. There is no mention of body protection.

Under ANSI Z359.1, throughout the standards, reference is always made to personal fall arrest equipment and systems not PPE. Only in one location under the explanatory column on page 9, Section E.1.1, which is not part of the standard; states the following: equipment used in personal fall arrest system is commonly referred to as personal protective equipment (PPE) in the literature of the safety field".

Under 29 CFR 1910 .66, Appendix "C" Personal Fall Arrest System, throughout this part there is no mention of PPE in the regulations, only fall arrest systems, and components are used.

Under 29 CFR 1926.500, Subpart M, the wording PPE is not used.

Most manufacturers do not use the wording PPE to define or describe fall arrest equipment or systems.

Under 1910 Subpart I, PPE, the requirements include eye, face, respiratory, head, foot protection, electrical protective equipment and hand protection. There is no mention of body protection.

Under 29CFR 1926 Subpart E, 1926.95, the criteria for PPE does not include any reference to fall arrest equipment. The title of this section is Personal Protective Equipment and Life saving equipment.

Only under 29 CFR 1915, such equipment is referenced as PPE. Furthermore, OSHA under Proposed Rulemaking on Personal Protective Equipment dated 31 March 1999, included fall protection equipment as PPE.

13.10 Aircraft Maintenance

(See figure 27)

Question: What are the different types of fall protection methods used for aircraft maintenance?

Answer: The most widely used method is Horizontal Lifelines, and Self-Retracting Lifelines. Other methods include work stands and platforms. The usage of HLL depends on so many factors including special design requirement to limit the total fall distance so that the user will not come in contact with the ground below, during a fall. Other factors include amount of sag of the line, training requirements for the users and annual testing and certification requirements. Furthermore, there are some limitations with HLL such as the number of users connected to the system, and the aircraft should be situated always at the same location inside the hangar.

On the other hand, work stands and platforms are also widely used in aircraft maintenance. It is safer to use work stands and platforms, and it can be build and assembled in sections to allow such assembly at different locations inside or outside the hangars. For smaller aircraft or at low elevation maintenance [below ten (feet)] using work-stands and platforms is the most desirable alternative because there is no need for user training, maintenance, annual testing, certification and inspection of HLL or fall arrest equipment. Usually work stands are built in sections and can be assembled around an aircraft and at different locations within a hangar.

Other fall protection systems include in addition to work stands and the use of HLL a restraining system utilizing air suction equipment attached to the wing of the aircraft. This system is new and not widely used. Some of the disadvantages of this system is limiting the movement of the user on the wing of the aircraft and the reliability of the suction power of the system used as the anchorage that requires monitoring at all times.

End of Section

14.0 AMERICAN NATIONAL STANDARD INSTITUTE (ANSI) FALL PROTECTION STANDARDS UPDATE

14.1 ANSI Z359.1-1992(R1999):

Safety Requirements for Personal Fall Arrest Systems, and Subsystems and Components:

The ANSI Z359.1 includes safety requirements for personal fall arrest systems, subsystems and components. The standard establishes requirements for performance, design, marking, qualification, testing, instruction, inspection, use, maintenance and removal from service of connectors, full body harnesses, lanyards, energy absorbers, anchorage connectors, fall arresters, vertical lifelines, self-retracting lanyards and other fall arrest equipment. The standards comprise of personal fall arrest systems for users within the capacity range of 130 to 310 pound weight. Combined weights include user's body weight, clothing, tools and other objects born or carried by the user. Above 310 or below 130 pounds combined weight of the user and equipment, consult full body harness manufactures.

The requirement of the standard does not address the construction industry, window cleaning belts and sports-related activities. ANSI Z359.1 addresses Personal Fall Arrest systems incorporating full body harnesses only. Body belts are not addressed as part of ANSI Z359.1.

Note: ANSI Z359 Standard Committee is drafting two new standards. Subcommittees were established to draft the two new standards. The scopes of the new standards are:

ANSI Z359.2: Requirements for Positioning and Restraining Systems

ANSI Z359.3: Requirements for Assisted Rescue and Self-Rescue Systems, Subsystems and Components.

14.2 ANSI A10.32:

Standard for Personal Fall Protection Used in Construction and Demolition Operations

This standard establishes performance criteria for personal fall protection equipment and systems and provide guideline, recommendations for their use and inspection. It includes but is not limited to; fall arrest restraint, positioning, climbing, descending, rescue, escape and training activities. Exceptions: this standard does not include linesmen's, body belt, pole straps, window washers, belt, chest harnesses, and sports equipment.

Note: ANSI A10.32 is presently being submitted for approval to ANSI A10 Committee for affirmation. Eventually, ANSI A10.32 will be replacing ANSI A10.14 Standards.

End of Section

15.0 FALL PROTECTION TRAINING

ROSTER

(Refer to Form 1-2)

- 15.1** Prior to start of a job, all workers exposed to fall hazards shall read, understand and sign FP&P Plan, acknowledging that the employee has been trained in the job hazard recognition and shall be trained in the proper use of fall protection equipment;
- 15.2** All contractors and subcontractors workers exposed to fall hazards shall be trained accordingly;
- 15.3** All employees (workers) newly assigned to a job must review the FP&P Plan and sign the roster. If the fall hazards, fall protection equipment, or methods change during the course of the job, the FP&P Plan must be reviewed and signed again by all employees working at the job site;
- 15.4** The written FP&P Plan and REP shall be part of written Accident Prevention Plan which is maintained at the job site;
- 15.5** If additional requirements arise or change at the job sit, as work progresses, the FP&P Plan and REP shall be reviewed and updated by a qualified person, and signed by all workers exposed to fall hazards.

End of Section

16.0 REFERENCES

- 29 CFR 1926.500, Subpart M, Fall Protection in the Construction Industry;
- 29 CFR 1910 - Occupational Safety and Health Standards;
- US Department of Labor, OSHA 3124 1993 (Revised), Stairways and Ladders;
- US Department of Labor, OSHA Instruction Standards, 3.1, December 1995, Interim Fall Protection Compliance Guidelines for Residential Construction;
- American National Standard, ANSI Z359.1-1992, Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components;
- American National Standard Institute, ANSI A10.32- (draft), Standard For Personal Fall Protection Used in Construction and Demolition Operations;
- American National Standard Institute, ANSI A10.14, Construction and Demolition Operations Requirements for Safety Belts, Harnesses, Lanyards and lifelines;
- Introduction to Fall Protection; J. Nigel Ellis, PHD., CSP, PE, Third Edition by American Society of Safety Engineers;

How to Obtain information

- OSHA Regulations/Standards from OSHA Web Page: <http://osha.osha-slc.gov/OshDoc/>
- DoD employees can acquire at no cost the “Construction Criteria Base (CCB)” from “National Institute of Building Sciences” CCB contain Seven CDs covering Codes Of Federal Regulations, OSHA Standards, Specifications, DoD Manuals and Design Criteria and other relevant information. P.O.C for Navy employees to order the CCB is:
Pat Broughton
Phone: (202) 289-7800

- To acquire “Introduction to Fall Protection” by Dr. Nigel Ellis, Ph.D., the handbook can be purchased for \$85 plus shipping and handling from:
American Society of Safety Engineers (ASSE)
1800 East Oakton Street
Des Plains, IL 60018-2187
Phone: (847) 699-2929
- ANSI Standards can be purchased from ASSE at the above address.
- This Guide can be found at the NAVFAC Safety Web site at:
<http://www.navfac-safety.navy.mil/> (What's New)

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APPENDIX “A”

APPENDIX “A”

PART I.

INSTRUCTIONS FOR USING FALL PROTECTION WORK

PLAN MATRIX

(Matrix is a separate file)

The following instructions/guide are included to help Navy personnel identify fall hazards at work place using work plan matrix and to identify the recommended fall protection systems to minimize the dangers of falls:

A.1 Identification of Fall Hazards in the Work Place:

A.1.1 Fall hazards more than six-foot

A.1.2 Fall Hazards - Above a hazard at any height (e.g. above debris, machinery, structures, reinforcing bars, liquids)

A.1.3 Open Sided - Floors Platforms Stairs Catwalks
 Scaffolds Machinery Other

A.2 How to Identify Fall Hazards in the work place

Read the first two items, (1 & 2) and check the boxes that apply. If either statement is applicable, you should fill out the Fall Protection Work Plan Matrix.

A.2.1 Continue to read the information describing fall hazards and indicate the items that apply by placing a check mark in the appropriate box to the left of the reference number.

A.2.2 Use the reference number to find additional information in part II.

A.2.3 If a hazard exists that is not listed, write it in the “Other” box.

A.3 Description of Fall Arrest/Restraint Methods

A.3.1 Select the method(s) to be used from those indicated by any open circle in the intersection between section (1) and (2) (Marked “A’ at the corner). Fill in the circle to indicate the method(s) that will be used and place a check mark in the appropriate box to the left of the reference number.

A.3.2 An existing **X**, in the boxes indicates a required item to be used.

A.3.3 Use the reference number to find additional information in part II.

A.3.4 If the method chosen is not listed; write it in the “Other” box.

A.4 Inspection and Instructions for Assembly/Disassembly and Storage

A.4.1 Fill in the open circle to indicate the item to be used from those recommended in the intersection between section (2) and (3), (Marked “**B**” at the corner). Place a check mark in the appropriate box to the left of the reference number.

A.4.2 An existing “**X**” in the boxes indicates a required item to be used.

A.4.3 Use the reference number to find additional information.

A.4.4 If the method chosen is not listed write it in the “Other” box.

A.5 Warning Systems/Falling Objects Protection

A.5.1 Fill in the open circle to indicate the items to be used from those recommended in the intersection between section (4) and (1) (marked “**C**” at the corner) then place a check mark in the appropriate box to the left of the reference number.

A.5.2 Hard hats/Hard caps **and** one other method to protect workers from falling objects should be select from items: 35, 36, 39, 41, 42, 47 or an appropriate “Other” method.

A.5.3 An existing “**X**” indicates a required item to be used.

A.5.4 Use the reference numbers in part II to find additional information.

A.5.5 If the method chosen is not listed; write it in the “Other” box.

End of Part 1

PART II.

HOW TO IDENTIFY FALL HAZARDS IN THE WORK PLACE UTILIZING WORK PLAN MATRIX

(Step by step procedure)

SECTION 1

Fall Protection Planning

To determine the requirement for fall protection, address the following questions:

Ref. # 1 Do Fall Hazard of more than 6 exist? (For general industry the height is 4 feet and shipyard is 5 feet)

Ref. # 2 Will work be performed above hazardous location?

a. If fall protection is required, fall protection work plan matrix should be completed.

b. After identifying fall hazards in the work place, check all boxes that apply.

Ref # 3 Open sided, Floors, Platforms, Stairs,
 Roof, Catwalks, Scaffolds, Machinery,
 Other.

Open sides and edges means any side or edge (except at entrances to points of access of floors, roofs, working platforms, stairs, cat-walks, scaffolds, ramps or runways where there is no wall or guardrail system 42 inches high.

Ref. # 4 Holes means a gap or void 2 inches or more, in its least dimension, in a floor, roof, or Walking/working surface:

Opening 2 inches or more in its least dimension.

Manholes Pits, Tanks, Skylights, Open shafts,
 Chutes, Other

Examples: such as a gap or opening in flooring, stairways, ramps, or

Roofing, 2 inches or larger through which material can fall through or in the case of larger holes a person can step or fall through. In either case FP in the form of a secured and marked covering, FP, or barricading is required. Consideration should also be given to guarding holes, which may be a trip hazard or entrapment hazard.

If there is a danger of falling through skylight opening, and the skylight itself is not capable of sustaining the weight of a two hundred pounds per person with a safety factor of four, standard guardrail system should be provided on all sides of the skylight.

Ref. # 5 Wall Opening- at least 30 inches high by 18 inches wide through which person may fall to a lower level.

This should be considered at any time, work is being performed near a wall or window opening with a fall hazard to a lower level.

Ref. # 6 Working in a boom supported articulating lift:

Before each elevation of the work platform, the operator will check to see that all occupants' full body harnesses are on, and properly attached.

Ref. # 7 Leaving the Floor Surface of a:

Lift, Catwalk, Platform
 Scaffold, Elevating work platform, Stairway, Other

Whenever an employee leaves the floor of any of the above, thereby, reducing the height of the top rail to less than 42 inches plus or minus 3 inches, in relation to the employee, FP should be utilized.

Ref. # 8 Working Above Suspended Ceilings:

Fall arrest, restrain systems or working stands/platforms should be used.

Ref. # 9 Leading Edge Work above 6 feet on a less than 4/12 Pitch (Low Pitched Roof):

Leading edge means the advancing edge of a floor, roof, or form-work which changes location as additional floor, roof, or form-work sections are placed, formed, or constructed. Leading edges not actively under construction are considered to be "unprotected sides and edges. Positive methods of fall arrest or fall restraint shall be required to protect exposed

workers to hazards of falls. Positive methods of fall arrest or fall restrained should be required for persons conducting inspection or surveying existing or old roofs.

Ref. # 10 Working within 6 feet of an Unguarded Roof Edges less than 4/12 Pitch:

During the performance of work on low-pitched roofs with a potential fall hazard greater than 6 feet, ensure that employees engaged in such work are protected from falling from all unprotected and edges of the roof as follows:

- a. By using fall restraint or fall arrest systems;
- b. By the use of a warning line system;
- c. Mechanical equipment shall be used or stored only in areas where employees are protected by a warning line system, fall restraint, or fall arrest systems.

Ref. # 11 Steep Roof (Greater than a 4/12 Pitch):

Fall protection or restraint system shall be used when working on steep roof. Warning line and safety monitor system are prohibited on surfaces exceeding a 4 in 12 pitch, and on any surface whose dimensions are less than 45 inches in all directions.

Ref. # 12 Elevating work platforms (e.g. scissors lifts):

When working from elevated work-platforms 6 feet or higher, elevating work platforms must be equipped with standard guard rail and toe boards. If the worker's feet leave the floor of the elevating work platform or the worker will be required to exit the lift, at height, FP&P Plan must be completed and continuous fall protection must be provided. Workers shall be provided with fall arrest system if the lifting equipment is positioned outside the wheel-base even if the equipment has guardrail. It is highly recommended to tie off in scissors lift even if the platform does not move away from the base.

Ref. # 13 Boatswain Chair:

The term "boatswain chair" shall mean a seat to support a worker in a sitting position, supported by rope slings attached to a suspension rope.

Ref. # 14 Working on Roofs when the possibility of Adverse Weather Conditions may be present, such as Wind, Ice, or Rain:

When the possibility of adverse weather conditions exist, extra caution must be exercised. Safety manager or competent person must be consulted where the work is occurring, duration of work, number of employees, and who to contact in case of adverse weather.

Ref. # 15 Other:

Write in any fall hazard identified during site inspection that is not listed above. Be as specific as possible. Describe fall arrest/restrained method. Fill in the open circles that apply and check the appropriate boxes to the left of reference box under section 2.

End of section 1

SECTION 2

Description of Fall Arrest/Restraint Methods

Ref. # 16 Guard Rails (Temporary):

Standard Guard railing, Temporary or permanent, shall consist of top rail, intermediate rail, toe-board, and posts, and shall have vertical height of 42 inches plus or minus 3 inches from the upper surface of top rail to floor, platform runway, or ramp level. The posts and framing members for railings of all types shall be capable of withstanding a load of 200 pounds applied in any outward or downward direction at any point along the top edge and with minimum deflection (29 CFR, 1926.502). In any case, the top edge of the guardrail shall not deflect to a height less than 39 inches above the walking working surfaces and with minimum of deflection.

Ref. # 17 Warning Line System:

Warning line system means a barrier erected on a walking and working surface or a low pitch roof (4 in 12 or less), to warn workers that they are approaching an unprotected fall hazard(s).

Warning line system must be erected around all sides of the work area. Where mechanical equipment is not being used, the warning line shall be erected not less than six (6) feet from the edge of the roof. When mechanical equipment is not being used, the warning line shall be erected no less than six feet from the roof edge, which is parallel to the direction of mechanical equipment operation. It shall not be less than 10 feet from the roof edge, which is perpendicular to the direction of mechanical equipment operation.

Ref. # 18 Catch Platform/Safety Nets:

A substantial catch platform shall be installed below the working area of roofs more than 20 feet from the ground to eaves with a slope greater than 3 inches in 12 inches without a parapet. In width the platform shall extend 2 feet beyond the projection of the eaves and shall be provided with a safety rail, mid rail and toe-board. This provision shall not apply to workers engaged in work upon such roofs and are protected by a harness attached to a lifeline.

Where work is in progress above workers, a catch platform or other means shall be provided to protect those working below. All workers shall be notified. One completed floor shall be maintained between workers and steel or concrete work above.

Ref. # 19 Vertical Lifeline/Rope Grab:

- Vertical lifeline means a vertical line from a fixed anchorage independent of the walking/working surface to which a lanyard or device is attached.
- Rope grab means a fall arrester designed to move up or down a lifeline, to which the harness is attached. For additional requirements refer to the definition section.

Only one person shall be attached to a vertical lifeline. Two workers will require two independent vertical lifelines.

Ref. # 20 Horizontal Lifeline:

Horizontal lifeline - (Catenary line, static line) means a rail, rope, wire, or synthetic cable that is installed in a horizontal plane between two anchorage's and used for attachments of a worker's lanyard or lifeline device while moving horizontally; used to control dangerous pendulum-like swing falls. **A qualified person** must design the system. The competent person will review and approve the installation only.

Ref. # 21 Fall Arrest System:

Fall Arrest equipment consists of:

- (a) Full body harness, approved lanyard, and an approved anchor point:
- **Full Body Harness** shall meet ANSI Z359.1 requirements.
 - **Lanyard** shall be a shock absorbing type lanyard (2, 4 or 6 feet long depending on the application).
 - **Anchor Point** shall be capable of supporting 5,000 pounds per employee or 3000 pounds per employee if a self-retracting lifeline is used. Anchor point shall be designed and approved by a qualified Person". (See definition).

Note: Use only full body harness. Body belts are not allowed in a fall arrest system.

- (b) Safety Nets.

Safety nets shall be installed as close as practical under the walking/working surface on which employees are working, but in no case more than 30 feet. Safety nets shall extend outward from the outermost projection of the work surface as follows:

Vertical Distance from Working Level to Horizontal <u>plane of net</u>	Minimum required Horizontal distance of outer edge of net <u>from the edge of working system</u>
Up to 5	8 feet
More than 5 feet up to 10 feet	10 feet
More than 10	13 feet

(c) Catch Platforms

(1) A catch platform shall be installed within 6 vertical feet of the work area.

(2) The catch platforms width shall equal the distance of the fall but shall be a minimum of 45 inches wide and shall be equipped with standard guard rail on all open sides.

Ref. # 22 Fall Restraint System:

Fall restraint protection consists of:

- (a) Harness attached to securely rigged restraint lines.
- (b) Safety Harness (full body harness)
- (c) Rope grab devices are prohibited for fall restraint applications unless they are part of a fall restraint system designed specifically for the purpose by the manufacturer's recommendations and instructions.
- (d) Anchorage points used for fall restraint shall be capable of supporting 4 times the intended load. (Minimum 800 pounds). Anchorage should withstand a force of 5,000 pounds.
- (e) Restraint protection shall be rigged to allow the movement of employees only as far as the sides and edges of the walking/working surfaces.

Ref. # 23 Egress Fall Protection:

Whenever employees are required to move from one elevated area to another that presents a fall hazard of 6 feet or greater, positive fall protection shall be provided. An example of this is utilizing a scissors lift to gain access to a roof or intermediate platform. The employee must be protected when exiting the scissors lift. This can be accomplished by using a double lanyard or a "Y" lanyard. At no time a worker shall be exposed to fall hazards. When exposed to fall hazards 100% fall protection is required at all times

Ref. # 24 Safety Monitor System (Competent Person):

A safety monitor system (SMS) may be used in conjunction with other fall arrest systems. **“NAVFAC NFGS 01525 Safety Requirements” prohibits the use of the safety monitor as the only fall protection method employed. Safety monitoring system may be used with warning line system as a method of guarding against falls during work on low-pitched roofs and leading edge work only.** The safety monitor system is used, only after evaluation it is shown that the use of other systems is not feasible or creates a greater hazards. The SMS shall not be used when weather conditions create additional hazards.

A person acting in the capacity of SMS shall be trained in the function of both the safety monitor and warning lines systems, and shall:

- (a) Have control authority over the work as it relates to fall protection.
- (b) Be instantly distinguishable from members of the work crew.
(Distinguishable markings or a different colored high visibility vest).
- (c) Engage in no other duties while acting as safety monitor.
- (d) Be positioned in relation to the workers under their protection, so as to have a clear, unobstructed view and be able to maintain normal voice communication.
- (e) Not supervise more than eight exposed workers at one time. Control zone workers shall be distinguished from other members of the crew by wearing a high visibility vest only while in the control zone.

Ref. # 25 Floor/Hole Covers (Temporary):

Trenches, and manhole covers and other appurtenances, when located in a roadway and vehicular aisles shall be designed to carry twice the maximum axle load of the largest vehicle expected to cross over.

All floor-opening covers shall be capable of supporting twice the maximum potential load including worker and equipment, but never less than two hundred pounds (with a safety factor of 2). The cover shall be the same level of the rest of floor and it shall be securely fastened to the floor to prevent accidental removal. All covers shall be color-coded or they shall be marked with the word “Hole” or “Cover” to provide warning of the hazard. If it becomes necessary to remove a cover, provide conventional fall protection system around the opening until the cover is replaced.

Ref. # 26 Other

List any other specific fall protection system that will be used on a project.

End of Section 2

SECTION 3

Inspection, and Instruction for Assembly/Disassembly and Storage

Fill in the open box, circles that apply and check the appropriate boxes to the left of the reference boxes.

Ref. #27 Inspect All Fall Protection/Restraint Equipment Prior to Every Use:

All equipment must be inspected per manufacturer's instructions. Operator's Manual shall be included with the equipment for employee's reference. Also follow all instructions of the "Qualified Person" prior to using the equipment.

Ref. # 28 Contact Qualified Person for Anchor Points Loading, Selection and Approval:

Due to the variability in the structural strength of different materials prior to using an anchorage point, a qualified person must be contacted to ensure that the anchorage point meets/exceeds regulatory requirements.

Ref. # 29 Protect Against Cuts and Abrasions:

All safety lines and lanyards shall be protected against being cut or abraded. Padding must be used wherever sharp edges exist.

Ref. # 30 Stored in an Approved Location:

All fall protection/restraint equipment shall be stored in a weatherproof container or locker when not in use. Equipment should not be allowed to lay in water or direct sunlight, since this will affect the strength of the equipment.

Ref. # 31 Shall be Engineered/Compatible System:

Contact Qualified person or manufacturer's representative for assistance. When using Fall arrest systems all components shall be designed for use with each other, or approval must be obtained from the Manufacturer or Qualified Person to use the configuration. All system components shall be compatible.

Ref. # 32 Follow Manufacturer's and the Qualified Person's Instructions for Installation, Assembly/Disassembly and Use:

All systems must be installed, assembled, disassembled per the Manufacturer's direction. Failure to follow these instructions could lead to the possible failure of a system.

Ref. # 33 In the event of a fall; secure all equipment involved and contact Safety for disposition "Do not reuse"

In the event of a fall the first response is to ensure the safety of the employees. After rescue and, if required, medical aid is provided, all equipment involved must be removed from service. Safety must be contacted.

Ref. # 34 Other:

Use this space to list other special identified instructions.

End of Section 3

SECTION 4

Warning Systems and Falling Object Protection

Fill in the open circles that apply and check the appropriate boxes to the left of the reference numbers.

Ref. # 35 Barricade Area:

All areas must be barricaded to safe guard employees. When working overhead, barricade the area below to prevent entry by unauthorized employees. A distance of 6 feet shall be barricaded around the worker.

Ref. # 36 Warning Tapes/Signs:

Construction warning tape and signs shall be posted so as to be clearly visible from all possible access points. When sign is used it should clearly indicate the entry requirements, potential hazards, and personal protective equipment requirement.

Ref. # 37 Hard Hat/hard Cap Requirements:

Hard Hats/ Hard Cap complying with ANSI Z89.1, 1997 Type I, Class E & G will be required when exposed to falling/flying objects. Furthermore, select one additional measure:

Barricades Canopy Structure Toe Boards

Hard hats/Hard caps must be worn any time that employees are working below other employees and/or the potential exist for falling objects to strike the employees working below. In addition to hard hats one additional preventive measure must be implemented.

As an example, when using hard hats/hard caps, the employee must use additional form of protection from falling objects such as: barricading the area, protective canopy structures, or platforms with toe boards.

Ref. # 38 Clothing and Safety Shoes:

Suitable clothing shall be worn. Sufficient and proper clothing shall be worn to assist in preventing scratches, abrasions, slivers, sunburn, or similar hazards. Loose or ragged clothing or ties shall not be worn while working around moving machinery. At a minimum, employee must wear short sleeve shirt, and long pants.

Substantial footwear, made of leather or other equally firm material, shall be worn by employees whenever there is a danger of injury to the feet through falling or moving objects, or from burning, cutting, penetration, or similar hazard. The soles and heels of such footwear shall be of a material that will not create a slipping hazard. Footwear that has deteriorated to the point where it does not provide the required protection shall not be used.

Ref. # 39 Evacuate Area Below:

All non-essential personnel below a construction area must be cleared or protection provided.

Ref. # 40 Secure Stored Material:

All construction materials and equipment stored on a roof or other exposed areas must be secured against inclement weather conditions. Prior to end of the workday all loose materials must be secured to prevent injury or property damage from falling objects. Caution must also be taken so as not to overload the roof. Materials shall not be stored within 6 feet of the edge of the roof unless guardrails are erected on the roof edge.

Ref. # 41 Traffic Control:

When working over or adjacent to a roadway, traffic control measures must be developed. Employee working adjacent to roadways must wear vests that are highly visible and have reflective markings. When working adjacent to transportation aisles traffic control measures should be reviewed to ensure the safety of the personnel on the job site.

Ref. # 42 Control Falling Objects:

When employees are working over other employees all tools and equipment will be secured so that they will not fall. Tethers should be used to tie off tools and equipment. Employee must wear hard hats whenever there is a potential for falling objects. (See reference #37). Toe-boards and solid floor surface without

openings shall be provided to prevent objects from falling through.

Ref. # 43 Debris Control:

Measures shall be taken to control debris in the construction area. Debris shall not be allowed to accumulate on walking/working surfaces.

Ref. # 44 Safety Monitoring on the Floor or Radio Communication is Recommended:

Whenever working on a roof, lift or other area where potential for fall exist a safety monitor or two-way radio communication is recommended.

Ref. # 45 Safety Communications:

Establish/maintain contact/communication with your activity Safety Manager or competent person whenever roof top work is being performed and the possibility of adverse weather conditions exists.

Ref. # 46 Perform Fall Protection Equipment Inspection:

All fall protection equipment shall be inspected each day prior to use. A competent person other than the user shall conduct thorough inspection of the equipment annually.

Ref. # 47 Canopy:

A covering that is erected to provide protection from falling or flying objects. The canopy must be designed and constructed to withstand the force of all potential falling objects and approved by a Qualified Person before it is erected or put into use.

Ref. # 48 Lock-Out/Tag-Out/Try-Out:

When working in the vicinity of energy sources lock-tag/try-out must be used to eliminate any potential hazards.

Ref. # 49 Crane Rail Stops:

Any time that work will be done within an overhead crane/WHE system, crane rail stops will be used to isolate the work area and prevent collisions between employees at height, and cranes and other overhead weight handling equipment.

Ref. # 50 Other:

Note any other falling object protection measures or other protective measures taken.

End of Section 4

APPENDIX "B"

APPENDIX 'B'

B.1 MATHEMATICAL PROBLEMS FOR LIFELINES AND ENERGY ABSORBERS

1. Horizontal Lifeline Anchor Strength

Determine the required anchor strength for a HLL system if a worker is attached to Self-Retracting Lanyard (SRL) and supported at the mid-span of a 100-foot line. The maximum deflection or sag of the cable (at the mid-span) after a fall occurs is 4.0 feet. According to the ANSI Z359.1 the SRL should have a peak arresting force of 1,800 pounds. Find the maximum arrest force at each anchor point and what is the strength requirement of an anchor for a factor safety of two. (See figure 28).

Since the weight or the impact force is maximum at the center of the line, each anchor point will take 1/2 of arresting force.

$$1800/2 = 900 \text{ pounds}$$

To calculate the impact force on one anchor point, the sag of the cable will form two equal right triangles with the sides being 4 and 50 feet long. Therefore the hypotenuse is equal to 50.16 feet. Due to the fall the force impact in the hypotenuse that will affect the anchor point is:

$$900 \times 50.16/4 = 11,286 \text{ pounds.}$$

The anchorage strength for a Factor of safety of 2 is:

$$11,286 \times 2 = 22,572 \text{ pounds}$$

Discussion: We can rationalize from this math problem that the anchorage strength requirement is much greater than the weight of the person attached and hanging at the center of HLL. The less the sag or deflection of the line is, the more impact the arresting force would be on the anchor point. Also if the deflection increases the impact force on the anchors will decrease. The more the deflection angle is, the less impact the arresting force would have on the anchors. One thing we should keep in mind, if the deflection or sag of the line is increased during a fall, the worker attached to the HLL might come in contact with the ground or equipment below. Furthermore, due to the weight of the cable, there is always an initial sag in the line that should be taken into consideration.

2. Total Fall Distance:

A worker is connected to a strong anchorage using a six feet Energy Absorbing Lanyard. The anchorage is located 3 feet below the worker's dorsal "D" ring. The energy absorber meets ANSI Z359.1. (See figure 29)

1.1 What is the maximum free fall distance:

$3 + 6 = 9$ feet, free fall distance.

1.2 If the anchor is stronger than 5,000 pounds, does this system meet OSHA requirements, as stated in 29 CFR 1926.502(d)(16)?

No, the system does not meet OSHA requirements because the free fall distance is more than 6 feet.

1.3 What is the clearance requirement, measured from the anchorage to the ground below. Assume the worker's "D" ring location is 5 feet from his toe at the instant the worker's fall come' to a complete stop? A three feet safety buffer is required between the bottom of the worker's shoe and the ground below.

$6' + 5' + 3.5' + 3' = 17.5$ feet total distance required from the anchorage to the ground below.

1.4 What is the minimum clearance requirement, measured from the work platform to the ground below?

$17.5' - 3' = 14.5$ feet

3. Lanyard Deployment:

If in question 2 above, the worker's weight is 250 pounds and the energy absorber deploys at a force of 900 pounds:

1.5 If we assume that a Personal Energy Absorber dissipates 100% of the fall arrest energy, how long will the energy absorber deploy:

$$X = WH/(F-W)$$

$$X = 250 \times 9/(900-250) = 3.5 \text{ feet}$$

End of Section

FORMS

EMERGENCY RESCUE PLAN FORM

Site & Location Identification:

Detailed Location:

Primary Emergency Phone Number:

Type of Phone/Location:

Local Phone Line/Outside Line:

Secondary Emergency Phone Number:

Backup Rescue Lift is Available/Located at:

First Aid kit Location(s):

Fire Extinguishers locations(s):

Nearest Hospital Route and Location:

Describe Rescue Operation:

Type of equipment (PPE, Ladder, Hoist, etc.)

Training on Rescue:

Name of Personnel Requiring Rescue:

Self-Rescue Equipment used:

Additional Comments: _____

FORM 1-1

FALL PROTECTION TRAINING ROSTER (FORM)

All employees signing this form shall indicate that they understand the fall hazards on the job site and they have been trained in the proper use of and will use the selected fall protection equipment and methods. Review and sign again if hazards or methods change.

NAME: _____
ORGANIZATION/CODE/SHOP: _____
SIGNATURE: _____
TRAINING DATE(s): _____
DURATION OF TRAINING (Hrs): _____
INSTRUCTORE'S NAME: _____
COURSE TITLE: _____
DESCRIPTION OF THE COURSE: _____

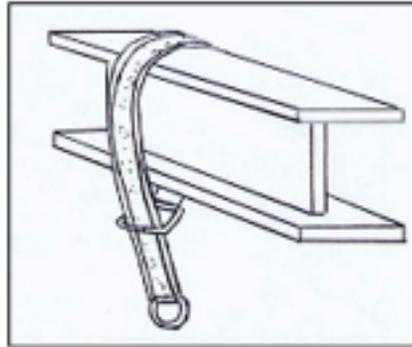
NAME: _____
ORGANIZATION/CODE/SHOP: _____
SIGNATURE: _____
TRAINING DATE(s): _____
DURATION OF TRAINING (Hrs): _____
INSTRUCTORE'S NAME: _____
COURSE TITLE: _____
DESCRIPTION OF THE COURSE: _____

NAME: _____
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DESCRIPTION OF THE COURSE: _____

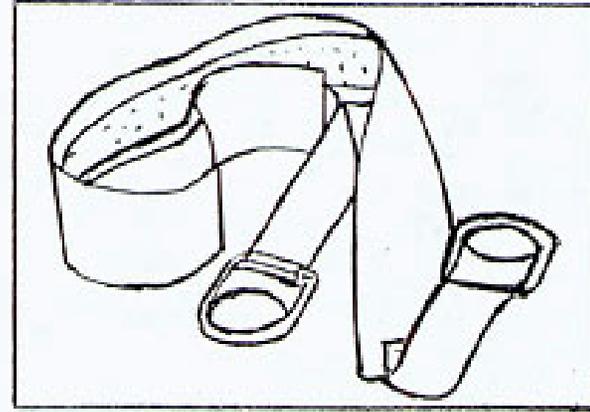
NAME: _____
ORGANIZATION/CODE/SHOP: _____
SIGNATURE: _____
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COURSE TITLE: _____
DESCRIPTION OF THE COURSE: _____

FORM 1-2

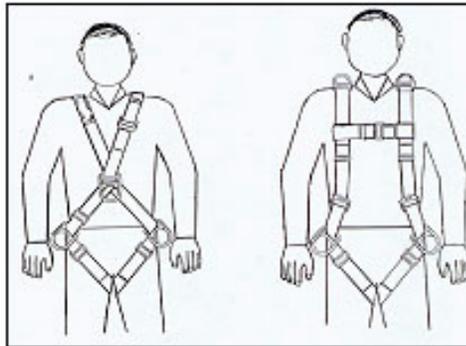
FIGURES



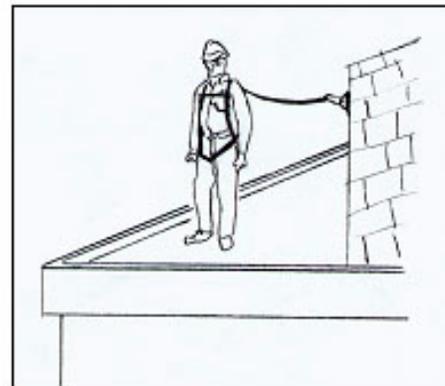
**Anchor Strap Connected to a Beam
(Figure 1)**



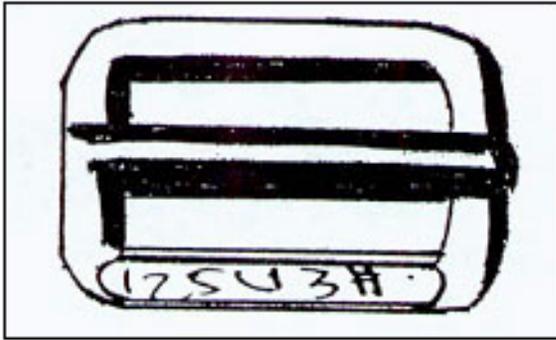
**Anchor Strap
(Figure 2)**



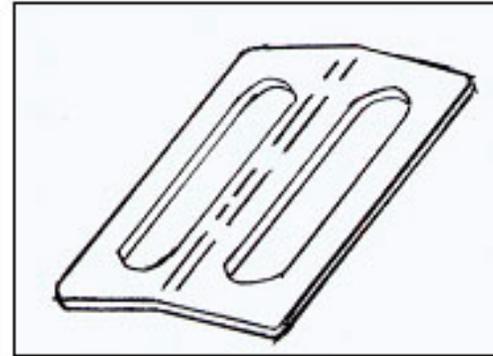
**Full Body Harness
(Figure 3)**



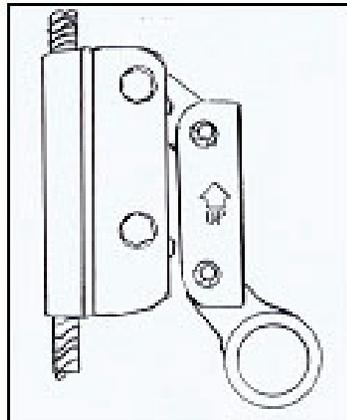
**Body Restraint System
(Figure 4)**



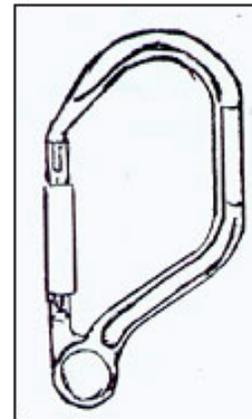
**Adjustable buckle
(Figure 5)**



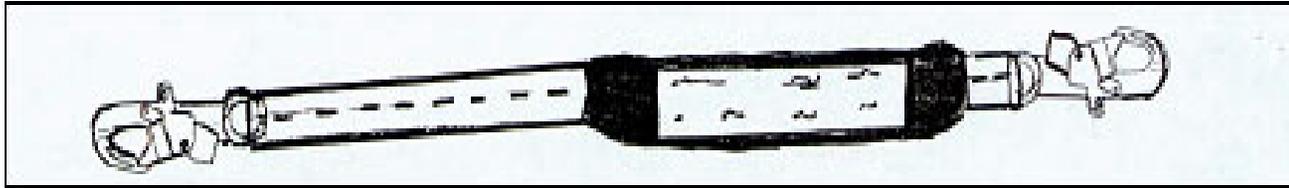
**Friction Buckle
(Figure 6)**



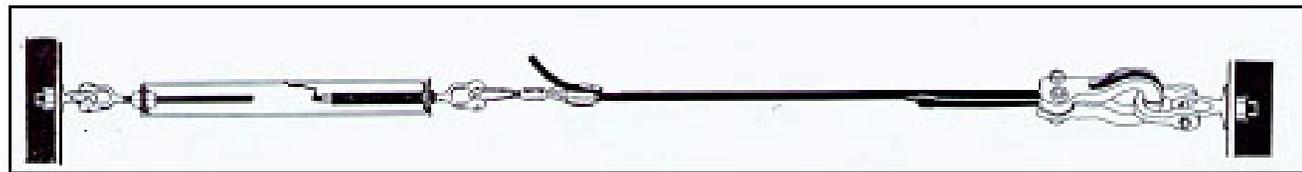
**Rope/Cable Grab
(Figure 7)**



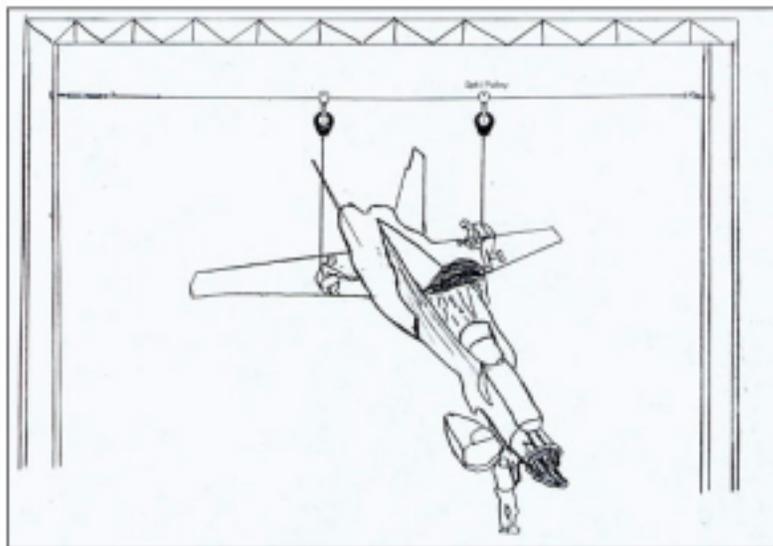
**Carabiner
(Figure 8)**



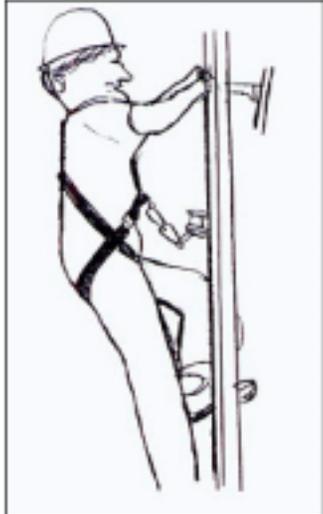
**Lanyard with energy Absorber
(Figure 9)**



**Horizontal Lifeline System
(Figure 10)**



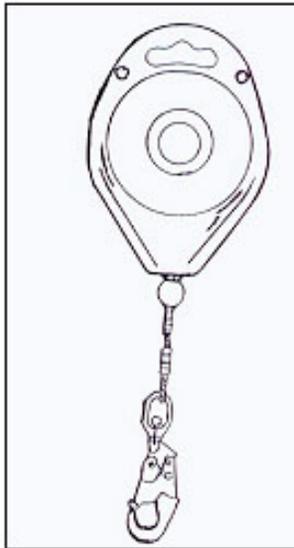
**Horizontal Lifeline system
For Aircraft Maintenance
(Figure 11)**



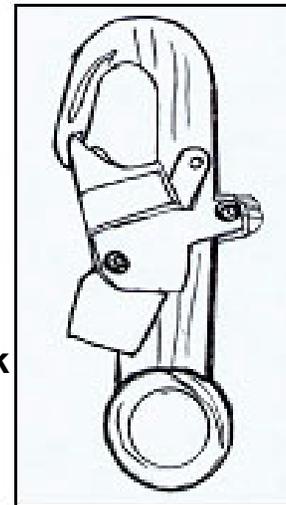
**Ladder Climbing Device
(Figure 12)**



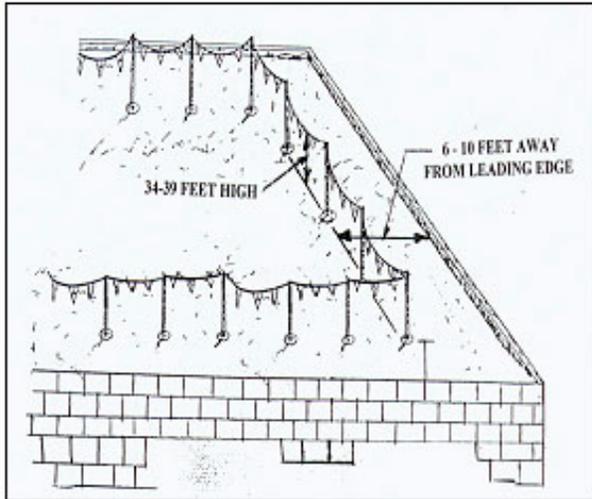
**Positioning system with
Vertical Lifeline
(Figure 13)**



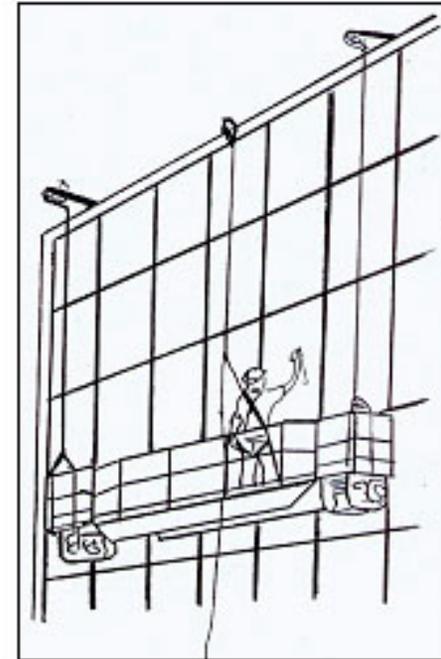
**Self Retracting Lanyard
(Figure 14)**



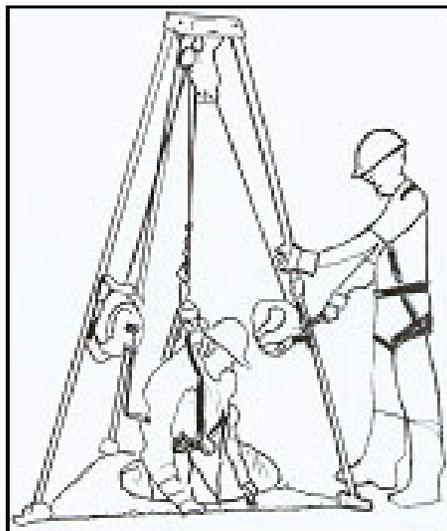
**Locking Snap Hook
(Figure 15)**



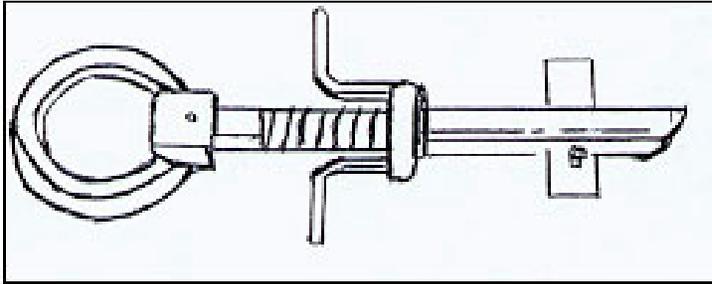
**Warning Line System
(Figure 16)**



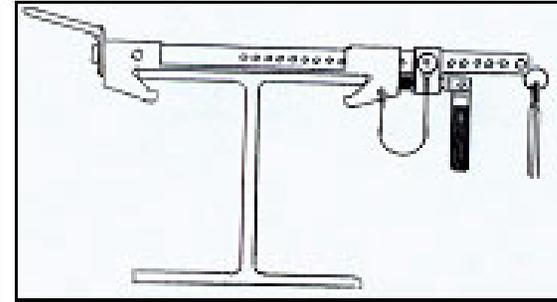
**Suspended Scaffold with
Vertical Lifeline
(Figure 17)**



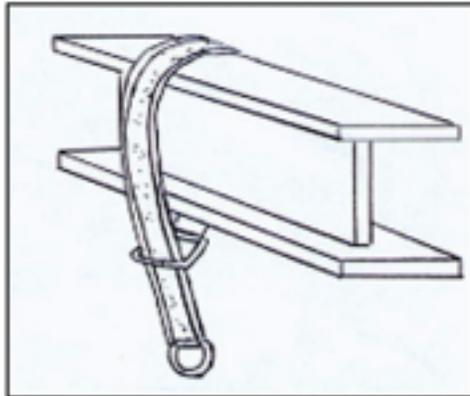
**Confined Space Entry
(Figure 18)**



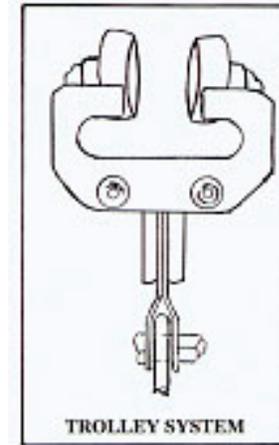
**Bolt Hole Anchor connection
(Figure 19)**



**Beam Anchor Connection
(Figure 20)**



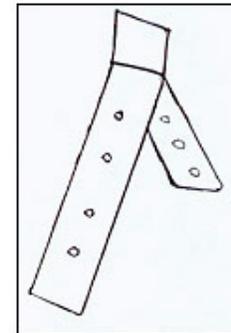
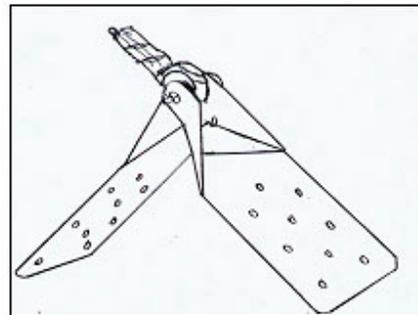
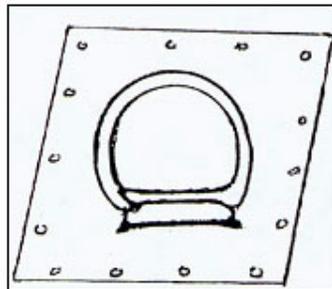
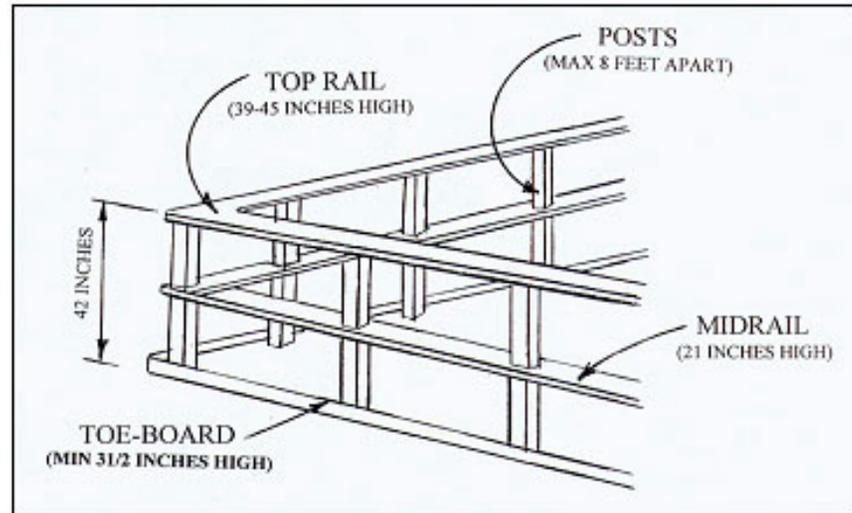
**Anchor Strap rapped around a beam
(Figure 21)**



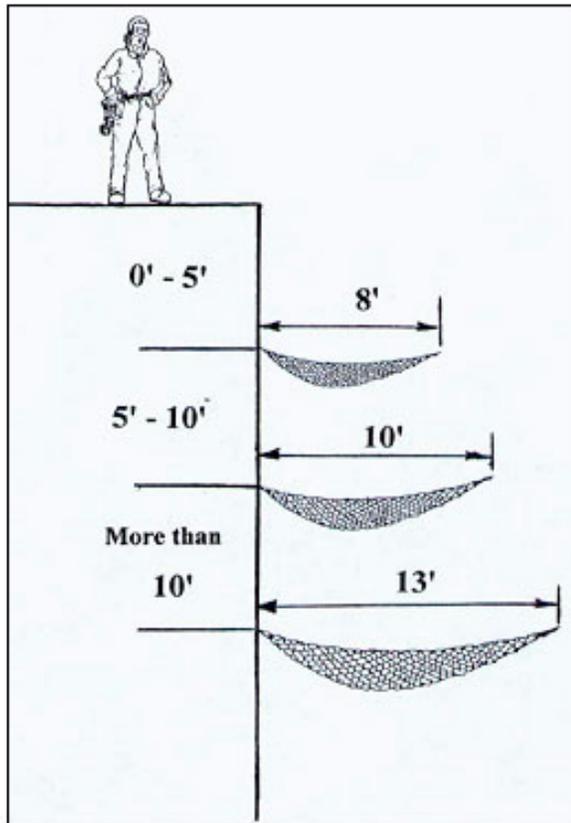
**Trolley System
(Figure 22)**

Miscellaneous Anchorage Connections

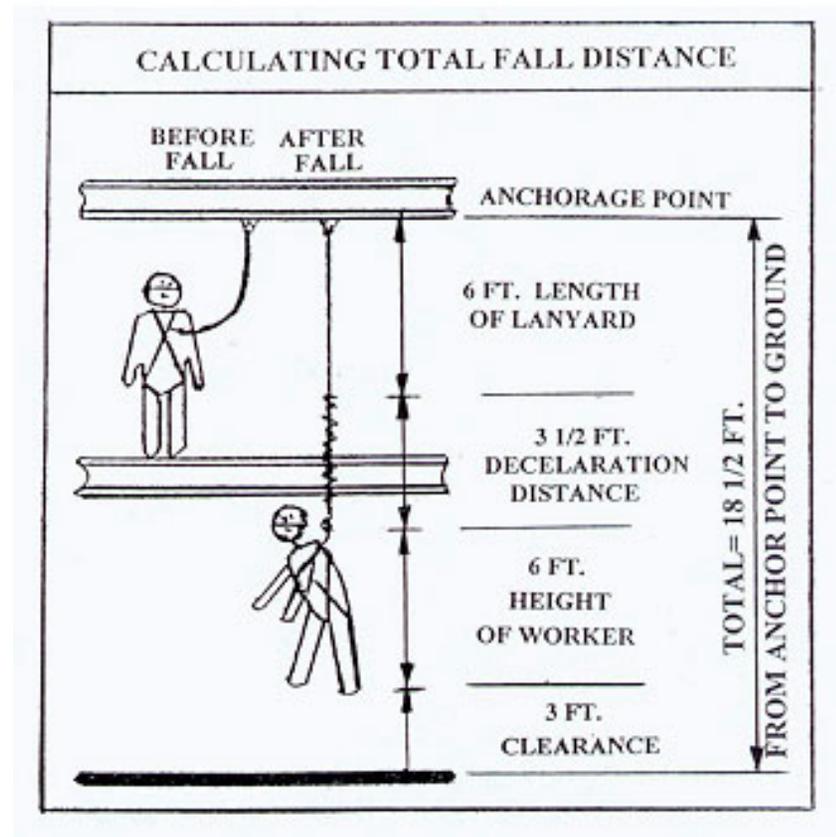
**Guard Rail system
(Figure 23)**



**Miscellaneous Roof anchors
(Figure 24)**



**Safety Net Extension
(Figure 25)**



**Total Fall Distance
(Figure 26)**

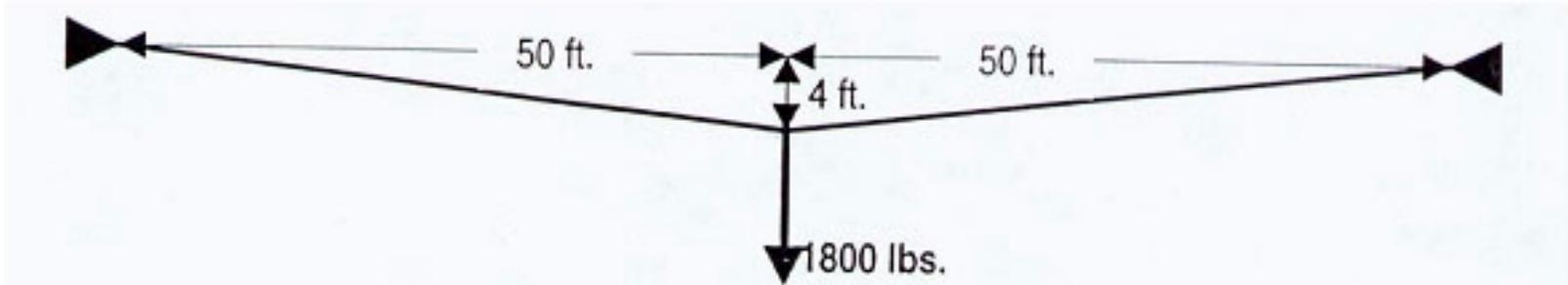


Work Stand for Small Aircraft

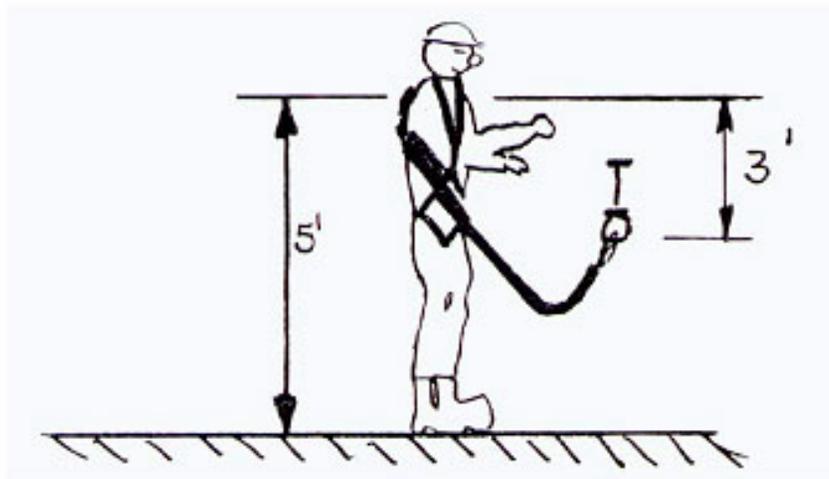


Various Work Stands and Platforms for Aircraft Maintenance

(Figure 27)



**Horizontal lifeline Anchor Strength
(Figure 28)**



**Total Fall Distance
(Figure 29)**