

M_006 Fall Protection Safety Lecture



**206* Reasons for
Fall Protection
(It's A Snap!)**



**Milton J. Shoup III
Mechanical Safety Officer
University of Rochester
Laboratory for Laser Energetics**

Safety is everyone's business and compliance with safety procedures is **MANDATORY**



- If an activity or practice seems unsafe, “Stop Work” and take the time to address concerns
- Only trained personnel may use fall protection equipment. Review this material as often as necessary to maintain your knowledge
- No LLE personnel are qualified or permitted to repair fall protection equipment
- It is the users responsibility to ensure all components of the fall protection equipment are safe for use. Seek assistance from Mechanical Engineering when in question.
- Situational Awareness – The best way to prevent an accident is to be aware of your surroundings. Take no chances and err on the side of safety.

If a fall occurs that results in injury and/or a suspended worker, immediately call 911 and report “high angle rescue is required”

Fall protection overview from Miller Fall Protection



- Click on YouTube link below to start the video “Gravity Kills. Defy It.”
- [\(YouTube link\)](#)

- **Why is Fall Protection important**
- **What is Fall Protection**
- **Personal Fall Arrest Systems**
 - **What are they**
 - **How to put a harness on**
 - **How to inspect a harness and lanyard**
- **What happens if I fall**
- **Rescue from a fall**
- **Fall Protection Rules**

Why is fall protection important?



- **Falls are among the most common causes of serious work related injuries and deaths. Employers must set up the work place to prevent employees from falling off of overhead platforms, elevated work stations or into holes in the floor and walls.**
- **Pursuant to Section 5(a)(1), the General Duty Clause of the Occupational Safety and Health (OSH) Act of 1970, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm**

OSHA Department of Labor (DOL) establishes the rules for fall protection



- **The rules for fall protection are established in Section 29 of the OSHA Code of Federal Regulation (CFR) 1910.23 “Protection for wall openings and holes” and 29 CFR 1926.500 “Fall Protection”**
- **From 1910.23(b)(1) Every wall opening from which there is a drop of more than 4 feet shall be guarded...**
- **From 1926.501(b)(1) "Unprotected sides and edges." Each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems.**

Fall protection must be used when there is a drop of 4 feet and personnel can approach within 6 feet of an unprotected edge

When is Fall Protection required?

- **Fall Protection must be worn when a work surface has no guardrail, is over 4' off the ground, and the worker can approach within 6' of an unprotected (no railings) edge**
- **OSHA requires that fall protection be provided when working over dangerous equipment and machinery, regardless of the fall distance**
- **Fall protection is required for fixed vertical ladders without cages over 24' in height**
 - **Fall protection is not required when using step or extension ladders.**
- **Fall protection must be worn whenever required by signage or equipment manufacturer's operating manuals (i.e. boom lifts)**

Fall protection methods that are employed in order of precedence



- **Fall Prevention** – a passive system that requires no specialized training
 - A system that will prevent a person from falling to a lower level
 - Example: Railings and hole covers
- **Fall Restraint** – a safety system that requires some training
 - A system that will allow a worker to approach a fall hazard and work but will not allow the worker to fall to a lower level
 - Example: Horizontal lifelines
- **Fall Arrest** – a safety system that requires the highest level of training
 - A system that will protect a person from crashing on to a lower level after a fall
 - Example: Fall Arrest Harness/lanyard

All fall protection products fit into four functional equipment categories – (I) Fall Arrest



- **A fall arrest system is required if any risk exists that a worker may fall from an elevated position, as a general rule, fall arrest system must be used at working heights of four feet or more**
 - **Working height is the distance from the walking/working surface to a grade or lower level**
- **A fall arrest system consists of**
 - **anchorage/anchorage connector**
 - **body wear (full-body harness)**
 - **connecting device (shock-absorbing lanyards, self-retracting lifelines)**

All fall protection products fit into four functional equipment categories – (II) Positioning/Restraint



- **A positioning/restraint system is used to hold a worker in place while allowing a hands-free work environment at elevated heights and/or restrict the worker's movement to prevent reaching a location where a fall hazard exists**
 - **Lifelines are an example of a restraint system**
- **A typical positioning/restraint system consists of:**
 - **anchorage/anchorage connector**
 - **body wear (full-body harness or body belt)**
 - **connecting device (positioning lanyard)**

Positioning systems are not designed for fall arrest, and therefore a back-up fall arrest system must be used.

All fall protection products fit into four functional equipment categories – (III) Suspension



- **Suspension**
 - **Suspension systems are used widely in the window washing and painting industries and are designed to lower and support a worker while allowing a hands free work environment.**
- **A typical suspension system would include:**
 - **anchorage/anchorage connector (anchor bolt, trolley, etc.)**
 - **body wear (full-body harness)**
 - **connecting device (workline)**
 - **suspension device (bosun chair)**

Suspension systems are not designed for fall arrest, and therefore a back-up fall arrest system must be used.

All fall protection products fit into four functional equipment categories – (IV) Retrieval



- **Retrieval**
 - The retrieval system is primarily used for rescue should an emergency occur
- A retrieval system typically consists of:
 - anchorage/anchorage connector (tripod, davit)
 - body wear (full-body harness)
 - connecting device (retractable lifeline/retrieval unit)

A retrieval system can be as simple as a ladder or an aerial work platform. Be sure to have a retrieval system readily available.

Personal Fall Arrest Systems (PFAS) consist of three basic components that must be in place and properly used to provide maximum worker protection

- **Anchorage Connector**
- **Body wear**
 - **Harness or vest**
- **Connecting device**
 - **Lanyard – Shock absorbing**
 - **Fall limiter**



Personal Fall Arrest Systems (PFAS) are as easy as “ABC”



- **Anchorage**
 - **Anchorage: Commonly referred to as a tie-off point (Ex: I-beam)**
 - **Anchorage Connector: Used to join the connecting device to the anchorage (Ex: beam anchor)**

- **Body Wear**
 - **The personal protective equipment worn by the worker (Ex: full-body harness)**

- **Connecting Device**
 - **The critical link which joins the body wear to the anchorage or anchorage connector (Ex: retractable lifeline, or shock-absorbing lanyard)**

Personal Fall Arrest Systems (PFAS) are as easy as “ABC” – Anchorage/Anchorage Connector



- ***Anchorage***
 - Commonly referred to as a tie-off point (Ex: I-beam, rebar, scaffolding, lifeline, etc.)
- **Anchorage must be capable of supporting 5,000 lbs. (22 kN) of force per worker**
- **Must be high enough for a worker to avoid contact with a lower level should a fall occur**

- ***Anchorage Connector***
 - Used to join the connecting device to the anchorage (Ex: cross-arm strap, beam anchor, D-bolt, hook anchor, etc.)
- **The anchorage connector should be positioned directly overhead to avoid a “swing fall”**

Personal Fall Arrest Systems (PFAS) are as easy as “ABC” – Body Wear



- ***Body Wear***
 - **The personal protective equipment worn by the worker (Ex: full-body harness)**
- **Only form of body wear acceptable for fall arrest is the full-body harness**
- **Should be selected based on work to be performed and the work environment**
- **Side and front D-rings are typically used for positioning only, however, front D-rings or web loops can also be used for ladder climbing and rescue**

Personal Fall Arrest Systems (PFAS) are as easy as “ABC” – Connecting Device

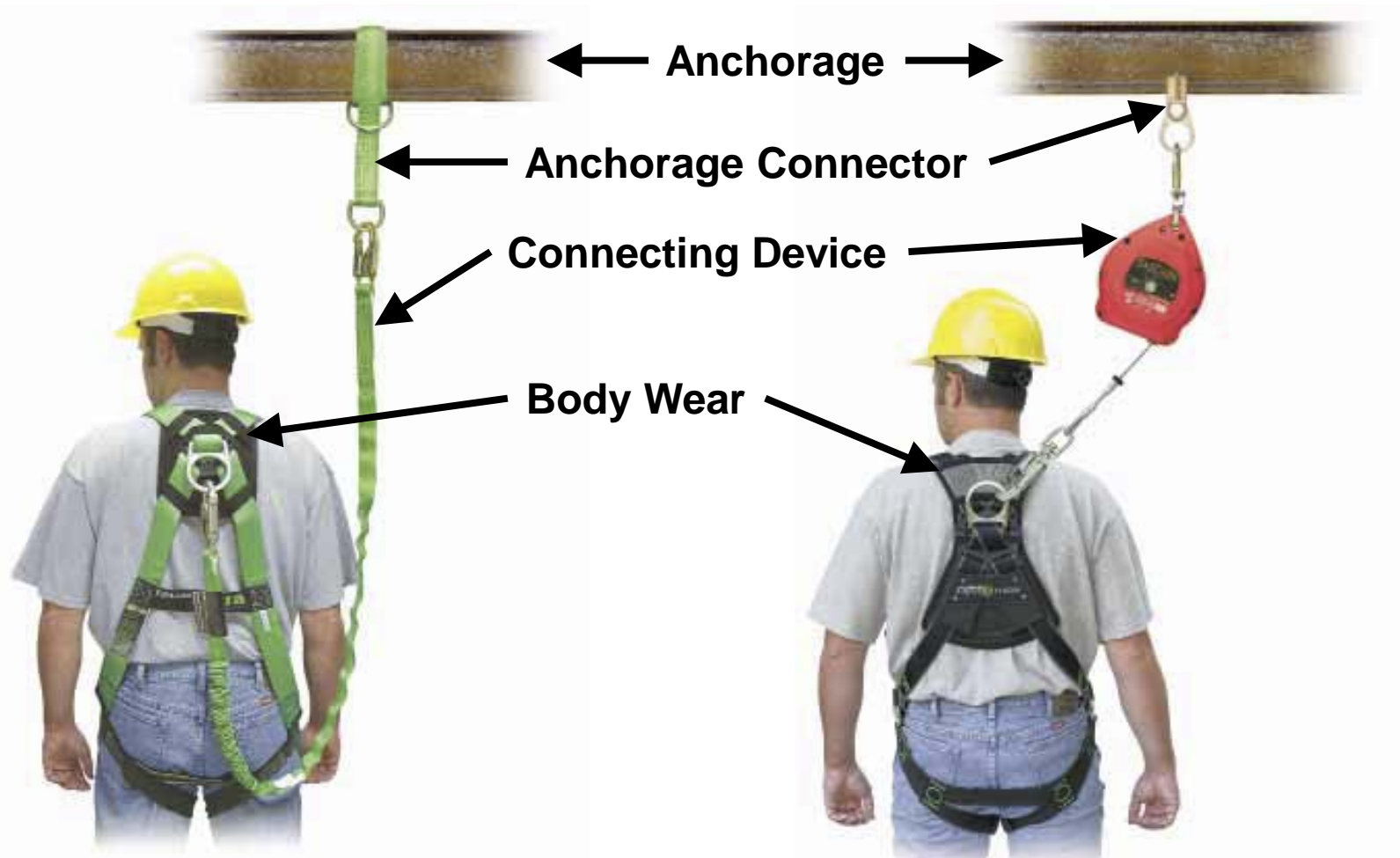


- ***Connecting Device***

- The critical link which joins the body wear to the anchorage/anchorage connector (Ex: shock-absorbing lanyard, fall limiter, self-retracting lifeline, rope grab, etc.)
- Required fall clearance must be calculated to determine type of connecting device to be used – typically, under 18-1/2 ft (5.6 m), always use a self-retracting lifeline/fall limiter; over 18-1/2 ft (5.6 m), use a shock-absorbing lanyard or self-retracting lifeline/fall limiter
- The type of Connecting Device should be selected based on work to be performed and the work environment
- Shock-absorbing lanyards expand when arresting a fall; attach lanyards to the harness back D-ring only

Never tie a knot in any web lanyard – it reduces the strength by 50%

Below are examples of two different configurations of a Personal Fall Arrest System



How to put on a harness from Miller Fall Protection



- **Click on YouTube link below to start the video “How to Put on a Harness”**
- **[\(YouTube link\)](#)**

Placement and connection of the chest and leg straps and back D-ring critically affect harness fit and safety



- It is vitally important that chest straps are positioned in the mid-chest area, and back D-rings located in the middle of the back between the shoulder blades
- Both chest and leg straps must be tightened for a snug fit
- An improperly worn harness has a high probability of causing severe injury



Inspection and Maintenance – Harness Inspection



1) Webbing

Grasp the webbing with your hands 6 to 8 inches apart. Bend the webbing in an inverted “U” as shown. The surface tension resulting makes damaged fibers or cuts easier to detect. Follow this procedure the entire length of the webbing, inspecting both sides of each strap. Look for frayed edges, broken fibers, pulled stitches, cuts, burns and chemical damage.



2) D-Rings/Back Pads

Check D-rings for distortion, cracks, breaks, and rough or sharp edges. The D-ring should pivot freely. Inspect for any unusual wear, frayed or cut fibers, or broken stitching of the D-ring attachments. Pads should also be inspected for cracks, excessive wear, or other signs of damage.



The user must inspect all components of a Personal Fall Arrest System prior to each use.

Inspection and Maintenance – Harness Inspection



3) Buckles

Inspect for any unusual wear, frayed or cut fibers, or broken stitching of the buckle attachments.



4) Tongue Buckles/Grommets

Buckle tongues should be free of distortion in shape and motion. They should overlap the buckle frame and move freely back and forth in their socket. Roller should turn freely on frame. Check for distortion or sharp edges. Inspect for loose, distorted or broken grommets. Webbing should not have additional punched holes.



5) Friction and Mating Buckles

Inspect the buckle for distortion. The outer bars and center bars must be straight. Pay special attention to corners and attachment points at the center bar.



Inspection and Maintenance – Harness Inspection



6) Quick-Connect Buckles

Inspect the buckle for distortion. The outer bars and center bars must be straight. Make sure dual-tab release mechanism is free of debris and engages properly.



7) Quick-Connect Buckles

Inspect fall arrest indicators (located on the back D-ring pad) for signs of activation. Remove from service if broken or stretched between any of the four (4) pairs of arrows.



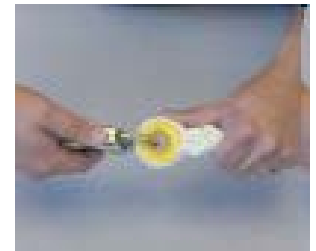
Inspection and Maintenance – Lanyard Inspection

1) Hardware

A) Snaps: Inspect closely for hook and eye distortions, cracks, corrosion, or pitted surfaces. The keeper (latch) should seat into the nose without binding and should not be distorted or obstructed. The keeper spring should exert sufficient force to firmly close the keeper. Keeper locks must prevent the keeper from opening when the keeper closes.



B) Thimbles: The thimble must be firmly seated in the eye of the splice, and the splice should have no loose or cut strands. The edges of the thimble must be free of sharp edges, distortion, or cracks.



Inspection and Maintenance – Lanyard Inspection



2) Wire Rope Lanyard

While rotating the wire rope lanyard, watch for cuts, frayed areas, or unusual wearing patterns on the wire. Broken strands will separate from the body of the lanyard.



3) Web Lanyard

While bending webbing over a pipe or mandrel, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Swelling, discoloration, cracks and charring are obvious signs of chemical or heat damage. Observe closely for any breaks in stitching.



4) Rope Lanyard

Rotate the rope lanyard while inspecting from end-to-end for any fuzzy, worn, broken or cut fibers. Weakened areas from extreme loads will appear as a noticeable change in original diameter. The rope diameter should be uniform throughout, following a short break-in period.



Inspection and Maintenance – Lanyard Inspection



5) Shock Absorber Pack

The outer portion of the pack should be examined for burn holes and tears. Stitching on areas where the pack is sewn to D-rings, belts or lanyards should be examined for loose strands, rips and deterioration.



6) Shock-Absorbing Lanyard

Shock-absorbing lanyards should be examined as a web lanyard (described in item 3 above). However, also look for the warning flag or signs of deployment. If the flag has been activated, remove this shock-absorbing lanyard from service.



Visual Indication of Damage to Webbing and Rope Lanyards



- **Abrasion, cuts & mechanical wear**
- **Heat**
 - **In excessive heat, nylon becomes brittle and has a shriveled brownish appearance. Fibers will break when flexed and should not be used above 180 degrees Fahrenheit.**
- **Chemical**
 - **Change in color usually appears as a brownish smear or smudge. Transverse cracks appear when belt is bent over tight. This causes a loss of elasticity in the belt.**

Visual Indication of Damage to Webbing and Rope Lanyards



- **Ultraviolet Rays**
 - **Do not store webbing and rope lanyards in direct sunlight, because ultraviolet rays can reduce the strength of some material. Fading is a good indication of exposure to UV rays.**
- **Molten Metal or Flame**
 - **Webbing and rope strands may be fused together by molten metal or flame. Watch for hard, shiny spots or a hard and brittle feel. Webbing will not support combustion, nylon will.**
- **Paint and Solvents**
 - **Paint will penetrate and dry, restricting movements of fibers. Drying agents and solvents in some paints will appear as chemical damage.**

Synthetic webs shall be immediately removed from service if any of the following conditions exist

Acid Damage



Heat Damage



Cuts



Cut & Tensile Damage



Abrasion Damage



Face Cuts



Punctures & Snags



Tensile Break



Illegible or Missing Tag



What can happen to me if I fall in my PFAS?



- **Prolonged suspension from fall arrest systems can cause orthostatic intolerance, which, in turn, can result in serious physical injury, or potentially, death**
- **OSHA recommends the following general practices/considerations:**
 - **Rescue suspended workers as quickly as possible**
 - **Be aware that suspended workers are at risk of orthostatic intolerance and suspension trauma**
 - **Be aware of signs and symptoms of orthostatic intolerance**
 - **Be aware that orthostatic intolerance is potentially life threatening. Suspended workers with head injuries or who are unconscious are particularly at risk.**
 - **Be aware of factors that can increase the risk of suspension trauma**

Research indicates that suspension in a fall arrest device can result in unconsciousness, followed by death, in less than 30 minutes

What is “Orthostatic intolerance?”



- **Orthostatic intolerance may be defined as "the development of symptoms such as light-headedness, palpitations, tremulousness, poor concentration, fatigue, nausea, dizziness, headache, sweating, weakness and occasionally fainting during upright standing"**
- **While in a sedentary position, blood can accumulate in the veins, which is commonly called "venous pooling," and causes orthostatic intolerance**

Signs and symptoms that may be observed in an individual who is approaching orthostatic intolerance

- **Faintness**
- **Breathlessness**
- **Sweating**
- **Paleness**
- **Hot Flashes**
- **Increased Heart Rate**
- **Nausea**
- **Dizziness**
- **Unusually Low Heart Rate**
- **Unusually Low Blood Pressure**
- **“Greying” or Loss of Vision**

Factors that can affect the degree of risk of suspension trauma include the following

- **Inability to move legs**
- **Pain**
- **Injuries during fall**
- **Fatigue**
- **Dehydration**
- **Hypothermia**
- **Shock**
- **Cardiovascular disease**
- **Respiratory disease**
- **Blood loss**

Rescue from a fall should be executed in one of the following manners



- **Self rescue**
- **Use of a locally available ladder or aerial work platform**
- **Rescue by an external agency that is qualified at high angle rescue.**
 - **For LLE the rescue agencies are the City of Rochester and West Brighton Fire Departments**

If a fall occurs immediately call 911. If the worker is suspended report that a “high angle rescue is required”

A Miller QuickPick Rescue Kit contains everything necessary for a rescue and only requires an overhead anchorage



1. Back-up braking system (only included with the premium kit)
2. Color-coded, high-strength aluminum pulleys for easy orientation
3. 7/16-in. (11 mm) semi-static kernmantle rope
4. Rescue Remote Connection Pole [4-ft. (1.2 m) collapsed, 12-ft (3.6 m) fully extended]
5. Carabineer clip/Pigtail
6. Handled pole carrying case
7. Rope Control Handle
8. Miller WristBandit™ Tool Lanyard
9. Cross-Arm Anchorage Connector
10. Convenient backpack



Miller QuickPick Rescue Kit from Miller Fall Protection



- **Click on YouTube link below to start the video “Miller QuickPick Rescue Kits ”**
- **[\(YouTube Link\)](#)**

Rescue procedures include the following contingency based actions



- **If rescue cannot be performed promptly, the worker should “pump” his/her legs frequently to activate the muscles and reduce the risk of venous pooling. Footholds can be used to alleviate pressure, delay symptoms, and provide support for “muscle pumping.”**
- **Continuously monitor the suspended worker for signs and symptoms of orthostatic intolerance and suspension trauma**
- **If the worker is unconscious, keeping the worker’s air passages open and obtain first aid**
- **Monitor the worker after rescue, and urge the worker to be evaluated by a health-care professional. Possible delayed effects, such as kidney failure, which is not unusual in these cases, are difficult to assess on the scene.**

In the event of a fall, 911 must be called to evaluate the worker.

Take the time to recognize fall hazards by asking yourself the following questions



- **If I fall is the lanyard long enough to permit me to hit the next surface below me (ground)?**
- **Are there any obstructions below me that I could land on before my lanyard brings me to a stop?**
- **If my anchorage is not directly above is there any obstruction that I could swing into?**
- **If I fall will it take more than 10 minutes be rescued?**

If the answers to these questions is “yes”, or you are unsure, STOP and get assistance from Mechanical Engineering.

LLE Fall Protection Rules



- A “buddy” qualified in fall protection is required to be present for all operations requiring fall protection.
- Fall protection workers must perform a site evaluation (hazard analysis) of the area where fall protection is to be used prior to any activity.
 - The hazard analysis must identify any potential hazards as well as anchorages for rescue and rescue means (rescue kit, ladder, etc.)
 - The hook of the overhead crane is an acceptable anchorage for rescue.
- Rescue means must be on-hand before starting any operations involving personal fall protection.
- The Mechanical Safety Officer or his designee must review any new situation requiring fall protection.
- Fall Protection must be worn when a work surface has no guardrail, is over 4’ off the ground, and the worker will be within 6’ of an unprotected (no railings) edge

LLE Fall Protection Rules



- **Fall protection is required for vertical ladders without cages over 24' in height**
 - **Step and extension ladders do not require fall protection**
- **Fall protection must be worn whenever required by signage or equipment manufacturer's operating manuals (i.e. boom lifts)**
- **Fall protection does not need be worn when using a scissors lift**
 - **Never use guardrails of aerial work platforms as anchorage points**
- **The user must understand how to use all fall protection equipment**
 - **See ME if you need assistance or have questions with your PPE**
- **It is the users responsibility to ensure all components of the fall protection equipment are safe for use**
 - **Inspect your gear before every use**

LLE Fall Protection Rules – continued



- **Load ratings of fall protection equipment shall never be exceeded**
- **Maintain an attachment to a structure or lifeline at all times with the use of dual lanyards**
 - **Make a second lanyard connection before breaking the first connection**
- **Be aware of your surroundings and move slowly**
 - **Constantly evaluate your situation for swing hazards**
- **Report any fall immediately to the Mechanical Engineering and Chief Safety Officers**
- **All equipment involved with a fall must be removed from service, tagged out (LOTO), and delivered to Mechanical Engineering Safety Officer. This includes the harness and lanyard.**

If you have any questions regarding Fall Protection safety you can contact the following people



- **Milton J Shoup**
 - **Office: x59636**
 - **Email: shoup@lle.rochester.edu**

- **Mark Romanofsky**
 - **Office: x57528**
 - **Cell: 585-733-4602**
 - **Email: mrom@lle.rochester.edu**

- **Eric Sanford**
 - **Office: x54095**
 - **Cell: 585-729-2225**
 - **Email: esan@lle.rochester.edu**

Safety is everyone's business and compliance with safety procedures is **MANDATORY**



- If an activity or practice seems unsafe, “Stop Work” and take the time to address concerns
- Only trained personnel may use fall protection equipment. Review this material as often as necessary to maintain your knowledge
- No LLE personnel are qualified or permitted to repair fall protection equipment
- It is the users responsibility to ensure all components of the fall protection equipment are safe for use. Seek assistance from Mechanical Engineering when in question.
- Situational Awareness – The best way to prevent an accident is to be aware of your surroundings. Take no chances and err on the side of safety.

If a fall occurs that results in injury and/or a suspended worker, immediately call 911 and report “high angle rescue is required”