RISK CONTROL

# Fatigue - In The Work Environment

Fatigue is the temporary inability or decrease in ability or a strong disinclination to respond to a situation because of previous over-activity, either mental, emotional or physical. Fatigue is defined as a reduced muscular ability to continue an existing effort. This phenomenon of reduced performance in the workplace is referred to as muscular fatigue and is characterized by reduced power and slower body movements. When muscular fatigue is excessive we see the manifestation of accidents (soft tissue injuries), increased errors that affect quality, and, in some cases, impaired coordination.

## Muscles

The primary purpose of muscles is to support the skeletal system and to provide movement to body segments. The use of muscles to affect movement is the basis of all industrial tasks. Whether the tasks are large or small, muscles must contract so the worker can perform their job task.

What happens to the muscle when an employee is involved in heavy work? We know that when you start pushing, pulling, lifting, and carrying, the muscular contraction that ensues initiates a chemical process that provides the energy for a mechanical effort (the movement of the body and limbs). After the muscle contracts and is in a resting state the energy reserve is replenished (aerobic state). If the energy demand from the work being completed exceeds the rate of regeneration, the muscles begin to fatigue and go into an anaerobic state (lack of oxygen). This results in the development of lactic acid and potassium, which are believed to be the primary reason for muscle fatigue that can lead to soft tissue injuries and a reduction in productivity.

## Dynamic and Static Movements

There are two types of work tasks; dynamic and static. The dynamic ones are characterized as movements of the body such as walking or lifting over hours or minutes. Static tasks are intense work activities for a short period, measured in seconds or minutes with an absence of body movement. The intensity of dynamic work that is acceptable in a job task varies with the length of time it must be sustained, so measuring this work is best done by determining the maximum percentage of oxygen uptake over different work times, expressed in hours. For example, a workload over an eight-hour shift should not exceed 33 % of a worker's capacity for that type work. If the hours are reduced, the maximum oxygen usage for a job task can be increased.

Static work efforts are when the muscles are contracted which, in turn, decreases the blood flow. This makes the heart work harder to overcome the resistance by increasing the beating rate and blood pressure. There is little energy supplied to the contracted muscles; however, this static state can be exhausting to the individual, leading to an increase in susceptibility to a soft tissue injury. When observing the industrial work environment, we see dynamic movement of bending; however, we typically do not recognize the use of static postures and do not identify these as risk factors in the workplace.

Therefore, we need to better design the job tasks to reduce the peaks and valleys of energy expenditure so there are short periods of high exertion and periods of lesser exertion. Working in this manner with peaks and valleys through an eight-hour work shift affects the productivity of the individuals by raising heart rates, blood pressure, and oxygen demands that are associated with excessive energy demands. These high levels of exertion require longer periods for rest and recovery, thus the efficiency and productivity of the employee begins to suffer over an eight-hour work shift, along with increased employee error rates, and reduced quality. Jobs should, therefore, be designed so the individual does not exceed 33% of their maximum aerobic capacity over an eight-hour shift.



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## Strategy for Lowering the Exertion Levels

There are three basic methods to achieve a reduction in energy expenditure for job tasks with significant physical demands. The first is redesigning the job task or eliminating the activity that facilitates the high level of energy expenditure. If this can be accomplished then in most cases, the high-energy expenditure can be eliminated and the employee can work in a steady state that allows the optimal oxygen intake, heart rate, and blood pressure, thus reducing worker fatigue and the probability of soft tissue injury while improving worker productivity.

The second method involves providing manual material handling aids, such as lift tables, hoist, vacuum lifts, and conveyors, etc., to assist the employee during the job task. By providing aids of this nature, the physical task demands are reduced, as well as the amount of oxygen needed and high heart rate in job tasks with high-energy expenditures. Although these will not eliminate the high-energy expenditures, they will reduce the amount of energy needed to complete the task.

The third method entails the use of administrative controls, whereby the employee would get help from another employee or job rotation is used with several employees rotating in and out of the high exertion job tasks. This allows for a recovery period where the body can get back to a steady state. This method should only be set up for short periods, typically ninety days or less. The preferred method is redesigning or eliminating the job task with high level of energy expenditure.

Fatigue is a real issue in the work environment, and with the onset of the aging workforce that all employers face in every job sector today, it is very important that management begin to identify and evaluate those jobs associated with a high level of energy expenditure. By taking actions that address physical job fatigue you will not only be able to reduce the risk factors associated with job tasks that create the high energy expenditures, but can likewise improve productivity, and enhance quality.

For more information on fatigue and your work environment, please contact CNA Ergonomic Services at 214-220-5807.



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# FATIGUE CAN BE FATAL

How many times have you caught yourself staring fixedly at the road ahead, hypnotized by the monotony of the highway? You suddenly realize that you have passed your turn off – totally inattentive.

Good drivers who spend long hours on the road realize that fatigue can be fatal. Extreme fatigue attacks a driver's mental ability and muscular coordination. Fatigue hampers a driver's ability to judge distances, speed, or driving conditions. These circumstances can lead to a serious accident.

Many times fatigue may also produce a mental state which will deceive drivers into believing that they are capable of driving safely. When tired, drivers often imagine conditions that do not exist. A reaction to some imaginary condition may be disastrous.

The Federal Bureau of Motor Carrier Safety states that, "No driver should operate a motor vehicle, and a motor carrier should not require or permit a driver to operate a motor vehicle, while the driver's ability or alertness is so impaired, or so likely to become impaired, through fatigue, as to make it unsafe to operate the motor vehicle." In fact, the Bureau has established definite time periods for maximum driving,

Why have these regulations been established? Experts have concluded that driver performance deteriorates, driver alertness diminishes, and accident probability increases as driving time increases. The frequency of accidents dramatically increases after about 7 hours of driving time.

All drivers should be aware of the signs of fatigue so that they may take measures to combat it.

While you are still alert, you will sit relatively quiet in your seat. As you begin to tire, you become restless, squirm in your seat, stretch, rub your eyes, and maybe start to crack your knuckles. A driver may experience short lapses of attention, but as fatigue sets in, you pay less and less attention to the instrument panel and the rear and side view mirrors. A driver may even stare fixedly ahead, actually appearing to be in a trance.

It is, at this point, that the driving patterns change. There is less steering, irregular or erratic speed changes, weaving back and forth, and finally, crossing the center line or drifting off the road entirely. This is the time when a fatigued driver is a hazard to himself, as well as others.

Here are some of the precautions you can take to combat fatigue:

1. A driver should not operate a vehicle when tired, ill, or when any other condition makes his driving ability less than 100%.
2. A driver should not operate a vehicle beyond the hours of service limitations developed by the Bureau of Motor Carrier Safety.
3. Frequent rest stops should be made.
4. Any activity which substitutes a different physical act for the monotony of driving helps refresh a driver.
5. If available, a drink of coffee or water is often enough to increase alertness.
6. Fatigue comes on very quickly. Drivers should get off the road before they fall asleep instead of afterwards. A driver who is dog-tired should pull well off the road and take an extended rest break.



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7. Do not use alcohol or drugs of any kind at any time.

Many drivers feel that drugs can increase alertness and efficiency so that they can operate a vehicle beyond their limitations. Drugs may increase alertness for a short period. However, their use is often followed by headaches, dizziness, agitation or irritability, decreased power of concentration, and marked fatigue.

An important factor to note is that the use of drugs can interfere with the body's normal warning symptoms of drowsiness and fatigue. Drivers can use up their body energy without realizing it until they may suddenly collapse.

They are given a false sense of self-confidence and do not realize that their driving ability and alertness are decreasing.



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# First Aid

It's an excellent idea for construction workers and for everyone to know first aid fundamentals: how to stop bleeding, start breathing, start a stopped heart beating again, and give any other vitally needed care until professional help arrives.

Whether or not you've had any first aid training, you should know this principle that is too often forgotten in many emergencies: Don't move anyone who appears to be seriously injured. Well-meaning people often have the impulse to hoist an accident victim to a sitting position, or pointlessly move them from here to there...or from there to here.

The victim of a bad fall, or of some other accident on your project, might have internal injuries or a fractured spine; if so, trying to move him needlessly might aggravate the injury – might permanently cripple, or even kill them!

Wait until experts arrive who will transport the victim to a hospital with a minimum of danger. If the person must be moved to save them from additional danger, try to work a blanket or coat under them, and then pull them gently along the ground to a safe location. If they must be lifted, support each part of the body so that the entire frame is kept in a straight line.

Good first aid is not only knowing what to do – how to stop excessive bleeding, or restore breathing; it's also knowing what not to do – not to move a seriously injured person unless absolutely necessary.

It is equally important that you protect yourself when giving first aid. Your good deed could cause you needless pain and suffering.

Avoid all contact with the victim's body fluid. This includes not only blood, but also saliva and other body fluids. If you think you might come into contact, obtain the necessary protection before beginning first aid. This could include disposable gloves, a disposable mouth to mouth resuscitator, safety glasses, or even a fluid-resistant mask. Check today to make certain your first aid kit has the appropriate equipment, and to familiarize yourself with its location. If you do come into contact with an injured person's body fluids, let your supervisor know, and seek medical attention as soon as practical.

So if someone is ever seriously hurt on the job, see that professional help is called right away – then see that what needs to be done is done...and that what need not be done isn't done.



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# Foresight Preserves Eyesight

There are all kinds of eye hazards in construction work – and there's excellent protection for every eye hazard you'll find on a project. Just remember: there's every kind of eye protective device readily available – but you're using your one and only pair of eyes right now.

Here are some of the more common operations where eye protection is an absolute must:

- Chipping, sledging and hammering on metal, stone or concrete.
- Using manual, pneumatic and power impact tools.
- Caulking, brushing and grinding.
- Drilling, scaling and scraping.
- Soldering and casting hot metals.
- Handling hot tar, oils, liquids, and molten substances.
- Handling acids, caustics, and creosoted materials.
- Gas welding, cutting and brazing.
- Electric arc welding and cutting; also, any operations that may expose the eyes to dust, gases, fumes or liquids. Drilling overhead.
- Working where there's dust blowing around.

Eye protection can be comfortable when you get a good fit. True, goggles can fog up, but you can wear a sweat-band if you sweat a lot – and there are anti-fog liquids, too. Maybe there's some inconvenience involved in using eye protection – but what's that compared with the "inconvenience" of having to learn how to read Braille?



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# Goggles - Gloves

## Goggles

There is nothing new about wearing goggles for eye protection. Every job is using them to a greater or lesser degree. But the question always arises as to who should not be asked to wear eye protection.

There is no job throughout construction that does not carry a potential eye hazard. In analyzing eye injury cases, it is found that the most common are caused from foreign bodies in the eye, flying objects, dust, and horseplay. The jobs include office workers, laborers, operators, warehousemen, millwrights, drivers, mechanics, carpenters, and so on down the line.

Actual reported cases describe accidents in which a laborer was cleaning out one thing or another when some of the contents of a chemical nature splashed in his eyes and resulted in the loss of his sight. Goggles were not worn, since they were not considered necessary for that type of work or worker. But follow this injury and others like it and you will find that most could have been prevented if the right eye protection had been used.

There's No Such Thing As Being Too Safe!

## Gloves

Your hands are your wage earners.

Hands are hurt more often than any other part of the body.

Hand injuries don't have to occur. As talented as your hands are, they can't think, they're your servants, and it is up to you to think and keep them out of trouble.

Be sure you wear the right kind of gloves for the particular kind of work you are doing.

When you wear gloves, you aren't trusting to luck and you're not taking unnecessary chances.

Wear gloves when you are doing a job that needs them, but, not around moving machinery.

Time spent in preparing your hands for the job will not only save trouble for you but will probably save time in doing the job.



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# Hard Hats

The average safety hard hat weighs about 14 ounces. The average man's head weighs 14 pounds. So there's an ounce of safety for every pound of head – provided the head protection is properly worn and maintained.

The brain is the control center of the body. The slightest damage to any part of the brain will cause malfunction of some area of the body. The skull, under normal circumstances, protects the brain. But when a possibility of injury from falling or flying objects exists, additional protection is required.

Hard hats not only reduce the chances of serious injury resulting from falling objects, but protect you when you bump your head on things – like machinery, ductwork, ceiling tie wires and forms. Non-conductive hard hats protect you from electrical shock and burns. Never wear metal hard hats around electrical work.

## How To Care For Hard Hats

The better care you take of your hard hat, the better care it will take of you. Here are some suggestions:

1. Properly adjust suspension systems to maintain clearance between your head and the shell of the hat.
2. Don't cut holes for ventilation. Don't heat and bend.
3. Don't substitute a "bump cap." They aren't strong enough.
4. Don't paint your hard hat.
5. Don't put anything under it except your head; this includes cigarettes or notebooks.
6. Don't wear it backwards.

## Some Common Complaints And The Real Truth

We sometimes hear the following complaints about hard hats. But is there any real basis for them?

"It's too heavy." Hard hats are only a few ounces heavier than a cloth cap, but the extra protection you get is worth the extra weight.

"It's too hot." Measurements taken in hot weather show that the temperature under a hard hat is often cooler than outside.

"It gives me a headache." A thump on the head from something, which has fallen two floors, will give you a worse one. There is, however, no medical reason why a properly adjusted hard hat should cause a headache. Don't alter the suspension system or the hard hat, because you won't get the designed protection.

"It won't stay on." You're right; it won't in a high wind. A chinstrap will solve this problem. Otherwise, you will find that a hard hat stays put no matter how much stooping or bending you have to do – if it's fitted properly.

"It's noisy." That's your imagination. In fact, tests show that properly worn hard hats will shield your ears from noise to some extent.

## No Help Unless You Wear It

The hard hat is a useful piece of safety equipment. But like any other protective device, it must be properly adjusted and worn and kept in good condition to give you maximum protection.

Don't be a hard head – get in the hard hat habit.



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# Heat Stress Prevention

As spring turns into summer and brings up "hot weather," we should all be aware of some tips to prevent heat stress. Remember, physical activity at high temperatures can directly affect health and indirectly be the cause of accidents.

**What is Heat Stress?**

It's a signal that says the body is having difficulty maintaining its narrow temperature range. The heart pumps faster, blood is diverted from internal organs to the skin, breathing rate increases, and sweating increases, all in an attempt to transfer more heat to the outside air and cool the skin by the evaporation of sweat. If the body can't keep up, then the person suffers effects ranging from heat cramps to heat exhaustion, and finally to heat stroke.

**Dry clothes and skin doesn't mean you're not sweating!**

In dry climates you might not feel wet or sticky, but you are still sweating. On a very warm day you can lose as much as two liters of fluid.

Beat the heat. Help prevent the ill effects of heat stress by:

- Drinking water frequently and moderately (about a glassful every 15-30 minutes). Due to the fact that most of us already consume excess salt in our diets, salt tablets are not recommended for general use.
- Resting frequently.
- Eating lightly.
- Doing more strenuous jobs during the cooler morning hours.
- Utilizing ventilation or fans in enclosed areas.
- Remembering that it takes about 1-2 weeks for the body to adjust to the heat; this adaptation is quickly lost – so your body will need time to adjust after a vacation, too.
- Avoiding alcohol consumption. Many cases have occurred the day after a "night on the town."
- Wearing light-colored, cotton clothes and keeping your shirt on – desert nomads don't wear all those clothes for nothing.



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# Housekeeping on the Job

You have a pretty good idea how safe a job is just by looking at it before you start to work. Even a "Sidewalk Superintendent" knows this. A job that looks clean, with everything in its place, is a safe job. That's all we mean when we talk about job housekeeping. Good housekeeping calls for just two things. Try to remember them:

***First:*** Keep trash and loose objects picked up and dispose of them.
***Second:*** Pile all materials and park all tools and equipment in the places where they belong.

These are the fundamentals of good housekeeping and they're simple enough. If we don't follow these two rules, we're letting ourselves in for trouble.

Putting the rules to work is not so simple. A grand clean-up once a week won't do the trick. Housekeeping is a job that can't be put off. We have to do it. It's up to each individual to be their own job housekeeper.

When you see something lying around where it could trip an individual or fall on them, put it in a safe place. Don't wait for someone else to do it. If it's something that he or she will be looking for, you can put it safely where they can see it.

You've seen jobs, and probably worked on some, where it wasn't safe to put your foot down without first looking twice to be sure you weren't going to twist an ankle or run a nail through your shoe. A job like that is poorly run, badly managed. Probably it's losing money as well as causing accidents.

Some jobs have walkways, aisles, stairs, and ladders by which you get from one place to another. It's particularly important that these lines of travel be kept safe and clear of loose objects. Workers often carry loads on these routes.

They can't always pick their steps or look around to be sure that nothing is going to trip them or fall on them.

A wet or greasy walkway may cause a bad accident. If you see a treacherous spot, make it your business to do some sweeping, mopping or scraping.

Brick, tile, pipe, steel rods and similar materials scattered about the job or insecurely piled on scaffolds or platforms can cause accidents. All material should be piled in the place set aside for it. Each kind of material has its own characteristic. But some rules for piling apply to all kinds:

First, you have to consider how the material is going to be taken out of the pile. If it's going to be a fast-moving operation with a big tonnage being unloaded in a short time, be sure to leave space for the worker and the equipment that will have to do the work.

Be courteous. Never pile material in such a way that it will endanger a worker who has to work on it or will make a backbreaking job for the worker who breaks down the pile.

Other points to think about are:

1. The strength of the support if you're piling material on a floor, platform or scaffold.
2. The stability of the ground if you're piling a heavy load.
3. The height of the pile so it won't topple.
4. The need for building racks if its pipe or rods you have to stack.
5. The wisdom of waiting for the proper equipment to handle structural steel and other heavy material.



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We all know the value of good lighting in job housekeeping. Poor lighting and accidents go together. When you find a light out, report it and get a replacement.

It's not hard to keep a job clean if all useless materials, boxes, scrap lumber and other trash are picked up and removed regularly. Remember, if they're allowed to accumulate for even a few days, the job becomes a messy and unsafe place to work.



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# Introduction to Fall Protection

Falls cost business owners millions of dollars each year in lost time, compensation, and third party lawsuits. However, with the right mix of pre-job planning, proper equipment selection and employee education and training, workers can continue to work at heights while limiting injuries and their associated costs.

There are a number of nationally recognized standards and legislative requirements that govern the use and need for fall protection. Typically, fall protection is required when working six feet above the level or obstruction below, or when a fall from a lesser height may result in a serious injury.

There are a number of important ingredients that must be included in any good fall prevention or protection program. These include identification of the fall hazards, implementation of a company policy, selection and use of the proper equipment and/or systems, and an in-depth training program including rescue.

## Fall Prevention

The term fall protection encompasses a broad spectrum of techniques, equipment, and legislation in hopes to minimize injury and damage due to falls. However, where possible, a fall prevention approach should be taken to eliminate the fall altogether. Some examples would include engineering out the hazard by relocating a valve to a more accessible location, or utilizing site fall protection systems such as guardrails and floor covers, and using Fall Restraint Systems where possible.

## Fall Arrest

Due to feasibility issues, cost and/or time restraints, fall prevention systems cannot always be used. For these situations, a fall arrest system can be used and can limit injury to a worker by stopping the fall prior to the worker hitting the level below.

Personal fall arrest systems are, at times, much more complex and require more detailed and comprehensive training to be effective and ensure safety. Further, the fall arrest system must limit the forces on the worker to less than 1,800 lbs.

## Fall Protection Basics

All personal fall protection systems will incorporate some form of anchorage, body support, and connector(s), and should incorporate a plan for descent/rescue. In addition, there are a number of other factors that must also be considered including freefall and available clearance, anchor location and strength, shock absorption and potential for swing fall.

## Body Support

The two most common types of body support used in the construction industry include the waist belt and full body harness. Both of these types of body support may be used for work restraint and positioning applications. However, if there is potential to fall (fall arrest) then only a full body harness should be used. A waist belt is banned for fall arrest and must not be used as it can cause serious injuries, has the potential to slip off, and limits suspension time.

## Full Body Harnesses

The full body harness has significant advantages over waist belts including: prolonged suspension, distribution of impact forces, decreased potential for serious injury, upright suspension, and easier rescue. All American National Standards Institute (ANSI) approved full body harnesses must have an attachment point (D-ring) located between the shoulder blades (dorsal location) for use with other fall arrest equipment.



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### Harness Types

Some harnesses have multiple attachment points for differing applications. Workers and supervisors should be aware that the harness of choice is one that is relatively simple, easy to adjust, and causes no confusion regarding the attachment point. The categories of harnesses are as follows:

- Fall Arrest
  - Back dorsal D ring
- Controlled Descent
  - Front D ring
- Confined Entry/Evacuation
  - Two D rings on shoulder
- Ladder Climbing
  - Front D ring
- Work Positioning
  - Two D rings at waist

### Harness Do's and Don'ts

DO:

- Adjust the harness to fit snuggly. A harness that does not fit snuggly can cause serious injury and limit the tolerable suspension time following fall arrest.
- Wear the chest strap. If the chest strap is not done up you may fall out of the harness in a headfirst fall.
- Inspect the harness prior to use. A harness that does not pass the pre-use inspection should not be used.
- Use the keepers to prevent the webbing from sliding through the buckles and to tuck back excess webbing.

DON'T

- Leave straps dangling or leave the harness partially done up. If the unattached straps are forgotten about, they may be caught in machinery or the harness may fall off during fall arrest.
- Use a harness that has been previously used to arrest a fall. It must be discarded following fall arrest.

### Donning a Full Body Harness

Lay the harness out on a clean, flat surface to ensure there are no tangles in the webbing and for ease in inspection. Place the shoulder straps on and secure all corresponding buckles. Adjust all straps and buckles so that the harness fits snuggly, but still allows free movement. Ensure the sub-pelvic strap is just below the buttock and the chest strap is across the chest at nipple height. Slide all keepers to their correct locations. Attach all other fall arrest equipment to the dorsal D-ring on the harness.

It is important to follow the manufacturer's direction for donning your particular harness, as donning procedure may change.

### Connectors

Connectors include equipment that is used to couple the body support to the anchorage. They include hardware, such as snaphooks and carabiners, as well as software, such as lanyards and shock absorbers.

### Snaphooks

A snaphook is a connector with a hook-shaped body that has an opening for attachment to a fall protection component and a self-closing gate to retain the component within the opening. Non-locking snaphooks must not be used in fall protection as they may unintentionally disengage (**rollout**) during operation.

The autolocking snaphook is the only type that should be used for fall arrest applications because it limits the hazard of rollout when used with a large D-ring. Other disengagement hazards include forced rollout, false connection, resting over a sharp steel edge and attaching two snaphooks together.

### Carabiners

Carabiners have an oval shaped body with a gate on one side that may be opened to attach to a fall protection or rescue component. Steel carabiners are recommended because of their durability and strength characteristics. All carabiners should be of the auto locking variety to prevent rollout. Some carabiners come with a split pin or captive



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eye to prevent side or cross-gate loading. They should be rated for 5,000 lbs.

**Lanyards**

Lanyards are used to connect the anchorage to the body support of a fall protection system. The three lanyard types are rope, webbing, and cable. **Note:** Cable lanyards are very static in nature and must be used with shock absorbers when used for fall arrest. Maximum lanyard length for fall arrest is six feet including the shock absorber. Lanyards should be long enough to ensure usability, while remaining as short as possible to minimize free-fall distance. Some lanyards are made to be adjustable allowing widespread use.

Double tethered lanyards (two lanyards that are integrally connected at one end) are also available to provide 100% tie-off protection.

**Lanyard Do's and Don'ts**

DO

- Attach the lanyard directly overhead to minimize swing fall hazard
- Use the shortest possible lanyard for the job.
- Inspect the lanyard prior to use.

DON'T

- Use a lanyard if has been used to arrest a fall.
- Attach two lanyards together to make them longer, as it could cause rollout, and the freefall is unacceptable.
- Tie knots in lanyards; it reduces the strength by 50%.
- Girth hitch lanyards, it can cut the lanyard.

**Shock Absorbers**

A shock absorber is used to dissipate the energy of a falling worker and minimize the resulting forces on the worker and the rest of the fall arrest system. Shock absorbers are designed to tear or extend, to reduce the forces of a fall. To meet ANSI standards, they must keep the forces below 900 lbs. and not extend the fall to more than 42''. This potential elongation must be added to calculations of total fall distance to ensure the worker does not hit the ground. Even if a shock absorber is only partially deployed, it must be retired. If a lanyard is used for fall arrest, a shock absorber should always be incorporated.

**Anchorages**

Anchorages can be defined as secure points to attach a lifeline, lanyard, or any other fall protection or rescue system. Some examples include structural steel members, pre-cast concrete beams, and davit arms.

There are two classes of anchorages, certified and non-certified. Certified anchorages have either been designed or engineered specifically for fall protection, or are existing structures that have been tested, evaluated and/or approved for use. Certified anchorages should be identified with paint or special markings to ensure that they are only used for their intended purpose. Once certified, an anchorage should be added to a plant or site location list.

Non-certified anchorages (temporary or improvised) include existing beams, trusses and other suitably strong structures throughout a job site that are not practically certified. As a result, workers using non-certified anchorages must be thoroughly trained in their use and proper identification. A quick check would be to visually assess if the anchorage would be able to support a ¾ ton truck and, if not, don't use it! Inappropriate anchorages include fluid carrying pipes, electrical conduits, and handrails.

**Strength Requirements and Freefall**

Anchorages used for fall protection should be capable of supporting a load of **5000 lbs.** per worker, unless certified by a professional engineer who maintains a safety factor of 2. The impact force or maximum arrest force (MAF) is the peak dynamic load that results from a falling worker being stopped by the system. This force is dependent upon the workers weight, free fall distance and energy dissipation by the system, i.e., use of a shock absorber. The MAF allowable is 1,800 lbs. However, it can be upwards of 3000-4000 lbs. when a shock absorber is not used.



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The free fall distance is the vertical distance from the location the worker started to fall from, to where the fall arrest system begins to slow the worker down. The maximum allowable free fall distance is six feet. To limit freefall, the anchorage should be located as high as possible above the worker.

### Anchorage Connectors

An anchorage connector is attached or connected around the anchorage to aid in attaching the rest of the fall protection system. The most common types include slings which can be made of webbing or cable.

All slings must be rated for 5000 lbs. and should be long enough to entirely encircle the anchorage with room to spare.

There are many other types of anchorage connectors, including roof anchors, beam clamps, eyebolts, and shepherd's hooks. It is most important to follow all manufacturers' directions prior to using any anchorage connector.

### Specialized Systems

### Self-Retracting Lifelines (SRLs)

A self-retracting lifeline contains a drum wound line under tension that is anchored vertically above the worker. When attached to the dorsal D-ring of a harness, the worker may climb up and down unimpeded. In the event of a fall, the device will lock the drum and prevent the lifeline form paying out, thus arresting the fall. The lifeline of the SRL can be composed of cable, webbing or synthetic rope, and may range in length from 7 to 250 feet. Most units have a load indicator to show if the device was previously loaded or fallen into. If this indicator is deployed, the SRL must be returned for servicing. Some of the guidelines that must be followed when using SRLs include keeping the lifeline away form sharp edges, never clamping or knotting the line and not using this device on flat roofs or while on granular surfaces.

### Vertical Lifelines

ANSI defines a Vertical Lifeline as a vertically suspended flexible line with a connector at the upper end for fastening it to an overhead anchorage, thus providing a path along which a fall arrester (rope grab) can travel. Vertical lifelines are typically composed of nylon or polyester due to their high strength and wear characteristics. Some things to understand when using vertical lifelines include watching for potential swing falls, keeping the rope away from sharp edges and heat sources, using the shorted possible lanyard to minimize freefall when climbing and mating the lifeline with the rope grab.

### Static Versus Mobile Fall Arresters

**Static fall arrester,** also referred to as manual rope grabs, are designed to remain locked onto the lifeline until the worker manually disengaged the locking mechanism (squeezes the device). Static arresters are used widely for protection while on powered swing stages, as the worker does not require his hands to climb, thus limiting freefall. They are also used in roofing applications for fall restraint scenarios as they stay in place when locked, but provide movement when required.

**Mobile Fall Arresters** (also referred to as automatic rope grabs) are best used when hands free use is required, i.e., climbing communication towers. These rope grabs will follow the worker up and down along the lifeline, but arrest the sudden fall of a worker. To minimize fall distances, the fall arrester should be positioned above the worker when arriving at the desired elevation. Additional clearance should be factored to include line stretch and arrestor lock off.

### Ladder Safety Systems

Ladder safety systems incorporate either a flexible cable or rail assembly permanently installed up the center of a ladder. A fall arrester or safety sleeve is connected to the cable or rail and provides free movement up and down the ladder when attached to the workers full body harness. In the event of a slip or fall, the sleeve will lock-off and arrest the falling worker in a relatively short distance, minimizing injury, as opposed to the use of a ladder cage. **Note:** These systems represent the only instance where workers will attach to the frontal attachment of the harness for fall arrest, since the means of connection is kept very short or less than 9 inches.



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### Horizontal Lifelines

A horizontal lifeline consists of a cable or rope that is connected between two fixed anchorages at the same level and provides a location to connect other fall arrest equipment such as lanyards, SRLs. It is designed to allow horizontal movement and protection of workers, i.e., along the length of a railcar. Industry standards dictate that they should be designed by a qualified person (professional engineer). The resulting forces exposed to the two anchorages of a horizontal lifeline during fall arrest can be many times greater than those expected from a single anchorage. Furthermore, the fall distance will also be greater because of the additional sag in the line during fall arrest.

### Equipment Care and Maintenance

### Inspection

All fall protection equipment should be inspected by the user prior to each use. A detailed annual inspection should also be performed by a competent person. All other inspections should be performed as detailed by the manufacturer. If there is ever any sign of an unsafe condition or if the equipment shows signs that it has been used to arrest a fall, it should be immediately retired or sent to an authorized service center for recertification.

Software, such as lanyards and harnesses, should be inspected for cuts, burns, discoloration, excess dirt or wear, knots or other damage, and must have all labels present. Hardware such as D-rings and snap hooks should be free of cracks, corrosion, deformation, burrs, missing parts, or other damage and/or wear.

### Care and Maintenance

All manufacturers' directions should be followed for proper care and maintenance. Most soft and hardware can be washed with mild soap detergent, water, and a rag. The equipment should be dried with a rag and left to hang, out of direct sunlight. Equipment should not be taken apart, modified or repaired in-house. Additional servicing should only be performed by factory authorized centers.

### Logging, Identification and Storage

Records of all equipment should be maintained in a centralized logbook including serial number, date of purchase or recertification, and inspection dates. Each worker should also be issued a personal logbook for daily inspections. All equipment should be tagged or marked as recommended by the manufacturer for identification. The storage location should be a cool, dry, and clean environment, out of direct sunlight; a locker or tool crib is recommended.

### Rescue and Escape

Rescue is the one component of many comprehensive fall protection programs that is most often overlooked. Workers who have fallen and are suspended in a full body harness may or may not be able to perform a self-rescue. Rescues do not have to be complicated and risky. For example, if a fallen worker can be accessed with a ladder or manlift, then this procedure should be used prior to using rope rescue techniques. Technical rope rescue operations can be quite effective and safe but require a great deal of training for personnel to acquire and maintain an acceptable degree of proficiency. Most important is that a plan and procedures are developed. Rescues should be as simple as possible while putting the fewest workers at risk. A site rescue team is often recommended.



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