SCAFFOLD INDUSTRY ASSOCIATION

TRAINING PROGRAM FOR

Suspended Scaffolds

SIA

STATEMENT OF PURPOSE

This manual and any course utilizing this manual are intended only to provide basic information related to the proper use of common types of suspended scaffolds and similar vertical suspension equipment,including many types of suspended work platforms, serving stages, powered and permanent platforms, portable stages, and plank rigs.

This manual is not intended to be an instruction book applicable to all types of scaffolding equipment under all circumstances. The manual does not address all currently known designs of this type of equipment and cannot anticipate what might be required for proper use of new designs and methods.
The Scaffold Industry Association emphasizes that the safe use of scaffolding equipment requires the user to evaluate the specific type of equipment being used,the location and other conditions under which it is being used,the number of persons and types of related equipment, and other variables. This manual cannot anticipate all of these variables.

This manual is not a government compliance manual. Government regulations regarding equipment use and workplace safety vary from jurisdiction to jurisdiction and are always subject to change. Persons responsible for the use of this type of equipment are responsible for ensuring that applicable governmental requirements are satisfied.

Finally, while reasonable efforts have been made to assure the accuracy of the information contained herein, the Scaffold Industry Association does not claim that all information in the manual is accurate in all respects.

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INTRODUCTION

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Chapter 1: Introduction

1.0 You and The Equipment

This training program explains how to set up, operate, and inspect suspended work platforms. The person completing the course will know the basics required to use suspended equipment safely. On-the-job training after this program will allow participants to apply what they have learned and to gain field experience necessary for any professional.

In practice, the equipment covered in this manual is called “suspended scaffold,” or “swing stages.” Tubular scaffold can also be called “suspended scaffold” when it is suspended from an overhead structure. Caution should be used when identifying the type.

Suspended work platforms demand know-how and attention to be used safely. You may overlook steps in setup and operation. **The equipment will not.** It will neither forgive nor forget your mistakes. Investigation of most accidents shows that the cause was worker error and not equipment failure.

Oversights on your part can lead to accidents. There are four things you should know right away about accidents with suspended equipment:

1. The accidents involve injuries.
2. The injuries are usually serious, e.g. crushed heels, broken bones, broken backs, injuries to skull and brain, etc.
3. Fall-arrest equipment used with independent lifelines, can prevent serious injury and death.
4. Accidents can be prevented by correcting obvious problems in the setup or operation.

2.0 The Basic Equipment

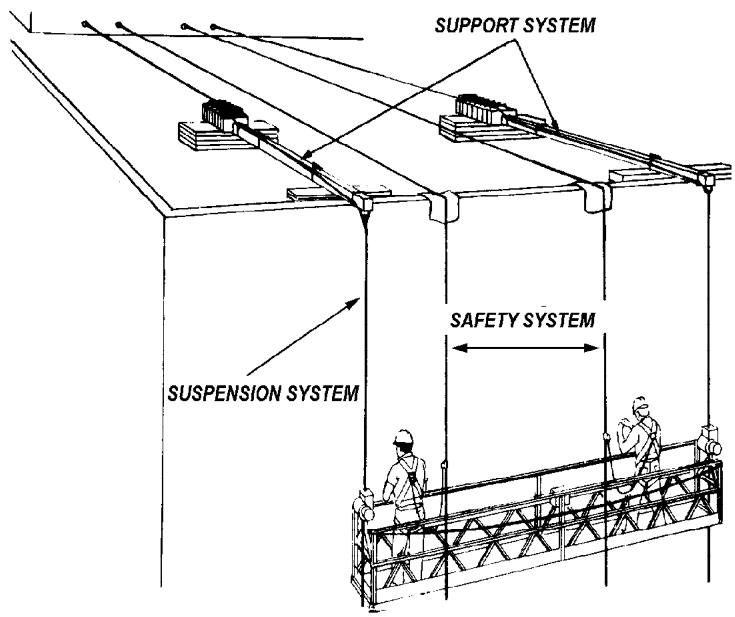
Before you can use any equipment, you have to know what it is and what it does. The equipment used with swing stages can be divided in several ways such as how it works, what it does, where it goes, and how it is used.

The use of swing stage equipment requires three systems to work together. These systems provide a safe and reliable place from which to work,

The three systems described here are the **support, suspended and safety** systems (Fig. 1-1).

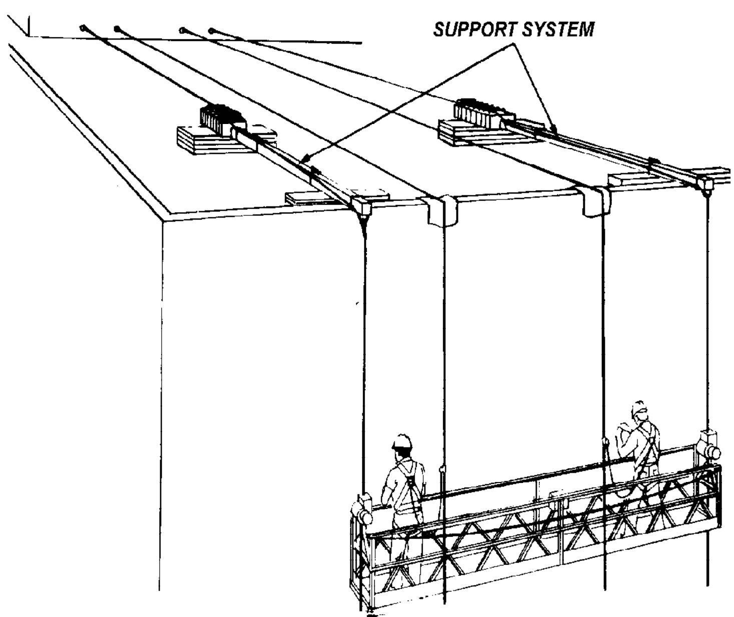
The three basic systems in a suspended scaffold system are, the Support System **(which holds),** the Suspended System **(which hangs),** and the Safety System **(which protects).**

The Support System holds the suspended equipment (Fig. 1-2). The Support System may include outriggers and weights, a roofcar, or other holding equipment. It always includes



THREE BASIC SYSTEMS

FIG. 1-1



SUPPORT SYSTEM

FIG. 1-2

the rope anchor, and relies on the strength of the building, structure, or tower. The support system is what keeps the swing stage equipment from falling.

The Suspended System is everything which hangs from the Support System (Fig. 1-3). It is the stage or platform, the wire rope, electrical cords, tools, equipment, material and the hoists. Most importantly, the Suspended System includes **YOU**.

The Safety System is also called the **Personal Protective or Fall Arrest System.** (Fig. 1-4). Its main duty is to protect you. It is your last line of defense against mistakes. The basic parts of the Safety System are your lifeline anchorage, your lifeline, your shock absorber, your rope grab, and your body harness. **Body harness** is the term used to describe the harness that holds your body in a fall.

Later, we will discuss the types of equipment which make up these systems, and the way they perform their tasks. Now, we will look at different types pertaining to each system.

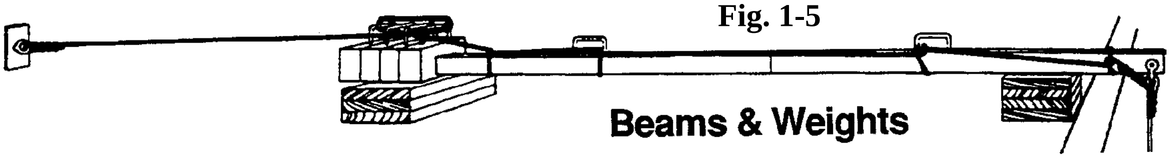
3.0 Support Systems

Standard Outrigger (Fig. 1-5), consists of:

- a **beam** which lets the rope anchor be placed out over the edge of a roof.
- a **fulcrum** on which to rest the beam.
- a **counterweight** to keep the beam from tipping.
- a **tieback cable** to keep the beam on the roof.
- an **anchor** to hold the tieback.

When you connect the wire rope from your hoist to the rope anchor at the end of the beam, you connect it to the part sticking out beyond the fulcrum; the part known as the **outreach or overhang.** When you load the rope, the rope pulls down and tries to pull the beam over. If it succeeds, you may fall.

Fig. 1-5



Another support system is a Socket and Davit (Fig. 1-6). The socket is a special tube permanently attached to the roof. This will be engineered and designed for the roof structure. An arm called a **davit** fits the socket and also reaches over the edge of the roof. In the socket and davit support system, the bottom of the davit arm fits into (or over) the socket. The wire rope from the hoist is connected to the anchor at the end of the davit arm. Where the arm reaches out beyond the socket, this part of the arm is (again) the outreach. When you load the wire rope, it tries to pull the davit over the edge by twisting the socket. The socket

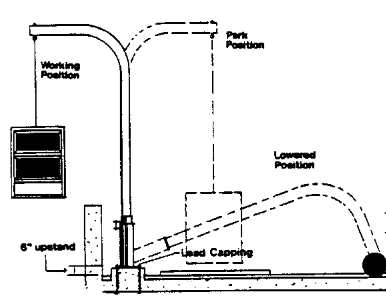
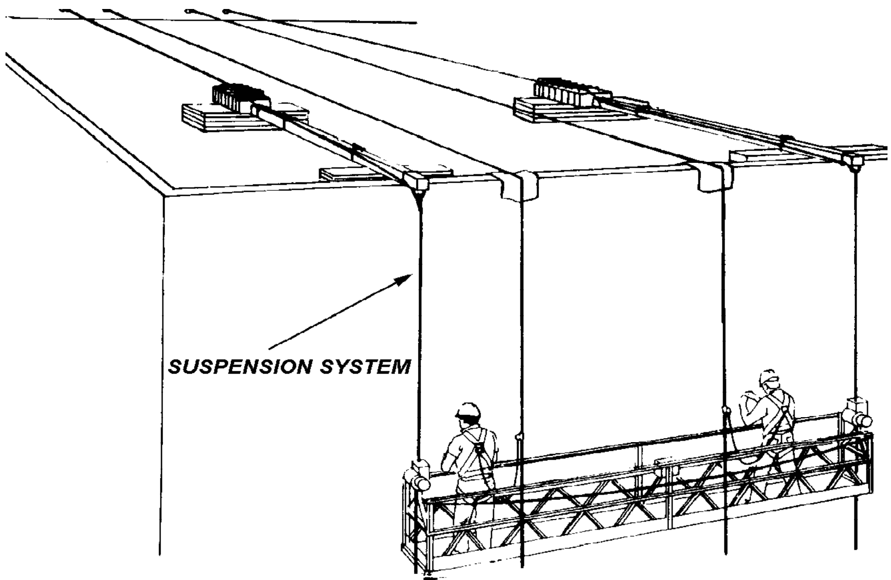
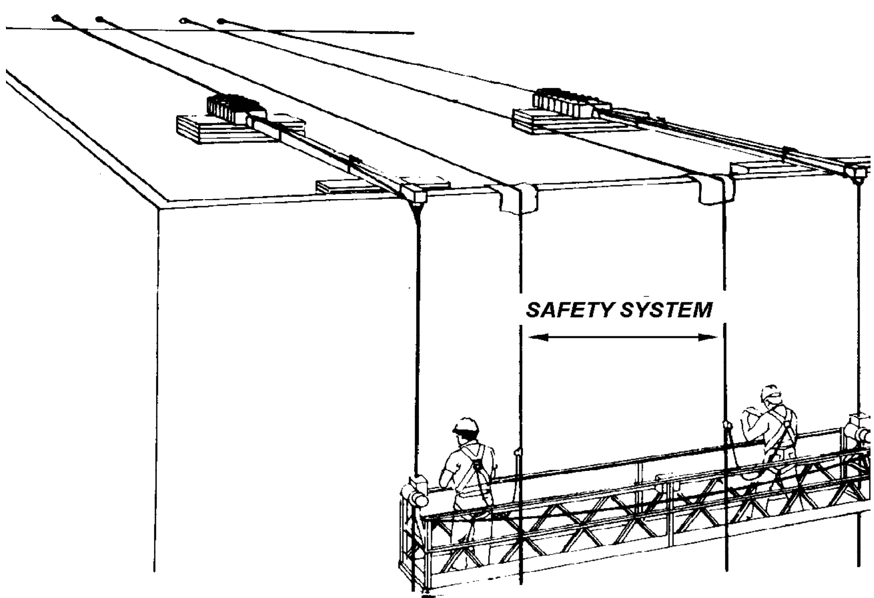


Fig. 1-6



SUSPENSION SYSTEM

FIG. 1-3



SAFETY SYSTEM

FIG. 1-4

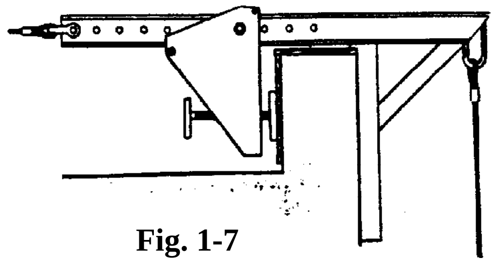


Fig. 1-7

anchors hold the load by transferring it to the structure instead. If you don't have your davit or your socket installed correctly, **you may fall**.

There are other types of roof edge support systems. These include parapet clamps, C-clamps, roof hooks, cornice hooks, all manufactured to provide support for the specific design of the roof edge. The building structure must be strong enough to take the load on the parapet, cornice, or roof edge. See Figs. 1-7 and 1-8. Riggers must ensure that the building edge has the strength necessary before using any of these methods. Any of these devices for support, all require that they be installed with a tie-back.

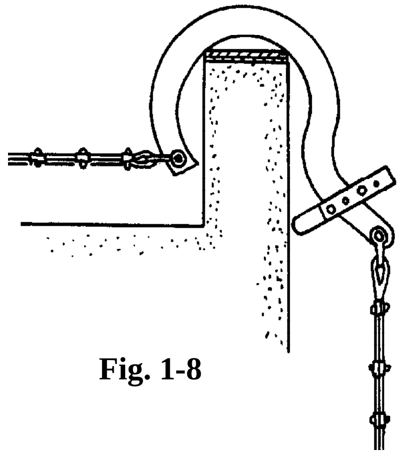


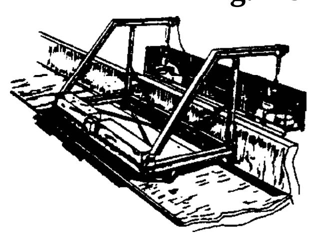
Fig. 1-8

A **Cornice Hook** (Fig. 1-8) is another support device. It is designed to take the load on the tip of the hook. It is often used on sloping roofs without a parapet. Its fulcrum is similar to a roof hook.

Still another support system is the **Carriage System** (Fig. 1-9). The carriage is a wheeled-support system, which allows the suspended equipment to be supported and moved. Carriages, which run on the roof surface (often called rolling rigs or roofcars), have outreach arms with anchors for attaching the wire rope. Some roof carriages have counterweight built into the carriage. Others have tie-down cables, which connect to roof anchors. (Tie-down anchors are used because the carriage would otherwise need extra counterweight.) Many of these units could be permanent installations, which are discussed separately in Chapter 6 of this manual.

A special kind of carriage is a **Trolley Carriage**, which is a wheeled support system that runs on an overhead track. The overhead track holds the trolley, and the trolley in turn holds the wire rope. These units don't have an arm reach.

Fig. 1-9



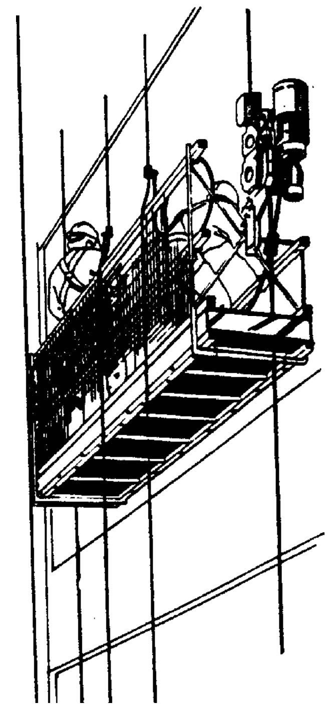
In carriage-support systems, engineers determine the allowed load and test the carriage before it is used. If you exceed the allowed load, you may fall.

Let's look now at some types of suspended systems.

4.0 Suspended Systems

The most widely used suspended system is the two-point powered suspended scaffold (Fig. 1-10). It is called "two-point" because the system is suspended by two wire ropes and two support systems. It is called "powered" because the system uses hoists usually powered by electricity. Two-point suspended scaffolds are also called suspended work platforms, power platforms, and swing stages.

Fig. 1-10



The two-point suspended scaffold has many parts. The work platform deck is the work surface. Guardrails consist of:

- top rail
- mid rail
- toeboard
- uprights

The guardrails are to keep workers from falling off the platform. Toeboards are designed to keep tools and equipment from falling. **Tie-ins** hold the platform to the workface, hold the deck steady while working, keep the workface from tipping the deck, and may help close an open side of a deck.

Rollers and bumpers help keep the platform from damaging the structure and guide the platform when moving.

The work platform is raised and lowered with machines called hoists. Each hoist is connected to the deck by a metal component called a **stirrup** or hanger. The **wire rope** is attached to the support system rope anchor above with a shackle which holds the hoist. Some types of hoists may use **wire winders** to collect the excess wire rope, which hangs below the hoist, or the rope may hang below the deck as a **tail line.** Some hoists have round **drums** to lift the suspended scaffold while gathering the wire rope. Powered hoists get their power from electrical cables or pneumatic hoses which may hang from above or be lifted from below, or both.

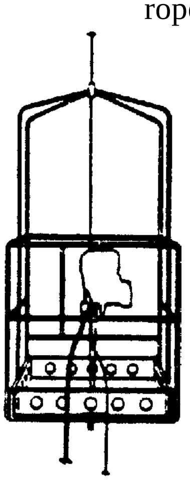


Fig. 1-11

A widely used suspended system is the **single-point suspended scaffold** (Fig. 1-11), also known as a work basket or work cage. It has nearly all the features of the two-point suspended scaffold, but uses only one hoist and one loaded wire rope. Some have second ropes fitted with auxiliary brakes, which act independently of the main hoist and rope.

Another common single-point suspended system is the **Bosun's Chair** (Fig. 1-12). This suspended system has a rope for support, a **chair** or seat for the worker, a hoist or **rope-fall,** and it may be equipped with fairlead, a wire rope guide, bumpers, tie-ins, and power cables. Many of these also have second ropes fitted with independent auxiliary brakes.

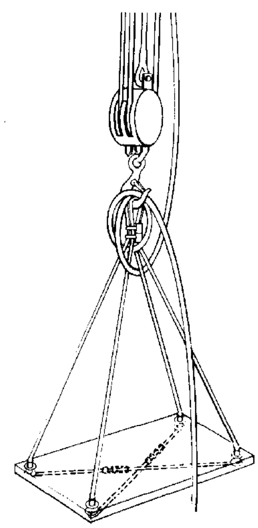


Fig. 1-12

5.0 Safety Systems

The Safety System or Personal Protective System used in suspended work is strictly regulated by legislation codes and standards, such as OSHA, ANSI and CSA.

The Safety System that limits your fall in suspended scaffold work is called the **fall-arrest system.** Although fall-arrest systems are quite simple, only certain types are permitted.

The most widely used fall-arrest system is the **independent hanging lifeline** system (Fig. 1-4). The **lifeline** is the rope that connects your personal fall equipment to the lifeline anchor above. It takes the load when you fall and it absorbs some of the shock of the fall. The **lifeline anchor** holds the upper or tensioned end of your lifeline and by law, the anchor has to be strong.

Since the platform holding the worker moves up and down but the hanging lifeline doesn't, a rope **grab** is used to slide up and down the lifeline with you. A **lanyard** is a short piece of rope or webbing that can be formed into a shock absorber, that lets you move along the platform. The lanyard is hooked to you at the connector on your **body harness.** Your body harness holds your body in a fall.

A slightly different fall-arrest system uses a wire rope lifeline, or **trolley line,** connected to the platform (Fig. 1-13). It is usually an engineered system; this type is also regulated.

In the trolley-line system, a second wire rope with an auxiliary brake is added to each end of the platform in order to keep the platform from falling when the primary wire rope or its support fails. Your body belt or harness is attached to a special short shock absorbing lanyard, which is in turn connected to a specially engineered horizontal lifeline on the work platform.

When using some platforms that are equipped with roof-mounted hoists and four-loaded wire ropes, the lanyard may be connected directly to the work platform, rather than to an independent lifeline.

Other personal safety equipment used in suspended scaffold work includes such items as hardhats, dust respirators, safety boots, and safety glasses.

We are now familiar with the basics of the three systems necessary to suspend work platforms:

- Support Systems
- Suspended Systems
- Safety Systems

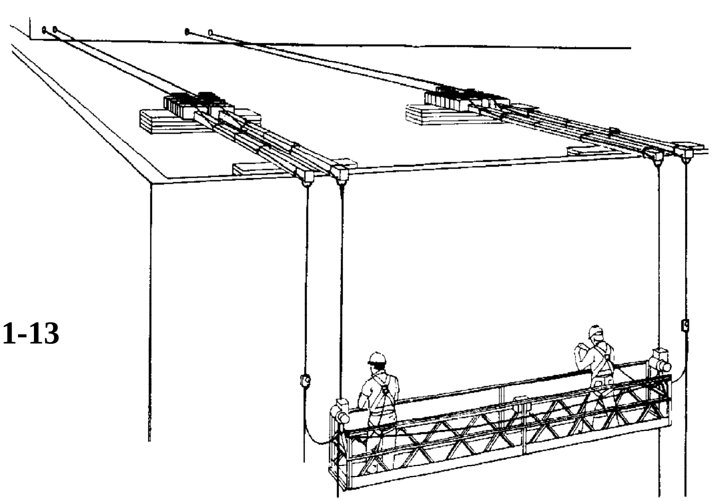


Fig. 1-13

CHAPTER 2

POWER
BALANCE
&
GRAVITY

Contents

Chapter 2: Power, Balance, And Gravity: Their Relationship To Suspended Scaffold Work

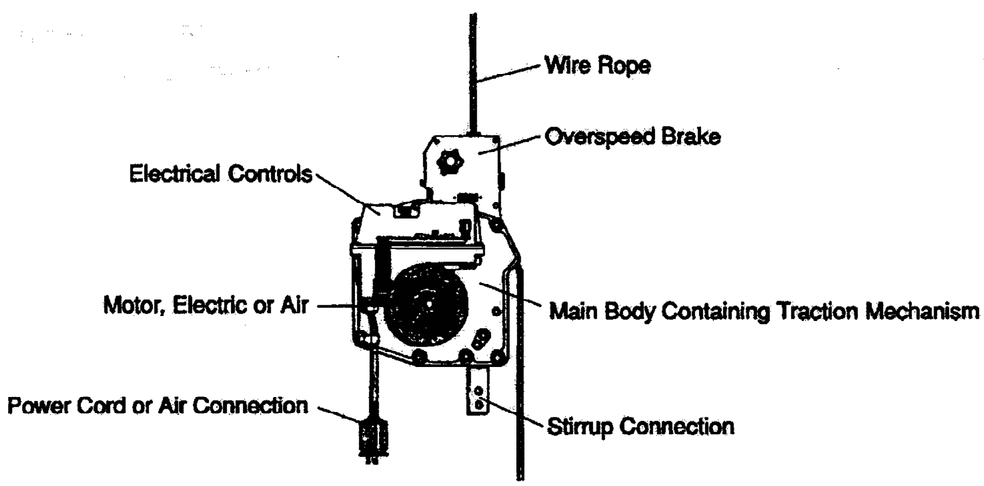
Before we go any further into suspended work platform setups, we need to explain some technical terms, concepts and principles.

Definitions of the words used by technical people may be different from the definitions we use in everyday language.

In this section we learn the technical meaning of words common to suspended scaffold work. Many times you will see the term “Swing Stage” used interchangeably with “Suspended Scaffold.” They are the same type of equipment we use.

1.0 Motors And Rotating Mechanical Concepts Electric Motors

Fig. 2-1



1.1 Electrical Motors

The hoists on many suspended scaffold systems use the amps and volts of electric motors, or the pressure and flow of air in air motors, to make the rpm (revolutions per minute) and torque to make rotating mechanical horsepower (Fig. 2-1).

A force turning a shaft is called torque (Fig. 2-2). If a force or push trying to turn the shaft is moved farther away from the center of the shaft, the torque increases. If the same force is moved closer to the center of the shaft, the torque decreases. It’s like leverage. A long bar has better leverage than a short bar.

An electric motor converts the pressure of volts and the flow of amps into the revolutions of the motor shaft, measured in revolutions per minute.

Every motor has a **horsepower rating** which indicates how much power you can get from the motor without damage.

You can get more torque and less rpm from the same horsepower if you have the right motor.

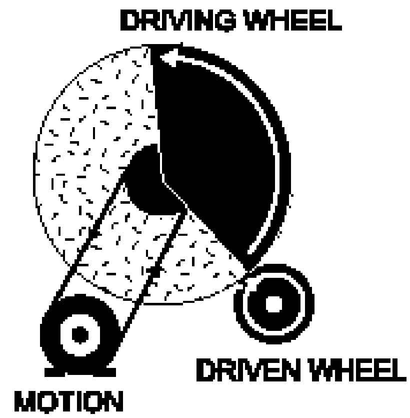


Fig. 2-2

1.2 Fluid Power Motors

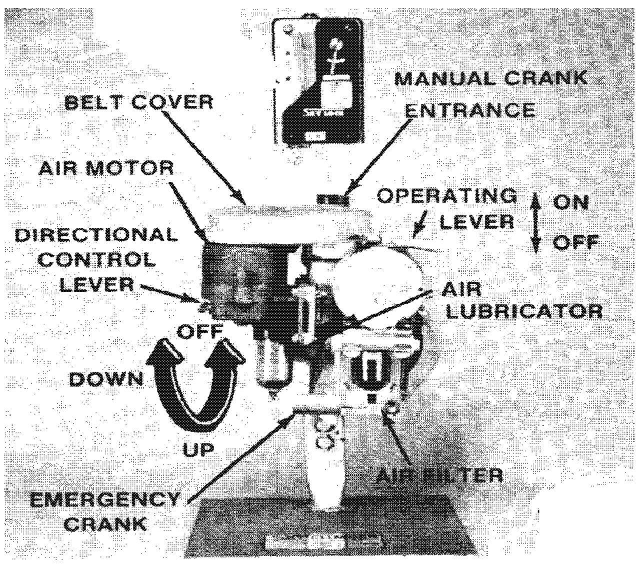


Fig. 2-3

In addition to electrical motors, there are both pneumatic (air driven) and hydraulic motors to hoist platforms (Fig. 2-3). Each of these can be considered in applications where there is a lack of electrical power or a risk of explosion (that could be triggered by electrical motors). Each of these units converts the pressure of air or oil into flow that causes movement of the motor shaft. The rpm's are higher than those of electrical motors.

1.3 Exchanging RPM for Torque

Exchanging RPM for Torque

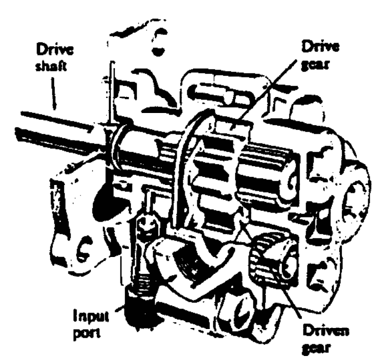


Fig. 2-4

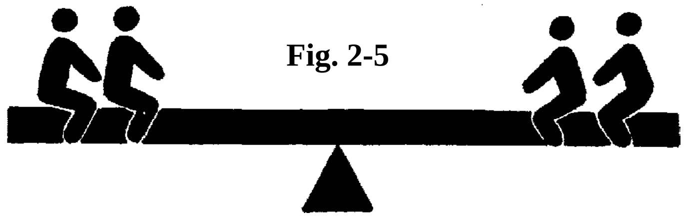
Most hoists use a transmission to exchange rpm for torque. Because hoist drums need to turn slowly, the rpm of the motor is slowed while the torque is raised. The higher the rpm, the lower the torque, the lower the rpm, the higher the torque. This is done by using a set of reducing gears called the **transmission.** The transmission turns the hoist drum slowly, but with great torque (Fig. 2-4) . The horsepower has been changed from the high rpm and low torque of the motor to the low rpm and high torque of the drum. Some torque is lost doing this.

Balance And Moments

The concept of moment is important in suspended scaffold work**. Moment is force acting at a distance**. In order to understand moments, we need to look at a special moment situation known as **balance** (Fig. 2-5).

The teeter-totter demonstrates balance**.** If the children weigh the same, and they are the same distance from the fulcrum, they are balanced. Technically, the moment from one child equals the moment from the other child.

Fig. 2-5



When one child moves toward the fulcrum the teeter-totter tips. This child goes up, and the child who did not move goes down. The forces from the weight of the children were the same. However the distance between one child and the fulcrum changed and that change caused the plank to tip. The distance from the fulcrum to the child AND the force of the child's weight determine the moment. A heavier child will be closer to the fulcrum than a lighter child on the other side of the balance (Fig. 2-6).

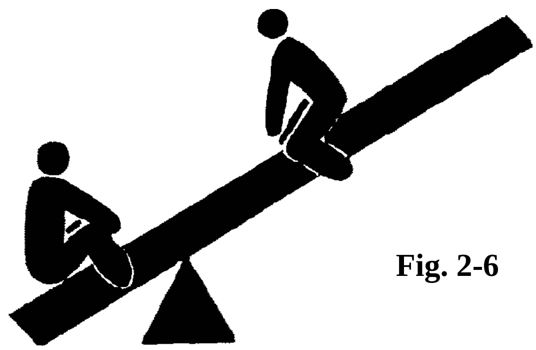


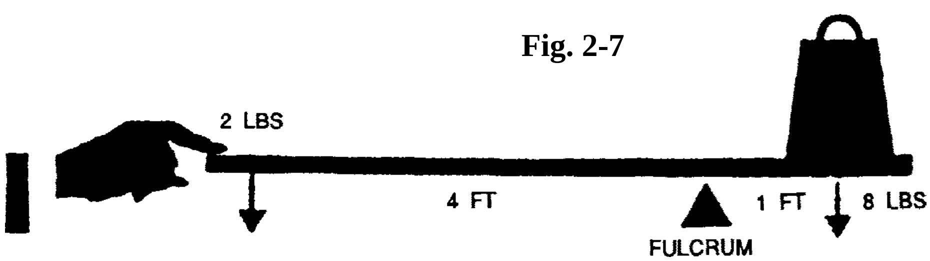
Fig. 2-6

Engineers multiply the distance to the fulcrum times the force, to get a number that is called the moment. **Moment is force multiplied by distance**. (Ft-lbs.)

If you multiply the distances times the force on one side, and you find the distance times the force on the other side is the same number, then the system is balanced. The same moment exists.

Remember that force has direction, so for balance to occur the moment on one side of the fulcrum must be opposite and equal to the moment on the other side. The moments are trying to tip the beam in opposite directions (Fig. 2-7).

Fig. 2-7



A beam already balanced will still be balanced even when you raise the force, if you also shorten the distance so the MOMENT NUMBER STAYS THE SAME. This means that **balance** can be made with different forces if the distance is changed to make the moments remain the same. If you only add load on the end of a beam, the moment (balance number) will change, and the beam will become unbalanced and move.

When one child on a teeter-totter is heavier, his end moves down until it is on the ground (Fig. 2-6). The heavier child will sit there until the other child moves out far enough to make his moment bigger than the heavier child's moment, or he/she will have to get more kids on their end to lift the heavier child. The heavier child won't move until the moments first balance.

If they don't have quite enough weight and can't get more kids to balance, they can get them to jump on the end of the beam. He/she can get dynamic force by having the kids jump because they suddenly stop when they hit the beam, adding force to get the beam moving. A suddenly stopping weight has more force than a moving or still weight. (That's why you check your rigging by raising **and then lowering** the platform — to use the stopping of the loaded deck to add dynamic force.)

If the heavier child stands up, he/she transfers some of his/her weight off the beam to the ground, and the other end of the beam will move down. This shows that the child's weight must be on the beam to count in the moment. (In suspended scaffold rigging counterweights have to be correctly and completely attached to the beam to be effective as counterweights.)

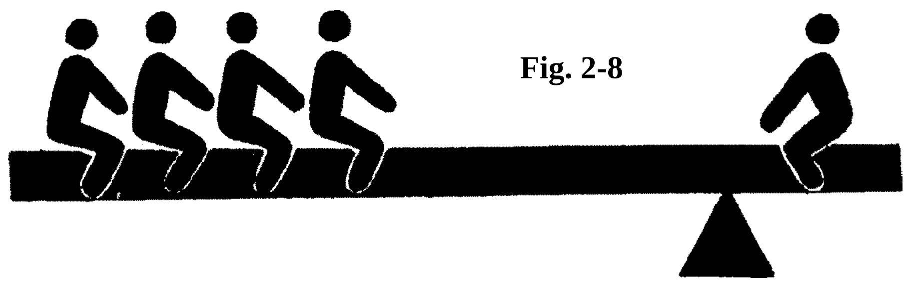


Fig. 2-8

Suppose one child is at one end of the beam with four children at the other end of the beam and all kids weigh the same. If the distance to fulcrum points is the same for one child as for the other kids, then the other children's moment is four times the single moment. There is a four-to-one ratio of the moment (Fig. 2-8). This ratio is the minimum permitted for rigging the support. It is often called the safety factor. Rather than balance we want four times the resistance to overturning. We want to make sure that the outrigger beam NEVER tips.

The key to the stability of outrigger beams is checking the distances and forces relative to the fulcrum or pivot point of the beam. It is just like the kids on the teeter-totter.

1.4 Torque and Moment

In discussing motors earlier, we talked about torque. Torque is the same concept as moment. Both are forces acting at a distance from a fulcrum or shaft. The force multiplied by the distance from the center of the shaft is called torque, while the force multiplied by the distance from the fulcrum point is called the moment.

One final word of caution regarding both moment and torque concerns the **direction of force.** The force direction has to be "around" the fulcrum point, in order to count the force fully. You know you have to pull a socket wrench handle so you rotate the socket, because you can't tighten a nut by pulling up or down on the wrench socket. That's just wasted effort. If you pull the socket handle across the socket, you don't turn the nut either. You must do it right. The force counted for torque or moment is only that part of the force which acts to turn the shaft or rotate the beam on the fulcrum, and not that part which tries to bend the shaft or slide the load.

1.5 Stress

Stress is a measure of the distribution of the force and moment inside a shape. Engineers determine the load rating of the beam. They check that it will safely support the load without bending or weakening and have the required safety factor.

A beam sees differing loads and moments. Moment and load cause stress. The greater the load, the greater the stress and the lower the safety factor (Fig. 2-6). At some point the loads and moments exceed the strength and the beam fails. This can happen if you overload the beam or extend the overhang too far. This increases the stresses on the beam. The **load rating is the maximum safe load** that can be put on the beam.

The safety factor is determined from investigation of loads and material. The lower safety factors are applied to carefully manufactured and tested products used in very controlled applications where the loads are known. The highest safety factors are used with equipment which might be selected and give momentary forces much greater than the operating load and with materials that can rust or weaken with time, especially with products that can injure or kill people if worn or weakened. A suspension beam or parapet clamp certainly is a product that needs a higher safety factor than a pipe hanger.

A platform moving up and encountering an obstruction or moving down and stopping, adds load to the support.

1.6 Mechanical Review

You should now review the important terms used when talking about parts of suspended work platform setups. These terms are

1. **Force** A push in a direction, measured in pounds or newtons.
2. **Work** Force used for a distance, measured in pounds/feet or joules.
3. **Power** Work used per unit time, measured in hp (lbs/ft/min or watts).
4. **Moment** Force acting at a distance from a fulcrum, measured in foot/lbs. or kg/m.
5. **Torque** Force acting at a distance from a shaft, measured in ft/lbs. or kg/meters.
6. **Stress** Distribution of force and moment in a shape measured in psi or Pascals.
7. **Strength** Capacity of a material measured in psi or Pascals.
8. **Safety Factor** Ratio of strength to stress.
9. **Balance** When two moments acting in opposite direction are equal.

2.0 Electrical Concepts

Many hoists use electricity to power their motors. Different hoists and hoist models may have different electrical needs. You must know something about electricity to properly set up your equipment. In this part, we will learn about some common electrical principles.

2.1 The Basics

Electricity is all around us and in us. When you walk across a carpet and get a shock, you have "made" electricity. What you did was to gather enough of one of the two kinds of electrical charge on your body to cause a spark. Charge is a group of positive, or a group of negative particles, gathered together.

The more particles, the greater the charge (Fig. 2-9).

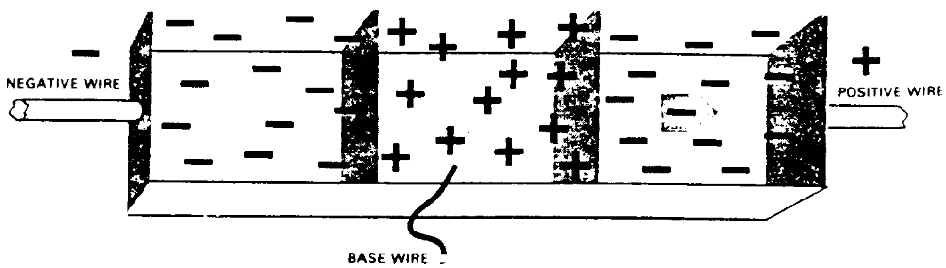
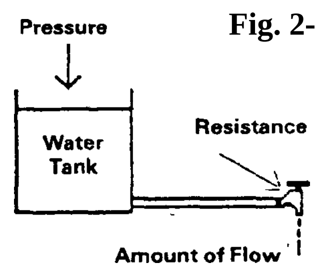


Fig. 2-9

Voltage flowing is much like a water tank (Fig. 2-10). If you don't have enough water in the tank to give you enough pressure (or if you don't have enough voltage to start), you won't have enough gallons per minute, (or as the current passes down the line there will be **line drop** and with the resistance in the line there will not be enough pressure [voltage] where you need it). In electrical, as the voltage flows it is called **current** and is measured in charge units per minute, or **amps**.

Fig. 2-10



When water flows in a pipe, the dragging of the water along the walls inside the pipe causes resistance. The "dragging" of the charge in a wire or appliance is called **resistance.** Resistance is measured in **ohms.**

Voltage, current, and resistance are related. If you raise the water pressure in a pipe, flow increases. If you raise the voltage in a fixed resistance, amperage (and current) increases. The same holds true for air: if you raise the air pressure the airflow increases. One of the biggest electrical problems with suspended scaffolding is the resistance we have in long power cords. As resistance increases, voltage drops. As the voltage drops, lift capacity drops.

2.2 Types Of Electricity

Electricity can be generated at the power plant – with one kind of charge, called **direct current** or DC, or with two kinds of charges, called **alternating current** or AC. Since it is easier to make, and more efficient, we have AC at our outlets.

AC electricity changes from positive charge to negative charge at the same speed as the turbines in the plant spin. It is a standard in the U.S. and Canada at 120 times a second, so therefore, we get a positive charge every 1/60 of a second. That is why it is called 60-cycle power.

2.3 Power From The Power Plant

Electric motor horsepower is voltage and amperage combined. Raise voltage and you raise power. Raise amperage and you raise power. The fact that amperage and voltage make power has let the plant solve one of its big problems in a very smart way.

The power companies have to deliver a huge amount of power to the cities, using wires. Amps make wires hot, and more amperage would mean larger wires. It would require huge wires to deliver power to the cities on low voltage and high amperage, so the power companies do the smart thing and use small wires to carry low amperage at high voltage. This compares to using a tiny flow of water at huge pressure. It can deliver a lot of power easily.

Unfortunately, high voltage is dangerous to humans, and a drill with enough protective insulation to safely use power-plant voltages would weigh a ton. **Transformers** change high voltage and low amperage into standard lower voltages at higher amperage, in order to power hoists, drills, and other tools.

Sometimes a machine needs more power than is practical to deliver using common household voltage (large wires again). The answer is to use a transformer that doesn't change the power-plant volts and amps quite as much. This is why many factories and buildings power their motors with 230 volts or 460 volts instead of 120 volts. Power delivered at higher voltage doesn't require large wires. A 110-volt hoist needs twice the power as a 220-volt hoist to lift the same load at the same speed.

When Power Company provides 120-volt residential power, it sends three AC wires to your house instead of two (Fig. 2-11). Two of the wires always have opposite charges; that is,

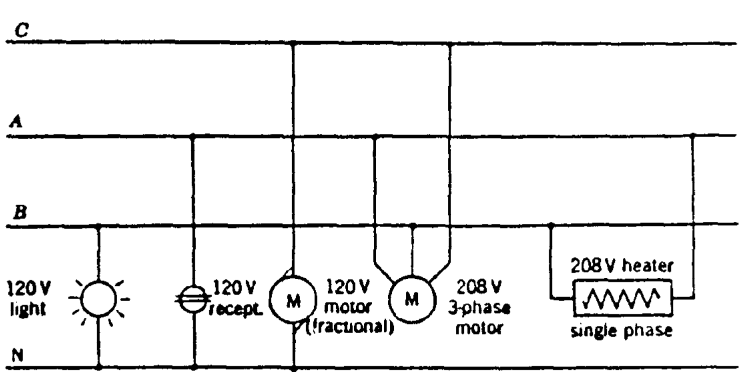


Fig. 2-11

when one has positive charges, the other has negative charges. These two wires provide you with 240-volt power for your big appliances, keeping the transformer on the pole nearly balanced in charges, and keeping the plant load balanced. The 240-volt power delivers power, using both “hot” wires.

The third wire is called neutral. When you want 120-volt power, the neutral returns the flow of charge, leaving the motor to the transformer and power plant.

Why 120 volts at all? First, you require a standard so the appliances will work. The transformer is made to allow the wall outlet to provide only 120 volts, but more power can be had by taking more amps.

Secondly, it was once believed that 120 volts weren’t high enough to burn through skin. We now know that both 120 and 240-volt power can kill you.

2.4 Three-Phase Power

The power plants also provide a type of power called three-phase power. As long as the turbine is spinning, why not have three coils making power rather than two? The power plant can put power on all three wires it sends to the transformer, and not use a neutral, which was only for returning charges, anyway. Then the transformer-to-house line is the only one that needs a neutral. Using three-phase power is more efficient (Fig. 2-11).

In three-phase power, the charges are not opposite as they are in the 240 volts house power. The charges are staggered. It is cheaper to send from the plant, and motors run more efficiently on three-phase power, too.

Many permanent suspended work platform installations use three-phase power. The advantages of three-phase power are: the motor is smaller and lighter for the same capacity and speed, there are no capacitors in the control box, there is no centrifugal switch, and the power required is less so the cord can be smaller and the motor runs cooler.

Now that you know something about electricity, let us look at some ways in which the power is used and controlled.

2.5 Safety Devices

The power plant requires that the building connect one of the incoming wires (the neutral wire) to ground. This keeps the power plant and the transformers from burning up from stray charges. The charges in the other wires (the “hot” wires) try desperately to get to neutral. If they get close, they go to it at all costs.

2.6 Fuses Stop Runaway Charges In A Short Circuit!

When we use electrical power, we force the charges to flow through our motors and heating elements. We control the amount of power we use by selecting the resistance the voltage encounters. This limits the amps of current.

If the charges in the hot wires can get to the neutral by taking a path of less resistance, they will. If the charges get loose and reach ground, they go straight to neutral at a fierce rate, heating up wires. This is called a short circuit. **A short circuit** is a runaway amount of charge. Fuses do not add current – they stop it (Fig. 2-12).

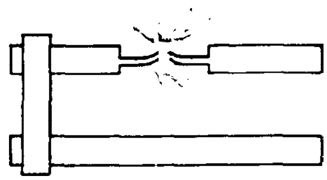


Fig. 2-12

Electricians guard against short circuits by using **fuses** in the hot wire or wires to break open the wire in the box, raising the resistance so high that no charges will flow. The fuse protects against short circuits. (A device called a circuit breaker is often used as a fuse.) A fuse melts and is replaced; a circuit breaker can be reset.

2.7 Thermal Overload Protectors

If you try to reduce the resistance of a tool, or increase the amp draw by overloading a motor, the wires feeding the motor or tool will get hotter than is safe. The heat will eventually melt the insulation protecting the operator, cause a fire, or cause a short circuit. (Raising the current three times creates nine times the heat in the wire.)

To protect the wires and motors from overheating, the current (flow of charges) in the wires must be limited (Fig. 2-13). Sometimes this is done with special fuses, and sometimes it is done with special devices which fit inside the motors and shut off the motors when they get too hot.

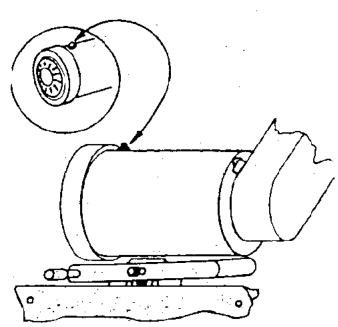


Fig. 2-13

They either automatically reset when the motor has cooled or are manually reset after cooling. They tell you that the power is too low or the hoist is overloaded. Corrective action is needed.

These thermal protectors are sometimes called “heaters” or bimetal protectors. “Heaters” protect against slow overloading and overheating of the wires, but they do not protect against sudden short circuits. They also do not protect against connecting the hoist motor to the wrong voltage, which will cause damage.

2.8 Grounds

The charges in the hot wires try to get to the neutral wire, or to another hot wire having an opposite charge (Fig. 2-14 three phase wire). They will travel through any path to get there. People can be that path. However, wires carry charges much better than people do, so we try to give the charges a choice of paths just in case the charges get free.

We give the loose charges an easy path back to neutral through a ground. A **ground** is a special wire path for current, which is an easier path for the current than going through people. Every suspended work platform has to have a ground in the electrical supply cord. The ground continues through the yoke to the hoist motor.

The way in which the ground works is quite simple. The charges in the hot wires become loose, sometimes by a wire being pulled out and touching the deck, or by a wire coming loose in the motor, or by any number of other ways. The loose charges look for the path of least resistance.

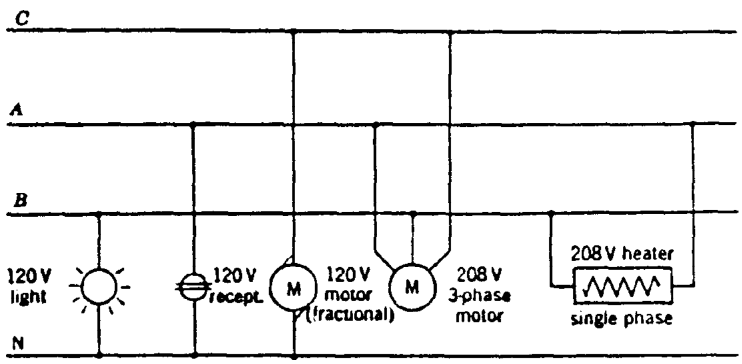


Fig. 2-14

If your hand is on the hoist frame and the hot wire touches the hoist frame, you are part of the path the charges take back to ground. If the charges see you as the path of least or equal resistance, most of them go through and electrocute you. If the frame of the hoist is grounded, the charges would much rather try to go through the metal wires than through you, so **most** of the charge goes through the ground wire. You still get some charge, and it may still be enough to injure you, but at least most of it goes "to ground" through the ground wire. To protect you, equipment is to be grounded and the grounds must be kept intact.

2.9 GFCI

Ground Fault Circuit Interrupters (GFCI) are devices for protecting a person using an outlet in places where the person may be between a "hot" wire and ground. The GFCI measures the charge leaving the "hot" wire, and the charge coming back into the neutral wire. The GFCI compares the two, and if they aren't the same, it decides that some of the charge is going some place it's not supposed to be going, and the GFCI shuts off the outlet current (Fig. 2-15).

GFCI's measure the lost charges in milliamps (MA). As little as 60 MA can kill you. 8-10 MA can cause you to freeze on the line. GFCI's shut down at 4-6 MA. The GFCI's have test and reset buttons to confirm proper operation. They are mandatory for use in many States for power tools that use 15 or 20 amp 110-volt power.

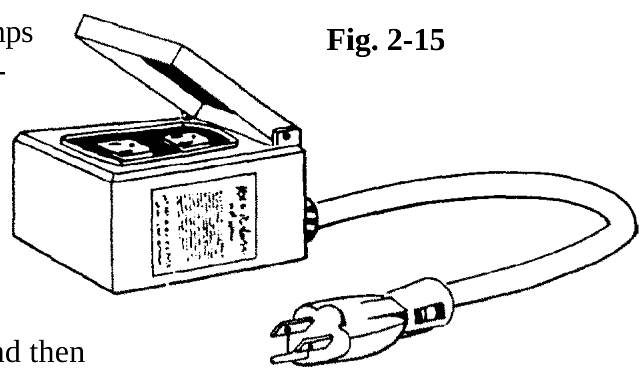


Fig. 2-15

Since all wires "leak" charge to the air and then to ground, the GFCI must keep the outlet on until a set amount of charge is lost. The kind of GFCI's that can protect most people "trip" at very low levels. There are other GFCI's made to protect equipment, and they trip at levels fatal to humans. These other kinds of GFCI's are often used when equipment is fed by long cables. Just because an outlet says it is GFCI protected doesn't mean that the GFCI will protect you.

2.10 Three-phase Special Protection

Three-phase motors may need special protection called phase-error protection. If you plug a three-phase hoist into a three-phase outlet, the hoist will run. However, if the wires are not connected in the right sequence in the outlet, the hoist will go up when you push the "down" button, and vice-versa. This may seem to be only an annoyance, but it can be serious.

Some three-phase hoists have control wiring or limit switches that can cause malfunction and create a hazard. For example if you push "down" and the hoist goes up and it has an overload or upper limit switch, it will go up with an overload and not stop when the upper limit switch is hit. If you push "up" and the hoist goes down and the hoist has a slack wire limit switch, the hoist will not stop going down when slack wire occurs. Always have phase error protection when using three-phase power. This will prevent reverse control.

If only two of the three phases are fed to the motor, the wires inside the motor which connect each of the two active phases to the missing phase become very hot rapidly. The missing or lower-voltage phase is called the "wild leg," and it can be dangerous. The heat can melt the motor core while your hand is on the hoist-mounted control. Use a phase-error detector that has a phase-loss feature, for all-around protection in three-phase hoist work.

2.11 Low Voltage At Suspended Scaffold Motors

A common problem facing the swing stage platform operator is low operating voltage at the hoist. Low voltage makes the hoist work hard with a normal load and the motor runs hot.

One reason the hoist has a low voltage problem because it takes whatever power it needs. When the voltage at the motor is low, the motor tries to "make-up" the power by pulling more amps. Amps = heat.

Problem One:

The motor substituting amps for volts is trying to run the platform hoist with low voltage. The hoist is trying to lift a hanging load from a dead stop, so it also needs extra torque to start.

Problem Two:

The electric motor is very inefficient at the instant it starts to lift, so it draws (uses current) six to ten times the amps it needs when it is running steady. The motor draws a lot more amps due to inefficient motor starting.

Problem Three:

The power supply outlet for the suspended work platform is usually on the roof, at the end of the long building electrical line. There probably is other equipment on the same circuit drawing power. This lowers the voltage available to the platform so more amps are taken again for the same power.

Problem Four:

The gears in the hoist transmission are sitting still when the hoist is started so the gears don't have oil between them yet. More friction means even more power is needed.

Problem Five:

The suspended work platform hoist is usually fed by a very long cord from the marginal roof outlet mentioned in Problem Four. Long cords have more resistance than short cords. Resistance means loss of voltage, which means more amps taken, which means more amps are needed.

Problem Six and Seven:

Many buildings only have 120-volt single phase roof outlets. 120-volt single-phase power means high amperage. Generally inefficient single-phase hoists are used, not three phase. Single phase means more amps and more heat.

Problem Eight:

The power plant lowers the voltage 3% or 5% or 8% when demand approaches the capacity of the power plant, because that's the way the turbines must be built. This happens typically on hot summer days when everyone is using air conditioners. The high consumption causes "brownout" making the hoist motor draw even more amps.

Problem Nine:

One last problem – the amps and volts don't always "line-up" when they reach the motor. Transformers can cause volts and amps to be "staggered" just a little, so you have less real power than if the volts and amps were in "line." The result is hot motors struggling to start or lift a load, and annoying trip-outs.

What can you do about it? First, reduce the load during hot days when the Power Company has heavy demands. Less platform load is less power needed. Second, use a heavy gauge cord in good condition with plugs that are in good condition. Use the shortest possible cord for the job. An extra 200 feet of power cord coiled on the roof does no good; it only makes things worse. If possible, come from the middle of the drop with a cord to reduce the length needed.

Look for the closest power supply and best circuit. A heavy gauge and shorter cord has less resistance and gives more voltage to the motor. Third, use a transformer booster to increase low voltage to the required load. Size the booster transformer properly. Keep in mind you are trying to start two hoists at once on a typical platform. Consider 2 to 3 Kva with a 15% boost. A small booster transformer may not provide enough amps to start two hoists with a load. Underpowering a hoist by providing low voltage is one of the main reasons for service calls from a jobsite.

It is important to note that measuring voltage at the end of a power cord doesn't tell you much other than 110 or 220 volts available. Voltage drop is measured with hoists running under a load.

Select the cord by the gauge. A heavy gauge has a small gauge number and less resistance. A #8 gauge wire has less resistance than a #10 gauge wire. Don't select your cord based on its amp rating, because a cord's amp rating simply indicates the amps allowed in the cord based on the heat rating of the insulation. Using a cord based on this rating allows too much voltage drop and can cause hoist problems.

3.0 Fluid Power

3.1 Air Power

There are occasions when electrical hoists are not wanted or compressed air is easier to find. Painters and industrial areas often use air hoists. The advantages of air power are high torque and power per pound, hazardous environment use, variable speed, and the ability to use hoists at a remote location by using a portable compressor (Fig. 2-16).

> **NEVER OPERATE BEFORE**
> **USING THE CHECK LIST**
> **IN OPERATING MANUAL!**
>
> **MAX. SAFE AIR PRESSURE 125 PSI**
> **MIN. OPERATING AIR PRESSURE - 80 PSI**

Fig. 2-16

3.2 Air Motors.

Usually a vane motor is used which is designed like a paddle wheel. A pressure increase causes the torque to increase. The greater the number of vanes reduces blow-by (internal leakage) and gives better starting torque. An exhaust restriction prevents over-speed of the shaft (Fig. 2-17).

Compressed air contains water and you should consider the compressor as a water pump. Water will cause rust and malfunction. Water can freeze when exhausted from an air motor even at 70F (21C) degrees on a normal day. Therefore precautions are necessary for air supply. Usually the air supply goes to a filter, regulator, and lubricator near the hoist. Check the instructions supplied with the hoist. Lack of lubrication causes reduced performance, corrosion, ice, and wear on the vanes. Be sure to follow instructions for lubrication and use the specified oil.

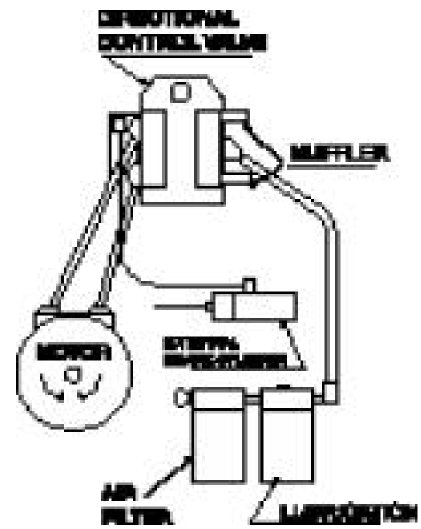


Fig. 2-17

3.3 Pressure

Pressure is force (push) per area. In suspended work platform work, the air pressure is usually measured in pounds per square inch (psi). A common pressure used is 90 psi. Each hoist model may have different requirements, so check the manufacturer's operating manual before you use the air hoist.

The pressure of 90 psi is a force of 13,000 pounds per square foot. That is a lot of force and means that you must use an air tank rated for the pressure you are using. Be sure it isn't rusted or dented. A ruptured tank can explode like a grenade, so don't hit the tank to see if it's OK.

3.4 Air Power Loss

A common size air motor is four horsepower. However, this motor has only the same lifting capacity as a one and one-half horsepower electric motor. How is that possible? It is, because the efficiency of the air motor is much less than that of the electric motor. They usually operate at 3000 rpm and are geared down.

Air is compressible, so you lose a lot of power trying to move air. It swirls and heats up as you try to move the air motor shaft, so you have to put in four horsepower to get out one and one-quarter hp. Electric motors only need one and one-half horsepower in to get one and one-quarter hp out. (Hydraulic motors, e.g. air motors, have leaks inside them, so they need about two hp in to get one and one-quarter hp out.) Every time air expands or compresses it costs power.

The particular needs of a hoist air motor will be covered in another section. You already understand pressure, flow, resistance, and efficiency. So, let us talk about the torque.

An air motor is basically a fan or windmill in a housing. The air moves through the housing and pushes on a blade, called a vane. The vane is attached to the motor shaft. The vane feels pressure on only one side, so it moves, and it turns the motor shaft. The higher the pressure, the greater the force on the vane, and the higher the torque out of the motor. The more flow, the faster the motor turns.

Unlike an electric motor, which normally uses the extra current it draws at starting to give an extra torque-kick, the air motor vanes have to break loose at start. The fluid motor has less starting torque than running torque. This means the air motor can be harder to start, and is more sensitive to heavy loads. It runs better than it starts.

3.5 The Air And The Air Path

The air motor needs proper air. Some motors need oil added to the air to lubricate the vanes. Other motors need the air to be free of oil. Check the manufacturer's instructions for the motor. Special oil, called "air line oil," is made for air devices and will not gum up the vanes and valves, eat up the seals, or hold dirt that gets past the filter. It should be used only on air motors requiring oil.

The air path has several steps. The compressor takes air in through the intake filter to compress it. The compressed air is then stored in a tank at high pressure. The compressed air is fed to the regulator, which sets the line pressure, and to the filter-separator lubricator, which removes any water from line air and conditions the air. (These may be one or more components.) The conditioned air is then fed to the airline, which carries air power to the valve.

The line pressure is felt at the motor control valve. The valve directs airflow to the up side or the down side of the motor vane, or it blocks the flow. The other side of the vane is usually slightly restricted so the hoist feels backpressure to make the motor run smoothly and prevent runaway. To go up, one side of the vane is pressurized. To go down, the other side of the vane is pressurized. The pressure pushes the vane and turns the vane shaft. The exhaust air goes into the outside air.

When the air is compressed, everything in the air is also compressed. Since moisture is in the intake air, water collects in the tank. It can rust the inside of the tank, so it is important to let a little air out of the bottom valve on the tank each day before and after the compressor is used. With constant use, it should be drained twice daily.

3.6 Hydraulic Oil Power

Hydraulic hoists operate in much the same manner as air hoists. They use high-pressure oil to turn the motor vanes, or sometimes gears in the hydraulic motor. The higher the pressure, the higher the torque. The greater the flow, the faster the motor rotor turns.

3.7 Oil And The Oil Path

Hydraulic oil hoists use a pump to provide fluid under pressure. The pump piston squeezes the hydraulic oil against the end of the pressure control valve spring, which raises the pressure of the oil. The setting of the spring in the valve determines the pressure of the line. As the piston pushes, the pressure in the line rises until the spring moves and lets trapped oil go back to the tank.

The pressure is felt at the flow control valve. When you select a direction, the control inside the valve moves, and oil flows to the motor. The pressure on one side of the motor vane or gear pushes the vane, turning the rotor. The rotor moves another vane into position and moves the first vane to the dump port in the motor. Here, the oil moves out of the motor and back to the tank through the filter. In the tank, it settles and cools before being picked up again.

4.0 Pressure – A Most Important Caution

The pressures used on hydraulic hoists can be more than 3000 pounds per square inch. That is a lot of pressure, so here is a word of caution. Just as electricity can shock you, pressurized oil can pierce and penetrate your skin, shredding the flesh underneath and mixing it with oil. The result is a wound impossible to clean; susceptible to infection and difficult to heal. Do not test for oil leaks with your hand (gloved or ungloved), because if you do find the leak, you may sustain serious injury.

5.0 Labels

Underwriter's Laboratory (U.L.), or Canadian Standards Association (CSA), dictates that there must be Warning Labels to specify the minimum standards acceptable. Let us now examine some typical labels you may find in suspended platform work (Fig. 2-19).

5.1 Hoist And Motor Power Electrical Labels

Fig. 2-19

Each hoist will have a voltage and amp rating label on the motor. There may also be another electrical label on the hoist (Fig. 2-20). If there are two electrical labels, use the label for the hoist. The hoist label shows the amps needed for both the electrical controls and the motor. You may also find duty cycle, which determines the allowable starts/ stops or amount of time per hour a motor can be used. The hoist label may tell you the maximum length of power cord you can use. Remember, each hoist will need power, so if one hoist needs ten amps, a pair of hoists will need twenty amps. Be sure the outlet can supply the right voltage, phase, and adequate amps.

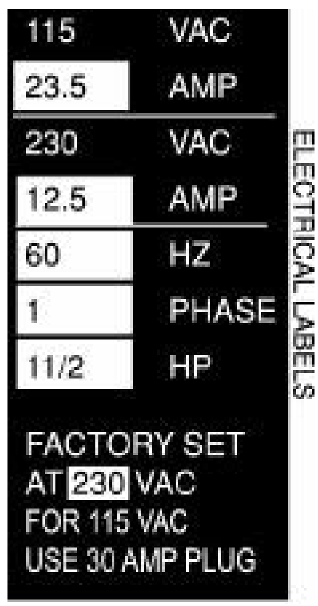


Fig.2-20

Sometimes you will find numbers on the electrical plug. They only list the most the plug can handle and aren't necessarily what the hoist needs. The hoist motor may be listed as a 120/230-volt motor. This means the motor can use either voltage. The hoist is set up for only one. If the hoist label isn't clear about the voltage, check the manual. Never guess! You can damage the motor and controls if it is hooked up to the wrong voltage.

Most U.S. and Canadian motors conform to the Motor Manufacturer Association standards. These standards require that the motor label show the motor design voltage. Motors are shown on the label as 110, 120 or 130-volt motors, which can use 110, 120 or 130 volts; 200-volt motors, which are used on 208 and sometimes 220, 230 and 240-volt sources.

Present standards permit the 460-volt motor only on roof mounted hoists. Incidentally, don't be worried about the difference between a 220 and 230 volt source for your hoist. A source that is 230 volts in the building basement is allowed to drop to 218 volts at the roof, and on a hot day may only be 195 volts on the roof, and 180 volts at the platform. When this happens you will have to use boosters.

5.2 Hoist Air Labels

Fig. 2-21

NEVER OPERATE BEFORE USING THE CHECK LIST IN OPERATING MANUAL!

MAX. SAFE AIR PRESSURE 125 PSI
MIN. OPERATING AIR PRESSURE - 80 PSI

Air hoists should have a label indicating how much pressure in psi (pounds per square inch), and flow in CFM (standard cubic feet per minute), is required to operate the hoist (Fig. 2-21). The label may also tell you when the air must be oiled or oil-less. Follow the manufacturer's instructions.

5.3 Hoist Rated Load Label

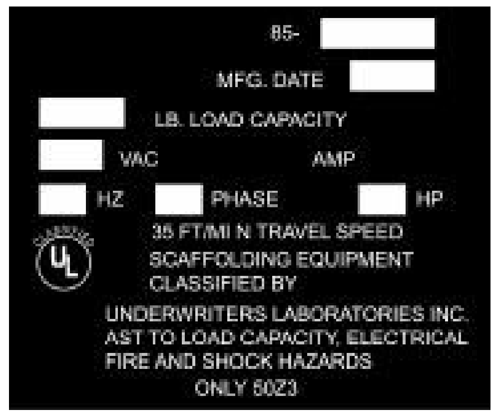


Fig. 2-22

The hoist rated load label is one of the most important labels in suspended scaffold work (Fig. 2-22). It means more to the setup than just stating the amount you can hang from the wire rope. The rated load label is determined by testing and regulating agencies. It specifies the force the hoist can safely exert and its maximum lifting capacity. **Do Not Exceed It!** The brakes and the amp draw of the hoist are based on this rated load. It is a key number.

By requiring that the hoist be able to lift slightly more than the load rating on the label, the standards ensure a hoist adequate for your uses. It won't fail and strand you under a full load on a cold day, or in a brownout.

By limiting hoist stall load, the standards make sure you can rig your support equipment using the hoist rated load and not pull the rigging down on your head.

Remember, the hoist rated load is the force the hoist can safely use to carry the load, and also the force it can safely transfer into the support equipment.

5.4 Support Equipment Rated Load Label

Rigging and support equipment is often labeled (See Fig. 2-23) to show the load carrying capability of the support device. The support device might be a cornice hook, an outrigger beam, a roof carriage, or a davit. The label is usually called the **load rating** of the device. The load rating is the maximum load that should ever be put on the device. If a device has no rated load label ask the manufacturer or supplier for documentation or find out.

Maximum Load = 1000 Pounds
600 Pounds Weight = 24" Maximum Extension Past Fulcrum Point
Beam Must Be Level
Beam Must Be Tied Back

Fig. 2-23

NEVER GUESS!

For example, most davits used for window washing have load rating labels, with the load rating stated in pounds and/or kilograms. Load rating means that when the davit is in the manufacturer's socket, the force from a hoist of the same or lower rated load will be safely supported.

Because the hoist transfers force to the support equipment, let us look at how the hoist rated load label and the rating of the support equipment affect each other.

5.5 How Rated Loads Are Coordinated

Hoists WILL lift more than the rated load if good power is available. If moving up and an obstruction is met, the maximum force that a hoist will deliver to the support equipment is more force than the load rating of that hoist. This is called the stall load of a hoist. It varies with power (voltage or air pressure). It could be from 1.25 to 3 times the rated load capacity. It is generally unknown so safety factors are added to the rigging. The maximum force from the hoist concerns us the most because that creates the greatest force to unbalance the rigging. If you use rigging that has a load rating as high or higher than the hoist, there is no problem. The support equipment is designed to be stronger than the maximum hoist pull. For example, a properly set up outrigger beam rated at 1000 pounds has no problem handling a hoist rated at 500, 750, or 1000 pounds. So, if your support equipment rated load is equal to or greater than your hoist rated load, you are OK.

If you use support equipment rated less than the rated load of the hoist, then the maximum force of the hoist can cause the support to fail. If the outrigger has a 1000 pound rating and the hoist has a 1500 pound rating, then the hoist can pull the outrigger over or bend it. This is a recipe for disaster, and here is why.

A properly set-up support (outrigger) has a four-to-one safety factor, so a 4000 pound force is needed to pull the 1000 pound rated support over (4 x1000 = 4000). A 1500 pound rated load hoist has a force limit of 4500 pounds. That is more load than the outrigger beam can take. If the 1000 pound rated load hoist catches, or stops with a heavy load, it can reach its force limit of 4500 pounds and cause the support to fail.

The support rated load must always be equal to or greater than the hoist's rated load.

5.6 Platform Rated Load Label

We have learned many lessons over time, with the changes to platform design, whether they are fixed length or modular design. The old theory of the label showing the number of persons permitted on the platform has changed, i.e. 2 persons – 500 pounds, 3 persons – 750 pounds. Manufacturers are now stating the maximum load capacity.

Labels will be different for fixed length platforms vs. modular platforms. Fixed length platforms are designed for 500 pounds, 750 pounds, or 1000 pound capacity live load for that length. The label (Fig. 2-23) will show the maximum load that can be applied safely. Modular platforms are much different. The label (Fig. 2-24) will show the modular sizes, how they should be assembled, and what load capacities you will have. These labels will be much more detailed and the manufacturer's instructions must be followed.

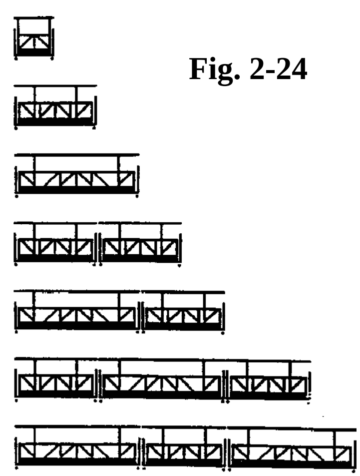


Fig. 2-24

CHAPTER 3

WORK PLATFORMS

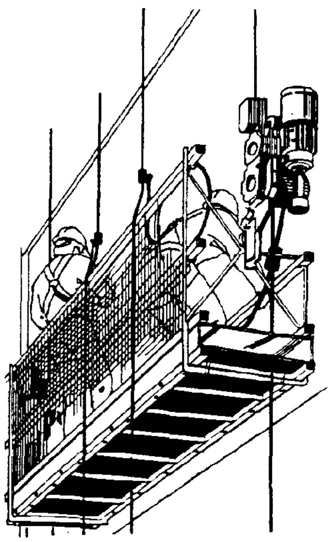
Contents

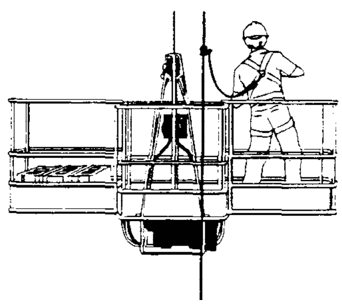
Chapter 3: Work Platforms

1.0 Types Of Work Platforms

The work platform is where you stand when you clean and caulk windows, when you put in concrete and do your pointing, and where you sheetrock, bolt, glaze, or perform other work in the air. The work platform holds you, your material, and all your tools.

The work platform is part of the suspended system. It uses powered or manual hoists. Its operation, use and capacity are regulated by legislation, standards and codes.





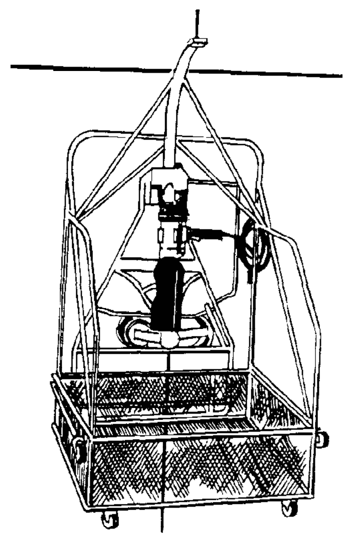


Fig. 3 -1

The work platform is usually made from metal, (Fig 3-1) generally from aluminum for its strength and durability. It may be held by only one wire rope, or it may be held by several wire ropes. It may be made of several platforms stacked one on top of another. It may be designed for only one person, or for an entire crew. Some work platforms are round for use on big smokestacks. Others are square, with eight or ten hoists to lift the work platform. Special work platforms may be hinged in the middle or made to reach around corners (Fig 3-2). Some are one single piece, and others are **modular;** that is, made of sections put together end-to-end. We will discuss the common principles and common requirements of the work platform.

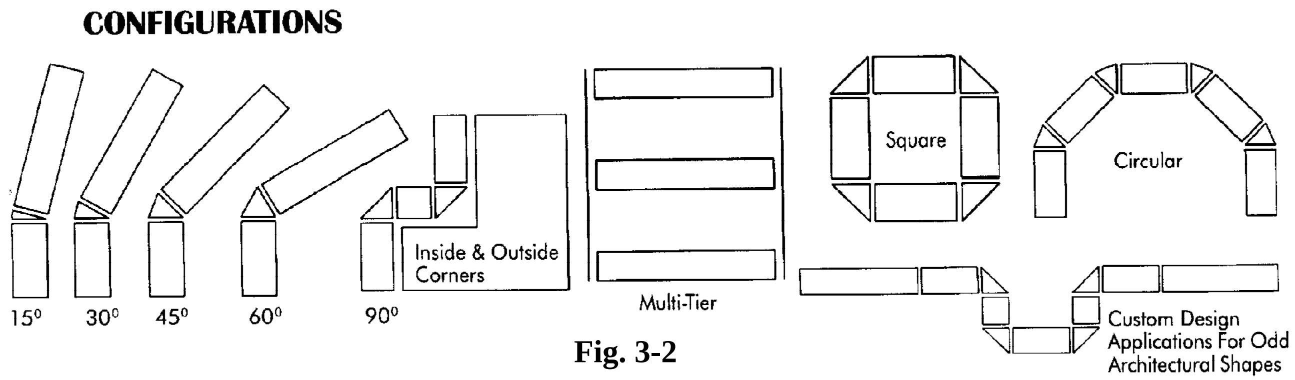


Fig. 3-2

1.1 The Basic Work Platform

The simplest work platform, commonly used, has a **deck** to stand and walk on, **toeboards** around the edge of the deck, **guardrails** along the edge of the deck, **uprights** to hold the guardrails to the deck, a strain relief anchor for the power cord, and equipment for holding the work platform onto a building or structure. Technically, the work platform has a working surface, guardrails, and a means of stabilizing the work platform; that is, a means to keep the deck from shifting around.

1.2 The Deck

The **deck** is the floor of the work platform. It is sometimes called a plank, stage, or stage platform. The deck can provide much of the strength required to hold the loads put on the work platform. (See Fig. 3-3)

Every deck has a load limit specifying how much weight it may carry. The limit depends on where the hoists are mounted to the deck, how the hoists are mounted to the deck, how much weight you put on the deck, where you put the weight on the deck, how concentrated the weight is, or a combination of these. For example, if you put on too much of a concentrated load in a small area, the deck may fail.

Load limits should be shown on the side of the deck. If the deck doesn't have a label or tag or if you cannot read the load, ask your "super" to check with the deck owner or manufacturer about the limits.

The deck can get a lot of unnecessary abuse. Chemicals and paint are spilled on it, sand and gravel cut it, it is stressed and unstressed, and it sees a lot of handling. These things can weaken your deck enough so it might fall out from under you.

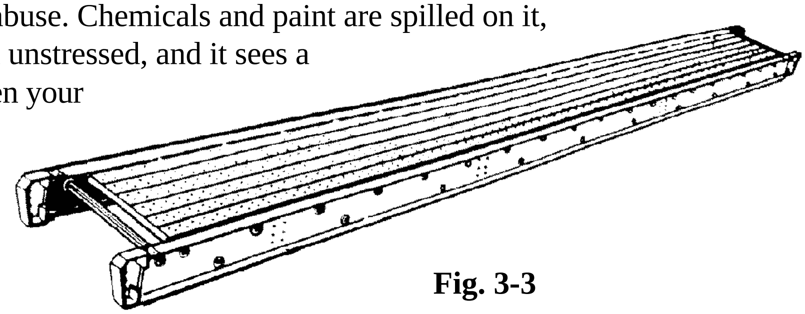


Fig. 3-3

If you have heavy and/or sharp tools to go on the deck, or loads other than yourself, your buddy and a bucket of tools, ask about the floor-load capacity. Some deck floors are made for heavy stone or tools, and some deck floors are made for workers and hand tools. Be sure you are using the right deck.

Please don't think that if you can lift the load, the deck is okay. For example, if you put too much load on to a wood deck, the wood actually gets weaker while the load is in place, and after a couple of hours just sitting still, it may suddenly fail. There are also good technical reasons why metal decks shouldn't be overloaded, so never overload any deck beyond its safe working load.

1.3 Classification of Platforms

The manufactured decks commonly used in suspended scaffold work are **UL classified, or Factory Mutual listed.** This means the manufacturer of the platform has an independent company test one or more new work platform decks to ensure they meet the standards established for platforms (stage platforms). The deck has weights put on it at different places along its length to be sure it is strong enough with adequate safety factors. The test company also looks for other hazards and deficiencies that may cause problems in the field (Fig. 3-4).

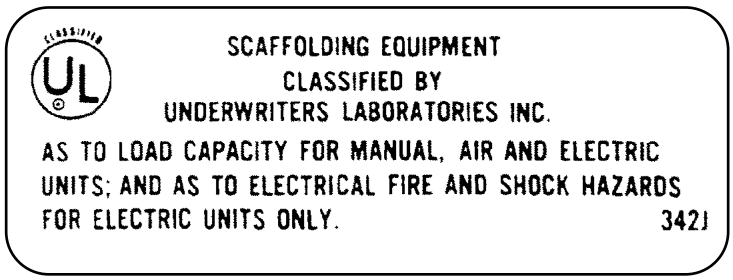


Fig. 3-4

Most manufactured decks are tested by Underwriters' Laboratories. You can be sure that work platforms or decks bearing the U.L. or C.S.A. labels meet the necessary requirements.

Remember, the equipment can only meet the standard **as long as the platform is not overloaded, abused, or damaged, and as long as it is maintained.** Proper use and maintenance keep the deck and work platform safe.

1.4 Load Rating On Decks And Work Platforms

Each deck or work platform built by a reputable manufacturer will have a **load-rating** label (Fig. 3-5), on the platform or deck. The label identifies the manufacturer and the load permitted on the deck or work platform. Some load-rating labels may show the maximum load allowed. They may also show the maximum number of persons permitted on the work platform or deck, although it is more common now to show the "Safe Working Load."

The load rating shown in pounds or kilograms means the combined weight of the **tools, material, and workers.** You may **NOT** load up to the load rating weight **and then** add the workers.

Fig. 3-5

If you use an engineered or **permanent** powered platform, like the platforms used on some buildings for window washing, the platform load rating plate tells you how much you can put into the platform.

If you have a built-up powered platform using a deck with put-on stirrups, hoists, etc., the deck rating label only tells you how much you can put on the deck, and not how much you can put onto your work platform. Never overload your hoists, your ropes, your rigging or the rest of your system. Remember, the deck may be able to carry more than the rigging can safely hold.

A platform and its components must have a safety factor against failure, based on the rated load. This means an advantage of four to one. The safety factor does NOT allow any extra load. Moreover, the “extra” 50 pounds (22.7 kg) you sneak aboard may be equal to 150 pounds (68 kg) of force in some circumstances. The maximum rated load is the maximum allowed.

1.5 Size Of The Fixed Length Deck

Platform decks come in many shapes and sizes. The components are: side rails, rungs and decking material. Platforms can vary in length. Two-point powered platforms must be between 20 inches (51 cm) and 36 inches (91 cm) wide (Fig. 3-6).

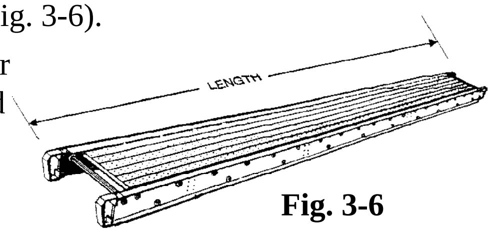


Fig. 3-6

Each work platform deck has to meet requirements for strength and other important characteristics to be approved by a recognized testing authority. The decks are tested to ensure that they meet the requirements of the standards.

With time, manufacturers have designed their fixed length platforms to be as much as 40 feet (12 m). Follow the manufacturers’ instructions for use.

1.6 Length Of The Fixed Length Deck

The first way to size a deck is by length. Manufactured decks usually are multiples of two feet (.6 m) or four feet (1.2 m); for example: 16 feet (4.9 m) long, 18 feet (5.5 m) long, 20 feet (6 m) long. You need to allow an extra two or three feet of deck beyond the supports to rig the work platform, because you need about a foot on each end for the stirrup attachment.

Then, choose the length of deck that covers the workface in the **least number of set-ups,** and choose a length that allows you to get to the platform **tie-offs** on the building or structure. A deck that fits the workface is easier to use, and you don’t have to spend all day rigging.

Check that you can get the work platform below the rigging points. The ropes must hang straight down from the rigging, so you must have a flat place below to put the deck for rigging.

One good way to determine the deck size is to measure the workface you will be rigging, then find a number that will divide into the workface length an even number of times. After you have that number, add the two feet (.6 m) for stirrups. For example, if the workface is 150 feet long (46 m), then you can use ten 15 foot (4.5 m) drops. Adding two feet (.6 m), you get 17 feet. Choose an 18 (5.5 m) or 20 foot (6 m) foot deck. You could do the drop with a 32 foot (10 m) deck (five 30-foot (9 m) drops + two feet (.6 m)), or several other combinations, as long as the ropes are straight down and the rigging points are the same distance apart as the hoists on the platform.

We talked about load, moment and stress in a previous section. Remember that if the distance of a moment is twice as long with the same load, you get twice the moment, and twice the stress. Now, if you double the length of the deck, the moment goes up at the middle to twice what it was. If you shorten the deck, the moment and stress at the middle go down. This means that a work platform is only as strong as the strength of its middle.

Why mention the stress and strength? Because a 32 foot (10 m) work platform deck, able to carry a 500-pound (227 kg) load, has to have more strength in its middle than does a 16-foot (4.9 m) work platform deck rated for 500 pounds (227 kg). This means that two 16-foot (4.9 m) work platforms spliced end-to-end, do NOT make a 32 foot (10 m) work platform (unless you have a **modular platform** with engineered sections designed to be put together up to that length). Therefore, never lash two short work platforms together and put a hoist on the far ends to make a new, longer work platform.

Use the right length work platform deck for the job.

1.7 Sizing By Load

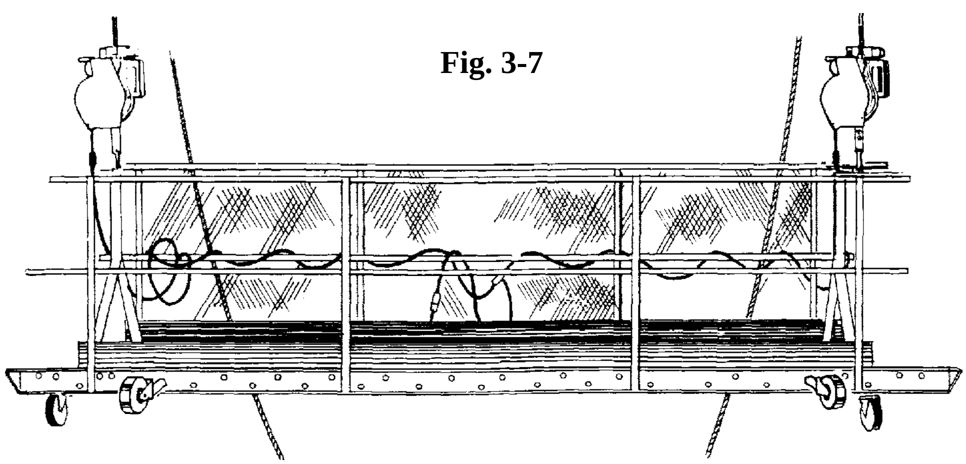
Another way to size a work platform deck is by load. Once you have the length, check on the number of workers and materials needed on the deck. Each person carried on a suspended platform deck is counted as 250 pounds (113 kg) of tools, person, and some material.

Regulations in the U.S. limit a two-point suspension platform by weight and persons. A work platform rated at 500 pounds (227 kg) can have no more than two persons on it at a time. A work platform rated at 750 pounds (340 kg) can have no more than three people on it at a time, no matter how much they weigh. (NOTE: If they each weigh more than 250 pounds (113 kg) only two can use the 750 pound (340 kg) platform since they'll be over the load weight limit.) The important point is to ensure that the safe working load is not exceeded.

2.0 Guardrails and Uprights

2.1 When to Use Guardrails

Fig. 3-7



The **guardrail** system protects the open sides of the deck and helps to keep you on the work platform. Usually made of pipes or boards, guardrails are held onto the **uprights** by bolts or clamps. Uprights are the pipes, boards, or brackets that hold the guardrails.

Guardrails consist of a toprail and midrail. The toprail is the rail at the top of the upright, and the midrail is the rail at the middle of the upright (See Fig 3-7).

In the U.S., guardrails are required on all open sides of a platform. Basically, an open side is a side or opening where a worker can fall through. On our basic two-point suspended platform, there are four sides. Because most hoists and stirrups block the ends of the work platform, most regulators consider the ends of the platform closed if the hoists are within 18” (45 cm) of the end of the deck. That leaves the front and back of the work platform possibly needing guardrails.

Unless you are dropping in a shaft slightly larger than the size of the deck, the open area of the platform next to the structure will require a guardrail. Even if you don’t need a guardrail on the back to protect you from falling out, you will need one to protect you from shearing hazards in the shaft. So, always install the backrail.

Now, determine if the front of a work platform is open. The question is, can a person fall through the opening in the front? The answer is yes if there is a 12” (30 cm) space between the deck and the workface.

What does that mean? It means that if the deck is tied off to the workface with a strong line preventing more than a 12” (30 cm) opening, it is not open and no front rail is needed. If the line is made of thin string, is longer than 12” (30 cm), is tied high above the deck so the deck can swing out more than 12” (30 cm), or if there is no workface, then you need a guardrail in front.

Remember that if when moving up or down a structure, the platform passes an area where a space of more than 12” (30 cm) occurs, a front guardrail is needed.

If you have any questions about the regulations and the need for guardrails in your area, contact your OSHA office for their interpretation.

2.2 Toprails and Midrails

Regulations require that toprails be about 42 inches (107 cm) above the deck. Some situations may require slightly more or less than that, and many inspectors will allow the toprail to be

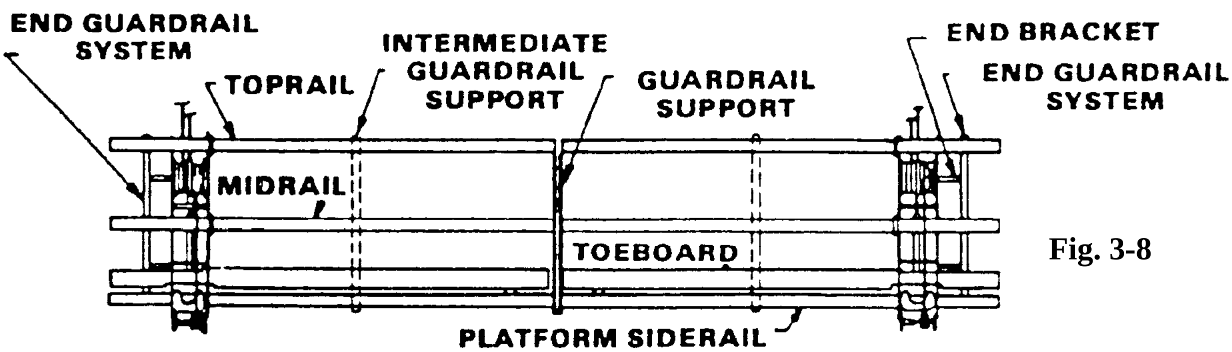


Fig. 3-8

between 36 inches (91 cm) and 45 inches above the deck. Check with your local inspector if a 42 inch (107 cm) toprail height will cause a problem. (See Fig. 3-8)

Toprails must be strong enough to withstand a fall against the rail by a worker. Toprails must be able to withstand a load of 100 pounds (45 kg) (some jurisdictions still require 200 pounds) in any direction along the rail, and the uprights must carry that load as well.

Wooden toprails are to be at least 2” x 4” (5x10 cm) lumber (number 1 Southern Pine or Douglas Fir), with the uprights not more than eight feet apart. The midrails can be 1” x 6” (2.5x15 cm) lumber.

Tube-type toprails, midrails, and upright posts must be at least 1-1/2 inch (3.8 cm) pipe, with the same eight-foot maximum spacing of uprights. Other metal railings may be used if they are at least equivalent to the strength and grip of the 1-1/2 inch (3.8 cm) pipe.

A reputable rental company will provide rails, uprights, and brackets of proper size. These rails may be aluminum tubes, pipes, or wood, depending on your needs.

The midrail goes between the toprail and the toeboard, or about 20 inches (51 cm) below the toprail. It helps keep a worker from falling under the toprail.

Uprights carry the load put on the guardrail. They are usually spaced evenly along the deck eight feet apart.

Uprights must carry the required load of 100 pounds (45 kg) on the guardrail, and they must be able to transfer the moment from the guardrail to the deck without damage.

The upright mounts and deck sides must carry the moment from the 100 pound (45 kg) required load at the top of the upright.

2.3 Toeboards

Anywhere you have a guardrail, you will need a toeboard. A toeboard is a 31/2” (9cm) high piece of metal or wood that sits on the deck and attaches to the uprights.

The toeboard is a barrier that keeps tools and material from falling off the deck, and it keeps your feet on the deck if you slip to the edge of the deck. It is required on all open sides. If you ever kick a tool off the deck ten floors up, you’ll know why you want one on all sides.

2.4 Mesh

Mesh is the wire screening or plastic screening that protects the workers and passersby below from objects falling off the platform. Some jurisdictions require using mesh whenever the suspended platform is over a place where there might be people working or walking, or when you have tools and material piled up to the toeboard (See Fig. 3-7).

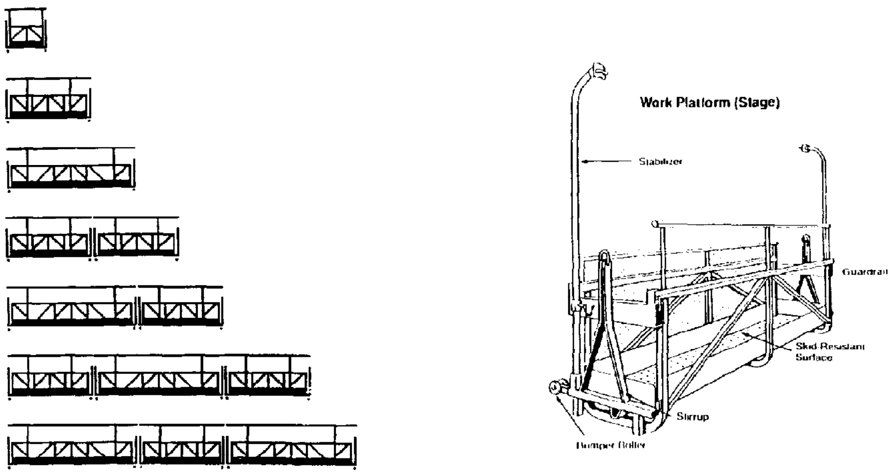
The mesh must extend along the entire opening and be Number 18-gauge U.S. Standard wire 1/2 inch (1.3 cm) mesh or the equivalent. Always securely fasten the mesh to the guardrail system.

3.0 Special Platforms

3.1 Modular Platforms

Modular platforms are designed in different lengths to provide flexibility and easier handling. For buildings with different length working areas, using Modular Platforms provides greater use of the product. Choosing different length modules allows the workers to assemble the needed length to suit the building. (See Fig. 3-9)

Fig. 3-9



Modular platforms can have powered end sections, with changeable center sections. When more center sections are added, the platform becomes longer. Some types of Modular Platforms have standard length center sections, and others have different lengths.

Many manufacturers have corner sections and other attachments that can provide flexibility for solving problems. Manufacturer's instructions shown on the labels on the side of the platform will dictate the assembly method.

All Modular Platforms have certain things in common:

- They rely on the connections between sections for their assembly.
- They have length limitations.
- The longer they are, the less load they can hold safely.

You must read, understand and follow the manufacturer's instructions and labels when using this type of platform. Modular Platforms consist of sections that assemble to give you length. Since the length can vary, the allowable load varies. For example: a Modular Platform may have a rated load of 750 pounds (340 kg) at 40 feet (12 m), but 1000 pounds (458 kg) at 30 feet (9m). The use and operating instructions must be referred to.

Double-check all connections and load capacities when using Modular Platforms. The many connection points presents a risk if they are not checked.

3.2 Tiered Platforms

Tiered platforms are used when more than one work level is desired at the workface. A tiered platform is a suspended scaffold with more than one level of deck (Fig. 3-10).

Tiered platforms sometimes require overhead protection which prevents falling objects from striking workers below.

Because the platform can fall with workers “inside”, workers on the lower platforms are not permitted to use independent lifelines. They must attach their lanyard and grab to a horizontal static line attached to the stage.

The tiered platform is equipped with secondary (auxiliary) wire ropes and brakes so that if a primary rope should fail, the secondary rope brake will catch and hold the platform level, thereby preventing the workers from falling.

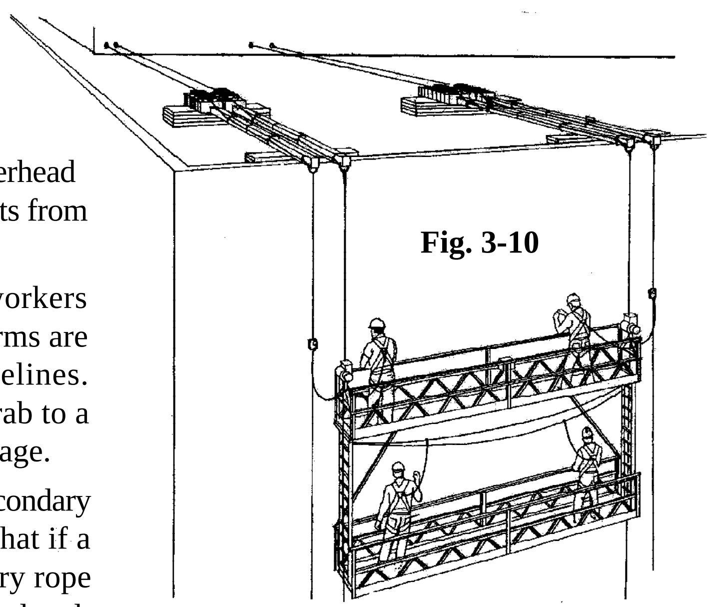


Fig. 3-10

A lower platform will add its full weight to the upper platform or stirrup. Many of the components, such as the stirrups and hangers, will change the assembled height. Therefore, care is needed when selecting connections. Any setup of tiered platforms should be left to experienced persons, and should be engineered for the application.

3.3 Masons’ And Stonesetters’ Platform

These are strong work platform decks which can carry the higher loads needed by masons and stonesetters. The main difference from other decks is that these must be able to carry 25 pounds a square foot for the stonesetters and 50 pounds (22.7 kg) a square foot for the masons (Fig. 3-11).

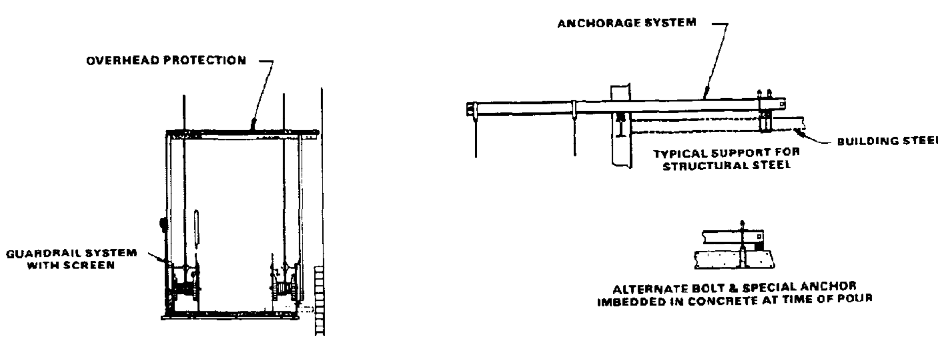


Fig. 3-11

The decks often have two hoists per outrigger, and when mounted are called multiple-point suspension scaffolds or platforms. Some of these decks pass the suspension rope around the deck before running it to the anchored hoist to permit a heavier load to be carried.

The platforms which pass the suspension rope around the deck require extra care in their operation. The platform is actually held in a sling made of suspension ropes. If a roller jams, the platform may not ride at the bottom of the “sling,” and it will tend to tip. The rollers in these platforms must be maintained and kept free of debris.

Even though these decks have strong flooring, i.e. stone, brick, and mortar, other heavy materials must not be stored on them. The decks are for transferring and holding material while working.

A word of caution: the **flooring** is stronger. This doesn’t mean you can fill up every foot of space with a 25-pound load and lift it safely since the rigging may not handle it. It’s like putting heavy-duty truck tires on a small car. The tires can take more load, but the car’s frame will break.

4.0 Precautions with Work Platforms

First, we want you to know that the precautions **only deal with the work platform** as we defined it, and do not address the hoists, rigging, or anything else in the setup. Precautions on hoists, rigging, and the other equipment in the setup will be addressed later. When you get ready to use your work platform, there are several things you must watch for. These precautions are listed as follows:

1. **Lifeline (Fall-Arrest System)**. **The number one precaution** you take around a work platform is to have your personal safety equipment and use it. Every time! The one time you don’t is probably the time you will need it. There are many people dead because they didn’t use their harnesses, lanyards, lifelines and adequate anchors. This is THE big number one.

2. **Weather.** Never use a platform in high winds of over 25 mph (40 kph) or during storms because the wind can drive a platform into the wall or the platform may be hit by lightning (wire rope is a great lightning rod). Stay on the ground when the weather is bad. Most platforms are to be brought in when winds are over 25 mph (40 kph) at the platform, but conditions often require bringing the platform in during lesser winds. Decide for yourself.

3. **Make sure everything works**. Inspect all parts of the working platform before each use, to be sure they are sound and present. Check the platform over. Check that the bolts are tight. Check that they are all there. Look over the metal and/or wood for wear, rot, or damage.
   Be sure the stringers (the side beams) aren’t damaged. They carry most of the deck load. A damaged stringer has to be replaced and the decking redone. Only the factory can fix stringers on manufactured decks.

Check the deck surface. If it is rotten or damaged, don't use it until it is fixed. Don't paint the deck. Paint becomes slippery and also hides dangerous defects such as wood rot. Use clear preservative on wood decks.

4. **Use guardrails and toeboards**. You already know the reasons why. They protect you and the people below.
5. **Clean off the platform**. Check the deck and the guardrails for oil and grease. Get any "garbage" off the deck. Take only the tools and material you need. Anything slippery on the deck or the rail can contribute to an accident.
6. **Tie down material.** This prevents slips, trips, and falls as well as falling objects. When you load any material, ensure it is tied down. Always lash the drums, tie down the boards, and tie off the buckets. If it can move on the deck, tie it down.
7. **Use the right hoist supports.** This means use proper stirrups or hangers, and put them where the manufacturer recommends. Don't hang the deck so it looks like a diving board, called **cantilevering** the deck. Cantilevering is only permitted in engineered systems.
8. **Do not overload**. The load-limit label tells you how much the platform is rated to carry. Don't guess at the weight of your material. One more thing about loading and damage. With loads of brick or other sharp, heavy material, use a pallet or plywood under the load to keep the deck surface from being damaged. Also, tie the load off.
9. **Don't drop the platform, or drop a load on the platform.** It adds extra stress on the deck, the stringers, the hoists, the ropes, and the support rigging. The first reason is that a dropped load has more force than a sitting load, which is why a struck hammer drives a nail and a pushed hammer doesn't. Secondly, a dropped load always lands on only one point first, no matter how wide the load, and so one point on the deck takes all the load first. Remember, a deck is made to carry loads evenly distributed, so distribute the load and don't drop the load or the deck.
10. **Avoid electricity**. Platforms should be kept away from power lines and electrical circuits. Conductors are put up in the air to keep them away from people. Before you start, look for power lines and wires, above and below you. While you're operating the platform, look for power lines and wires, above and below you. The platform is heavy enough to cut and break those "hot" wires, and your ropes and lifelines can move around quite a bit, enough to hit power lines 50 to 100 feet away. The tail line drops below the deck, and can hit wires below that you would otherwise avoid. The distance to keep away from the power source will depend on the voltage. Your local power authorities will dictate how far you must be. Just remember that you are on a swing stage that can move closer.
11. **Do Not Use non-approved acids or corrosives.** Acids and other corrosive substances can seriously affect the strength of the platform. These substances must be immediately neutralized when spilled. As we said earlier, a platform suspected of corrosive attack must be removed from service.

Check with the platform supplier to see if the corrosive or acid you are using is compatible with the platform. Also check that the neutralizer and antidote are compatible for the corrosive or acid.

Washing down a deck after using a non-approved substance is no cure, either. It may already have done its damage. Worse, it can collect in the nooks and crannies of the platform connections, and that's the last place you want a corrosive. Regulations require that the user notify the owner or future user of the equipment about any substances used on the equipment. If you don't tell your employer or supervisor, you could be liable for an accident.

12. **Do Not Use ladders** or planks between the midrails, or other temporary supports on the working platform to increase working height. Do not use the guardrails as steps. These practices upset the balance and stability designed into the platform. When a platform's stability is off, it can flip in a second, without warning. Also, the guardrail cannot protect you when you stand on or above it.

13. **Level the platform**. First, if the deck is out of level, something is wrong with the setup. Secondly, the support and suspended systems are not designed to be used with an out-of-level work platform, which can impose strange and dangerous loads. Finally, it's very hard on your knees and legs.

14. **Enter and leave the platform safely.** Fall-arrest equipment must be hooked up before you enter a platform and only unhooked after you exit. Do not climb up or down the rope. More than one person who has done so is now crippled. It has been fatal for more than one worker. Don't "step off' before you're inboard, because the platform swings out as you step in. Get in and out on the ground if you can. Otherwise, bring the platform in and tie it off before you get off. Remove your fall arrest equipment only **AFTER** you are on a safe surface, and never before leaving the platform.

15. **Tie off the platform.** This means to tie off the platform to the structure or workface. It is the law. It's dangerous up there. The deck likes to move around under you. Updrafts can make the deck roll and shift. You and your partner can move and make the platform suddenly drift away. Side winds and updrafts can move you far enough out to turn the platform completely around.

16. **Nobody rides while moving the platform sideways**. Do not allow workers and/or materials to remain on the platform while it is being moved from work position to work position. Moving the platform while loaded requires a specially engineered system beyond the scope of this course. Move an empty platform, on the ground or roof, and move the rigging separately.

17. **Follow directions.** Before using any work platform, read and follow the manufacturer's instructions and the regulations governing your setup. The federal regulations in force at the time of this writing are in the pocket manual. Check state/provincial regulations. As well, check the local regulations. They all want you to be safe.

18. **Store the equipment properly.** This means properly stored during setup and also when taken down. Keep the work platform in a safe place overnight. Lash it down with heavy rope. Light cord won't hold a platform in a wind. Cover the hoists and ropes. Don't store material on the deck. For example, water and cement can react slowly with aluminum. Remove material from the platform and clean off the deck. It will last longer. When you break the platform down to move it, support the deck and stringers while on the truck. Clean off the deck and be sure to get the corners and crevices. Store the deck inside, on edge, and on wooden boards every few feet. Never use decks as storage racks.

CHAPTER 4

Cages, Baskets, Chairs
&
Similar Equipment

Contents

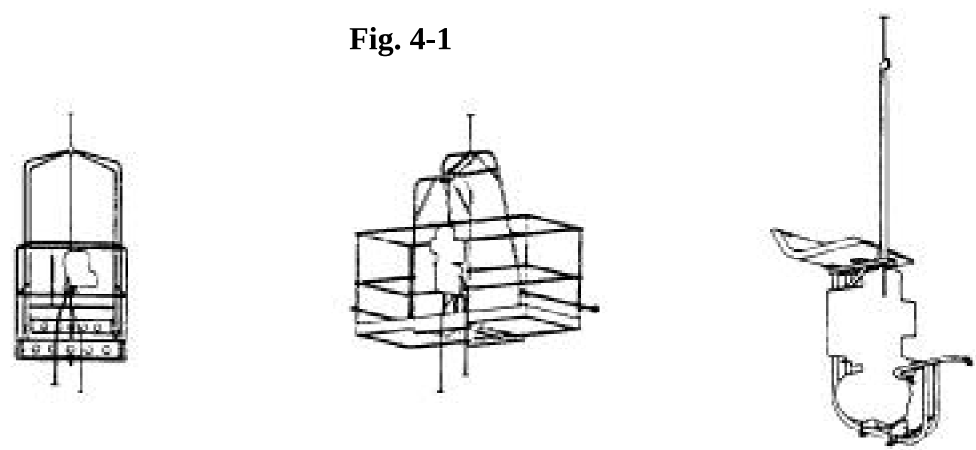
Cages, Baskets, Chairs, And Similar Equipment

1.0 Introduction of Equipment

Special types of suspended equipment use only one support rope. These devices are known by many names such as single-point suspension platforms, single point cages, work baskets, chairs, etc. (See Fig. 4-1).

The single-point system is usually chosen when the job location makes it difficult or dangerous to use a two-point suspended platform. Examples include: covered bins or shafts where the access may be a trapdoor on top; a short face of building where the roof and wall are too narrow for a two-point platform; sloped roofs that cannot support a two-point platform; and round tanks where the two-point platform would need to wrap around the curved side of the tank to fit.

Fig. 4-1



Single-point equipment requires all three of the basic systems: a support system to hold the suspended platform and its load, a suspended system or work platform, and a safety system in case of accident.

Support for single-point equipment is much the same as the support for two-point equipment. There may be an outreach, a reaction into the structure, and a tieback.

The safety equipment for single-point systems is the same as the independent safety system in other suspended scaffolds. There is a secondary line with anchorage, an auxiliary brake, a rope grab, and a full body harness with shock absorbing lanyard.

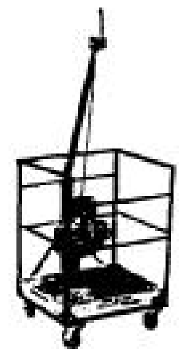
Single-point baskets have a protrusion over the cage or seat to help keep the device stable. This part is often called the “mast,” because of its shape. (See Fig.4-2).

The mast protrudes into the free space above the worker. If the basket should fall while the worker is held by an independent lifeline, the worker can be struck and injured by the mast. **Be careful,** and try to work to the side of this mast.

To minimize the risk of injury, some single-point baskets use a second wire rope and brake, with an independent tie-off on the roof to hold the basket should the primary support fail. The worker “ties off’ the lanyard directly to an anchorage on the basket.

2.0 Stability

Fig. 4-2



The stability of a one-line system depends upon the height of the wire rope guide on the suspension rope. The higher the wire rope guide, the more stable the basket.

The basket is most stable when the worker is directly under the suspension rope.

Single-line systems must deal with rotation. As the rope runs over the sheave, or in the hoist, it is squeezed and starts to twist. You will tend to spin as the basket tries to unwind the twisted rope. Nearly all single-line systems have rollers or bumpers that bear against the wall and minimize the basket spinning.

3.0 Handling The Lines

A single-point system has more than one line. In addition to the primary support line, there is either a secondary support line or an independent lifeline. If the unit is powered, there is a power cord. Certain work applications may require additional lines or hoses. Handling all of these lines can be difficult, particularly in swirling winds.

Lines held together at regular intervals with a strap or special holders are less likely to blow around and tangle. If possible, hold the lines to the building or structure with a Strap to minimize sway. **DO NOT** tie knots in power cable or suspension lines. Remember that all the lines that hang down are in a small area and not spread out like you will have in two point suspension.

4.0 Working Alone

With a single-point system, you may be alone on the basket cage, or chair. Extra precautions are required.

Injury or illness can leave you stuck in midair without help.

Always have a partner to “spell you off’ when you return to the roof or to get help in an emergency.

It is important that you have a way to communicate with the worker who is working alone. Today there are many ways to have contact if it is needed. Telephones and walkie-talkies, are just two methods that can be used.

The employer or supervisor should ensure that:

a) A method of checking with the worker has been established.

b) Check-in intervals are understood.

c) The contact person knows the work schedule.

d) Any communication equipment is in good working order.

5.0 Inspection and Rigging.

5.1 Inspect the equipment and follow the manufacturer's instructions. If parts are worn or damaged, they should be replaced.

5.2 If (manual) Bosun Chairs are used, the seats must be at least 12" (30 cm) by 24" (60 cm) and 1/2" (1.3 cm) thick with underside cleats to prevent splitting. No knots. The rope must cross under the seat, to act as a seat should the seat ever break. Cracked seats are not to be used.

5.3 The RASBURRY check list of Chapter 8, Section 2-12, must be used with the Single-Point Suspension, just as it is with the two-point suspension. It must be remembered that there is only one suspension point holding the equipment from going to the ground, not two. This makes it critical that everything is correctly rigged.

5.3 All the procedures outlined in this manual for two-point suspension units, are required for single-point.

5.4 With only one suspension point, there is no need for a spacing check, other than equipment to structure distance.

5.5 If there is a parapet, can it safely carry the load?

CHAPTER 5

HOISTS
AND
ACCESSORIES

Table of Contents

Chapter 5 - Hoist & Accessories

1.0 Introduction

Hoists, like many other products for suspended scaffold, are of different design. This course teaches generics and not specifics for each. Workers using equipment must study the manufacturer's instructions for proper maintenance and safe use of their products.

The hoist is the machine that raises and lowers the suspended equipment. The hoist also holds the work platform and its load on a stirrup or hanger. Sometimes wire rope guides are used to help keep the platform stable.

Powered hoists have brakes to stop and hold the load. They also have backup brakes to hold the hoist and load on the rope in case of emergency. Many hoists are equipped with mechanical overload protection to avoid dangerous overloading.

2.0 Types Of Hoists

The hoist can be powered by an electric motor, an air motor, a hydraulic motor, or manually. Manual hoists move as slowly as you want. Powered hoists have different speeds and rated loads.

The traction-type hoist grips the rope and moves by using friction on a short part of the rope. The drum hoist winds the rope on a drum and uses the rope's grip on the drum to lift the load.

Reeving means inserting the rope into the hoist and through the various parts inside to ensure that the rope follows its proper path and the tail line exits the hoist. A self-reeving hoist feeds the rope onto the hoist drum or sheave by itself under power. Other hoists require that you manually reeve the rope into the hoist.

Self-powered platforms have hoists that are mounted on the work platform, and roof-powered platforms have their hoists mounted on the support structure above.

2.1 Roof-powered Platforms

One of the more obvious differences in hoists is where the hoist is mounted. When a hoist is mounted on the work platform, it is called a **self-powered platform**. When a hoist is mounted on the overhead support, it is called a **roof-powered permanent platform**.

Roof-powered platforms will be discussed in greater depth in Chapter 6.

Many permanent work platforms used in building maintenance have their hoists mounted in the support equipment. Some of these roof-powered platforms are lifted by high-speed heavy load hoists, Many roof-powered systems are specially made for a particular building, and are engineered installations. (See Fig. 5-1).

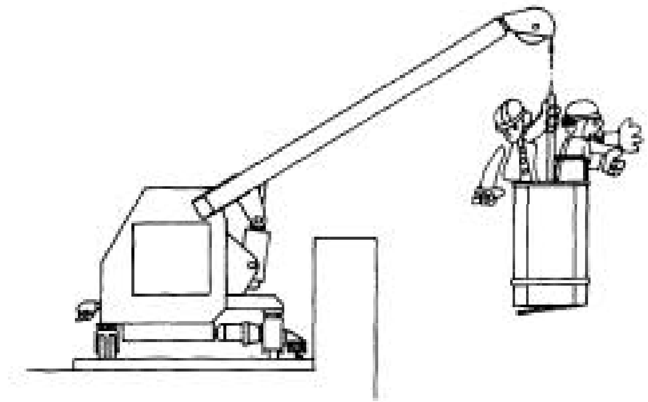


Fig. 5-1

Whenever you use one of these systems, follow the manufacturer's instructions. Many of these systems require operators trained by factory authorized personnel.

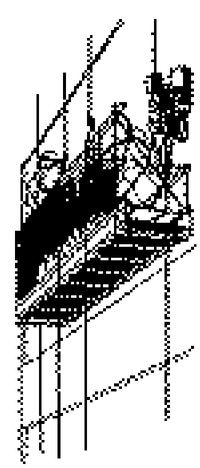
The main controls for roof-mounted hoists are located on the work platform. Operator commands are sent to the roof hoist by electric wires, radio or magnetic pulses in the wire rope. The commands cause the control box on the roof to route power to the hoist motor and to release the brakes. The hoist motor then raises or lowers the work platform by turning the drum holding the wire ropes (either two or four suspension ropes). Only the wire rope termination and the operator's controls are on the work platform of a roof-powered system.

The wire ropes on these hoists are routed from the drum to the **boom arms.** The boom arms reach over the side of the building to hold the work platform. Because of the way the big drums are mounted, the wire rope often has to change direction. Each time the wire rope changes direction, the load on the wire rope is carried by **sheaves**. A sheave is a steel wheel which holds wire rope in a groove around its circumference. The sheave rotates as the wire rope is fed on or off the drum, guiding and supporting the rope.

2.2 Self-Powered Platforms

Self-powered platforms have all the hoisting equipment on the work platform. Nearly all work platforms used in construction, and nearly all work platforms brought to a job, are self-powered. (See Fig. 5-2).

Fig. 5-2



The design of these hoists must be approved by an independent federally approved testing laboratory. Virtually all hoists used on self-powered platforms are Underwriters' Laboratories tested. The rest of this Chapter concentrates only on self-powered hoists.

3.0 Hoist Basics

All powered hoists:

- are machines
- grip the rope
- support and lift a load
- have a transmission to increase torque for lifting
- have two or more braking devices
- must meet strict standards
- require maintenance to perform properly

We'll look at both similarities and differences in hoists as we see how they are categorized by location and construction.

3.1 How a Hoist Works

Fig. 5-3

On self-powered platforms, the hoist and its load are supported by rope. The rope may be the wire rope used in a powered hoist or the fiber rope used in a manual rope fall. The rope above the hoist is **tensioned**, that is, it is straight and holding a load.

The rope enters the hoist and wraps around a circular turning and gripping part (Fig. 5-3). That part can be different in different kinds of hoists and may be called the **traction sheave**, the **traction drum,** or the **winding drum,** depending on the kind of hoist you use. For now we will call it the drum.

The drum is connected to the drive that is used to lift and lower the hoist and its load. The drum is connected through bearings to the housing. This connection ultimately holds the load. If the drum turns one way the hoist moves up; if the other way the hoist moves down.

There is one sure way to prevent rope coming off the drum. That is to have enough rope to reach the ground, with some to spare. Then, you will set the platform on the ground before you run out of rope. Regulations require at least four turns of rope left on the drum of a winding drum and traction drum hoist.

3.2 The Drive From Motor To Hoist Drum

Before we follow the rope path through the hoist, let's look at the machinery that actually does the work, starting with the motor.

The motor changes the electricity, air, or muscle, into mechanical power of high rpm and low torque. (See Fig. 5-4).

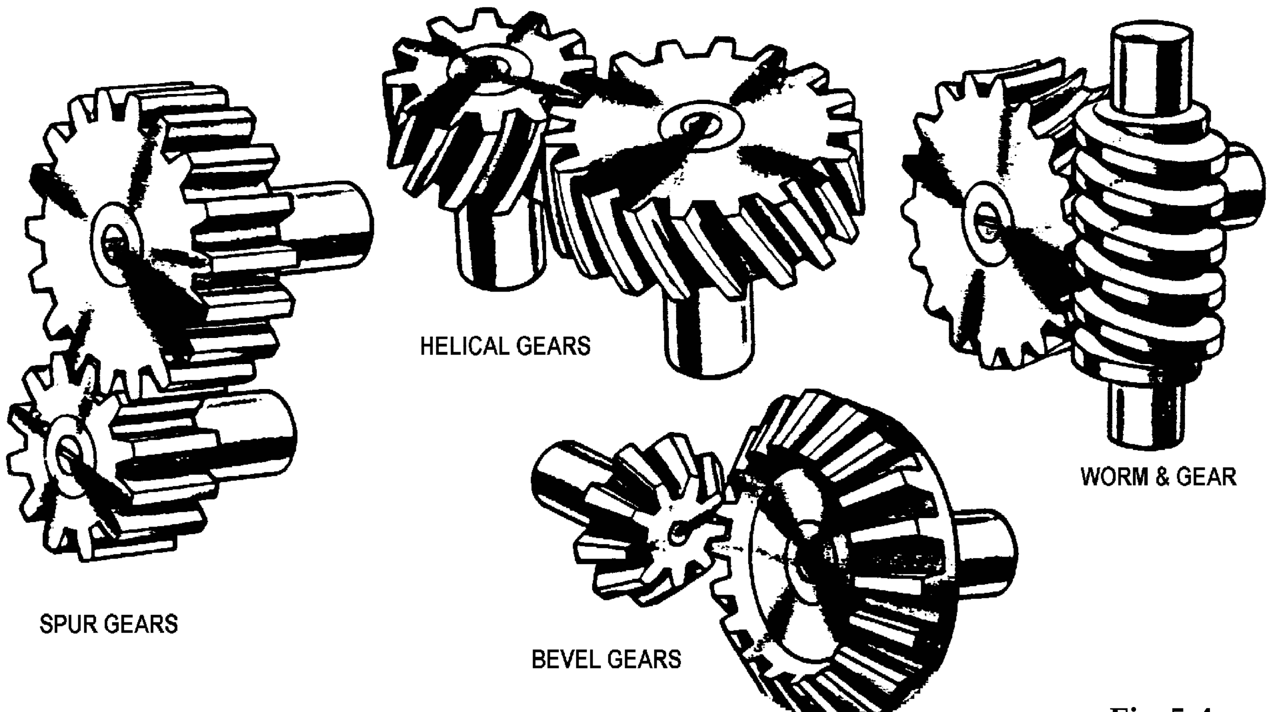
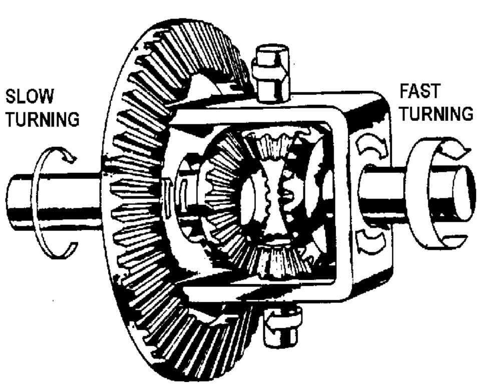
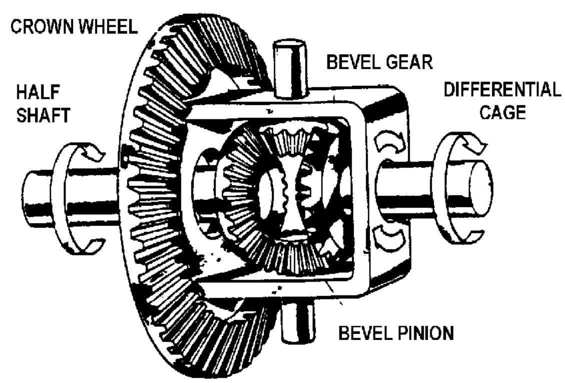


Fig. 5-4





To be able to move up or down, a motor used for suspended work platforms is **reversible.** It can deliver its torque in two directions, depending on whether the operator pushes the up or down button.

The turning output shaft of the motor drives the **gear reducer.** The gear reducer changes the high rpm and low torque of the motor into the low rpm and high torque necessary to lift the loads using a drum. Gear reducers are sets of gears held in position by bearings.

The motor input gear has few teeth while the drum drive gear has many teeth. The teeth on both gears are the same size so they can mesh. This means that the motor input gear is smaller than the drum drive gear. As a result, several revolutions of the motor gear are required for one revolution of the drum drive gear. At the same time, there is an increase in torque from the smaller to the larger gear. In this way, the reducer converts the higher rpm and low torque of the motor into a high torque and low rpm of the drum.

Different gear reducers use different types of gears to change torque. Each type has requirements and characteristics selected by the manufacturer.

The drive gear in our example may be the final gear in the gear reducer, or there may be additional gears to further reduce the rpm and increase the torque. The last gear in the gear reducer is connected to the drive output shaft, which turns the drum at slow rpm and high torque. The rope wrapped around the outside of the drum moves when the drum moves, lifting or lowering the load.

3.3 The Drum

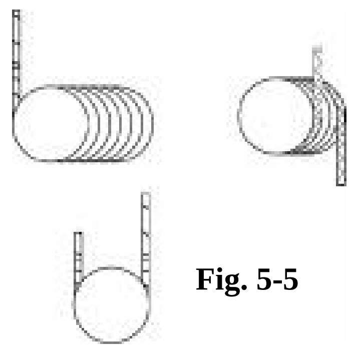


Fig. 5-5

The drum may be one of four basic kinds. Some winding drums have grooves to hold the rope; other drums have a smooth surface. (See Fig. 5-5.)

The **traction drum** lifts the load by winding several wraps of rope around the drum and feeding the rest out of the hoist as the tail line. Manufacturer's instructions will specify the size and construction of the wire rope.

The **traction sheave** hoist is a special kind of traction drum hoist that uses a single-wrap v-grooved drum called a sheave, or a single wrap of rope clamped between two rotating discs. The rope is held on or in the traction sheave by spring action and by the the load on the hoist.

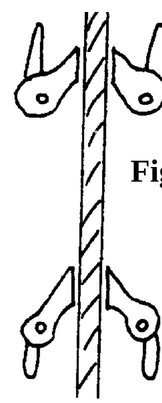


Fig. 5-6

The fourth kind of drum is not really a drum at all, but uses a set of **grips** to hold the rope while another set of grips grabs the rope and moves the hoist and load. The first set of grips slides along and regrips the rope as the second set releases, in a stepping or hand-over-hand action. (See Fig. 5-6.)

3.4 Winding Drums

The winding drum hoist uses a round drum to gather the rope and to move the load. Some winding drums have grooves to hold the rope; some are smooth-bottomed. You should always be familiar with the hoist manufacturer's instructions for proper operation of the particular make and model you are using. Some manufacturers require that the bottom layer always be filled with rope while others require at least four wraps on the winding drum at all times. See Regulation Chapter 12.

Winding drums are designed to be used with a particular rope. Otherwise, the rope may pile up on the drum. If it wraps in the grooves, or on top of the grooves, the grooves may damage the rope. The pressure at the bottom of the rope wraps is very high. Mis-wrapped wire rope can suffer damage. Instructions will specify the kind of rope and the direction of wrap. Always put the rope on neatly and follow manufacturers instructions.

Winding drums have devices designed to keep the rope layering neatly on the drum. These are called **level winds,** because they lay the wire on the drum so it is wound in a level manner. Some winding drums use level winds that move evenly across the drum similar to a fishing reel winder, synchronizing the laying with the turning of the drum. Other winding drum hoists pivot the winding drum in order to align the wire rope properly with a fixed fairlead, or guide, and use the tendency of the wire rope to wrap upon itself to provide an even wrap. Still other winding drum hoists use the wire rope position on the drum to move the fairlead.

In all of these level wind methods, the moving parts require only a light coat of lubricant for best operation.

3.5 Traction Drums and Traction Sheaves

Traction drum hoists use the weight of the hoist and its load to pull the rope tightly onto the drum. The drive shaft turns the drum. The grip of the rope is caused by friction and a number of wraps on the drum which move the rope through the hoist. These hoists are very much like the winding drum hoists, except they do not store or collect rope. The rope is shifted from the drum to the rope outlet on the hoist.

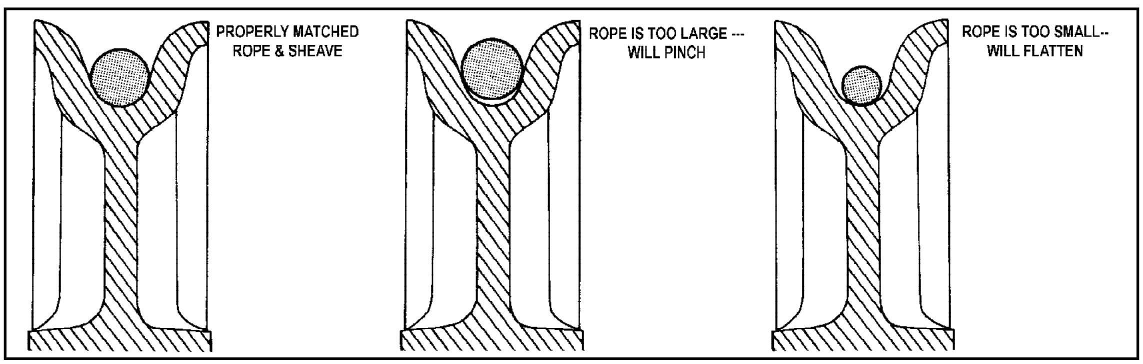


Fig. 5-7

Traction drums feed the rope out of the hoist. They can climb long ropes without the hoist having to lift the weight of the rope. (See Fig. 5-7) With traction drum and traction sheave hoists, the hanging rope above and below the hoist has to be considered part of the load on the support.

Because traction drum hoists don't continue to collect rope on the drum, they can climb long ropes without the hoist having to lift the full weight of the entire rope. Some hoists have spiral drums to move the rope across one rope thickness each time the drum turns once, so the rope moves along the drum as the drum turns. The rope is taken off the drum by a "kicker" after a few turns and goes out the bottom of the hoist.

Other types of traction hoists shift the rope from groove to groove on the traction drum by pushing it sideways using small metal or plastic tabs, sometimes called "fingers" or "finger guides." One kind of hoist moves several wrapped ropes over, and others move one rope over. The rope then leaves the drum and exits the hoist.

Many traction hoists use rollers or wheels to hold the rope in position on the drum. These rollers or wheels also aid in ensuring good contact between rope and drum to prevent rope slippage.

3.6 Gripping the Rope

Hoisting drums use the gripping action of the rope on the drum or sheave to move the rope through the hoist. The better the grip, the more reliable the movement of the rope. However, once the grip is strong enough that the rope doesn't slip, then more grip doesn't help. Winding drums must have at least four wraps around the drum for proper grip. Drums are made from various hardened metals. The friction that allows the drum to grip the rope causes wear of the traction drums over time. Follow the manufacturer's instructions to inspect and maintain drums to ensure good gripping.

The grip on the drum depends on several things. The drum surface needs to be clean and in good condition. Certain oils and greases on the drum may make it more slippery. A poorly maintained drum may have less grip.

The rope coming out of the hoist, or sharp bends in the hoist rope exit guide, can push rope back up onto the drum and lessen the grip. Using too stiff a rope can cause the rope to "fight" the bending around the drum and lessen the grip. Poor rope that is worn or bent can also cause gripping problems.

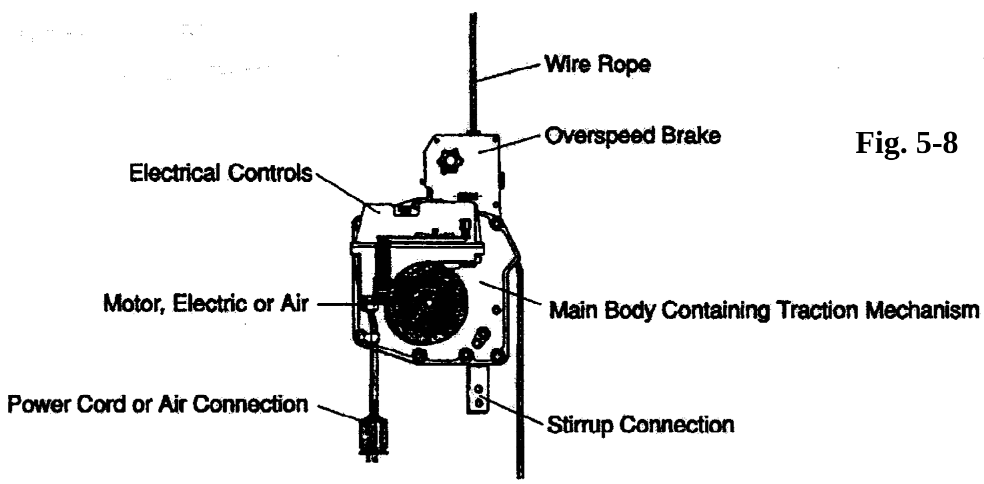


Fig. 5-8

The tail line has to have a straight and clear path down and away from the exit. (Fig. 5.8.)

Most traction hoists require that wire rope be routed straight out the bottom of the hoist exit, and some require that rope go straight down through the deck. For safety and efficiency, always follow each manufacturer's instructions closely regarding proper selection of and routing of the wire rope. Improper routing of the rope out of the hoists, for instance up and over the guardrail, can cause premature wear to the hoist, rope, and platform.

3.7 Brakes

A hoist must have two means of braking. The primary means is used to automatically stop and hold the hoist every time the motor is stopped. The secondary brake is used to stop the hoist on the rope if it travels down too fast (overspeed condition).

3.8 Primary Brakes

Many of the hoists you will use have their primary brakes connected to the motor. This means power must be applied to the motor to release the primary brake. (See Fig. 5-9.)

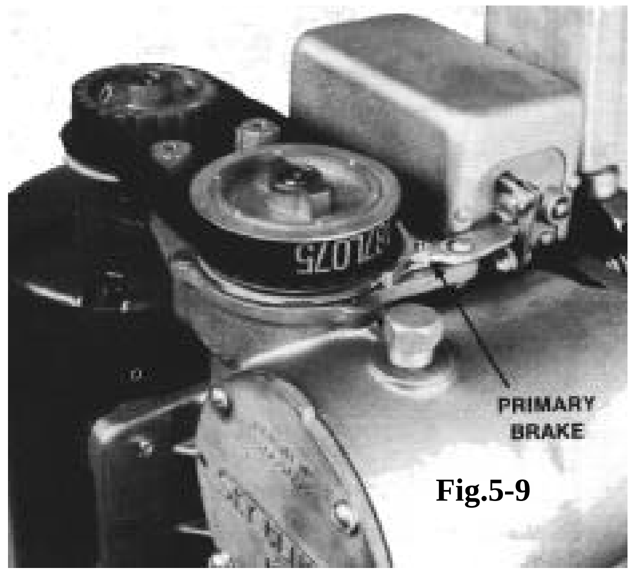


Fig.5-9

The springs pushing the brake shoes against the motor shaft are pulled back, and the motor can move freely. When the motor command is no longer sent and no power goes to the motor, the springs push the shoes back onto the shaft and stop the motor. Stopping the motor stops the drive train, which stops the drum, which stops the hoist and its load.

Some hoists have one-way primary brakes. These hoists drive against their brakes in the DOWN direction, and the brakes “free-wheel” in the UP direction. Releasing the “operate” control stops the motor. If you are going down and release the control, the already engaged brake stops the hoist and its load.

Checking the brakes is one more reason why you go up and then go down during your daily test — **Up, and then down.**

Fig. 5-10

3.9 Secondary Brakes

Secondary brakes are used to stop the hoist and its load on the rope in case of overspeed or other emergency. These brakes are automatic. Some brakes can also be tripped manually. When activated, they stop the hoist and often shut off power. Secondary brakes are also called overspeed brakes or brakes. (See Fig. 5-10).

A secondary brake has two distinct mechanisms. The first is a speed sensing mechanism. The second is a locking mechanism to grip and hold the wire rope. Both must work.

Secondary brakes usually grab the rope where it passes just above the hoist, or just above the drum. The brake uses rollers to hold the passing rope against a wheel, which turns a disc that has spring-held weights mounted to it. This is called the governor. The faster the governor turns, the further the weights move out, until one catches the trigger**.** The faster the wheel and disc turn, the farther the weights move out, until one catches the **trigger.** The trigger in turn releases the cam. (Some brakes use jaws.)

A cam is a curved metal shoe mounted on a pivot. When released by the trigger, the cam traps the rope between the cam face and a grab block. The trapped rope stops, and the hoist stops.

The governor senses the rope speed, the trigger releases the cam, and the cam holds the rope. All must work properly for the brake to work.

If the speed sensor has not been maintained, it may take longer to lock the accelerating falling load which is you.

The secondary brake on winding drum hoists acts directly on the drum. Some hoists use shoes which lock themselves, stopping the drum as soon as they touch the drum flange. Others use spring-loaded brakes held off by electrical or hydraulic solenoids, which operate as soon as pressure or power is lost.

In winding drum hoists, the speed of the hoist can be determined by the rpm of the drum. The faster the rope is moving off the drum, the faster the hoist is moving. The brake uses gears or sprockets bolted to the drum to run the governor disc. When the drum turns fast enough, a weight trips the trigger, which releases the brake shoe or solenoid. Some hoists use electronics to count special drum marks and trip when too many are counted in a second.

No matter which kind of secondary brake or sensor the hoist has, always refer to the instruction manual for the correct and complete procedure necessary to operate and check the function of the brakes.

Remember that the brakes are there to stop you. You have a primary system and a spare. Remember from Chapter 2, "A suddenly stopping weight has more force than a moving or still weight." With poor support equipment above, even the finest brake is no good.

3.10 Secondary Brake Manual Trip and Reset

Use the emergency stop button or manual brake actuator when you aren't sure of the situation and need to stop the hoist quickly to give yourself time to think, and when you need to stop **RIGHT NOW**. The manual brake trip is the button (usually red) on the hoist marked "Emergency Stop" or words to that effect. Look in the instruction manual for the location of the manual trip on the hoist you are using.

Don't hesitate when you use the manual trip. During normal operations, you should stop the hoist during normal operations by releasing the direction control button, to let the primary brake set and stop the hoist. If for any reason the primary brake doesn't stop the hoist, or if you aren't absolutely sure of what's happening, manually engage the secondary brake.

3.11 Setting The Secondary Brake

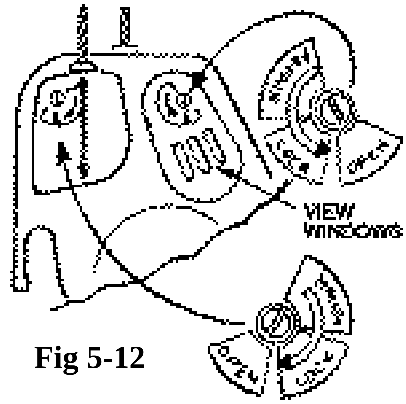


Fig 5-12

The secondary brake has to be "set" before it can operate. The **arming** or **reset** of the secondary brake is done by you.

Once the brake trips, it must be manually reset. The system is designed this way to ensure you check the hoist and correct any problem before you resume operation. Refer to the manufacturer's manual for information on the tripping and resetting of your secondary brake system. (See Fig. 5-12.)

3.12 The Rope Path

Threading the wire rope through the hoist, keepers, and safeties is called **reeving** the hoist. It is important that you put the rope through every device intended for it and that you carefully follow the reeving instructions.

3.13 Closed and Open Breach Hoists

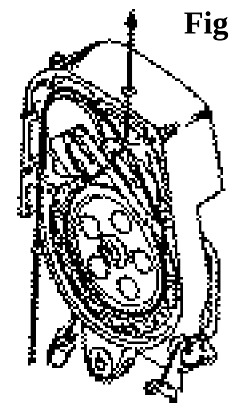


Fig 5-13

Hoists that require a free end of the rope in order to be reeved are called **closed-breach hoists.**. You must remove the rope by pulling the free end out of the hoist. The hoist housing is closed, and the rope cannot be inserted or removed at its middle. (See Fig. 5-13.)

Closed-breach hoists can be self-reeving or manually reeved. A self-reeving hoist usually requires that the end of the wire rope be prepared by brazing or welding it into a tapered point to prevent unraveling and be tapered to move smoothly through the hoist. The end is fed into the top of the hoist, and then into a guide or finger, and then onto the running hoist drum. Guards or rollers around the drum turn the rope end and guide it through its proper path around the drum, into the deflector at the exit, and out of the hoist. (See Fig. 5-14).

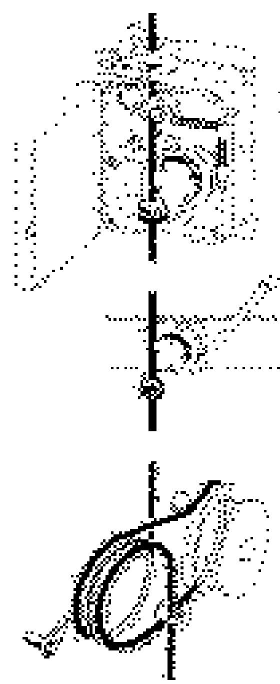


Fig 5-14

Breech reeving is useful if a brazed end is unavailable, if no power is available at the time of reeving or only a short section of the wire rope will be used for travelling.

Manually reeved hoists are reeved by bringing the rope into the top of the hoist, feeding the rope around the drum and between its fingers several times, placing the rope under the rollers, and then routing the rope out of the hoist. They can be reeved to a standing line and unreeved from a standing line. (A **standing line** is a straight rope that has no ends available.)

These hoists do not need the end of the rope to reeve the hoist. The rope is reeved into keepers above and below the drum. The keepers keep the rope in place and prevent it from unreeving. It is very important to double check that the rope is securely in all the keepers of an open breach hoist.

3.14 Rope Path

Rope paths may vary with different kinds of hoists. Each model is slightly different. The path described here gives you a general idea of rope path. Always see the manufacturer's instructions for proper reeving of the hoist.

The rope enters the hoist through a keeper or guide in the top of the hoist or frame. On some hoists, this guide is called the fairlead. The guide and fairlead align the rope with the rest of the hoist parts.

On traction hoists, the rope next goes through the secondary brake mechanism.

The rope travels down to the drum of the hoist. It wraps and turns on the drum as many times as the manufacturer specifies. In some hoists it will also pass under the rollers or wheels. In others, it will go through the fingers. In still other hoists, the rope is captured between the rotating discs that grip the rope.

In a winding drum hoist, the rope is secured to the drum by a termination, a special end on the rope made to correctly secure the rope. A minimum of 4 wraps must be left on the drum. See Section 3.4 and Chapter 12.

In a traction hoist, the rope is given its final shift sideways and sent to the exit guide. It is pushed out the exit guide by the drum action and becomes the **tail line.**

The platform and everything on it is moving; the wire rope is not. The wire rope will slowly saw through anything rubbing against it that is moving, so take precautions with power cords and platform components that may be in its path.

4.0 Accessories

This section covers a variety of hoist accessories: stirrups or hanagers, bolted connections, wire winders, top limit switches, slack rope brakes, auxiliary brakes and secondary ropes, control descent features, overload switches, power cables, and hand cranks. Although many are not actually part of the hoist, they can affect the operation of the hoist.

4.1 Stirrups or Hangers

The connection between the work platform and the hoist is called the **stirrup.** The stirrup can be connected to the hoist below the deck, as with many winding drums, or on the deck. The stirrup can pivot the hoist to keep it in line with the rope, or the stirrup can have wire rope guides to provide more stability and a load reaction point above the hoist.

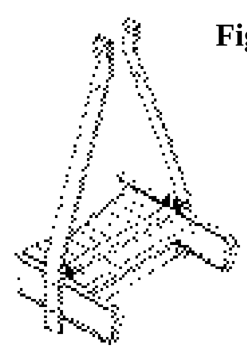


Fig 5-15

The stirrup, then, performs several tasks. It transfers the load between the hoist and platform. It controls the loading of the hoist and deck so they aren't damaged. It aids in platform stability. It helps line up the rope with the hoist or drum. (See Fig. 5-15).

Instructions for the stirrup-hoist assembly will tell you how the stirrup is to be connected to the hoist, and to the deck. It is strongly recommended that you use a hoist and stirrup from the same manufacturer, and that the stirrup be for the right model hoist.

Tighten the connections according to the manufacturer's instructions. Too loose or too tight can both cause problems. If there are two bolt holes or a bolt hole and slot, use two bolts, not just one.

DO NOT modify a stirrup to fit another hoist. The holes where the hoist connects to the stirrup are made to fit the right hoist for that stirrup. Holes are spaced or sized differently in different models to keep people from using the wrong combination. Don't ruin stirrups or hoists by drilling new holes in them. Stirrup adapters join an incompatible stirrup to a hoist. These adapters must be engineered connections.

4.2 Bolted Connections

The Operator's Manual or Manufacturer's Instructions will tell you what kind of bolts to use to connect the hoist to the stirrup. Stirrup-hoist instructions will tell you what kind of bolts to use to connect the stirrup to the deck.

Bolts come in different strength, toughness, material, thread, hardness, head, and shape. Grade is a common measure of strength. Some of the more common grades are grade 2, grade 5, and grade 8. A grade 5 bolt of a given thread and diameter is stronger than a grade 2 bolt of the same thread and diameter. Stainless bolts are almost always weaker than a grade 2 bolt.

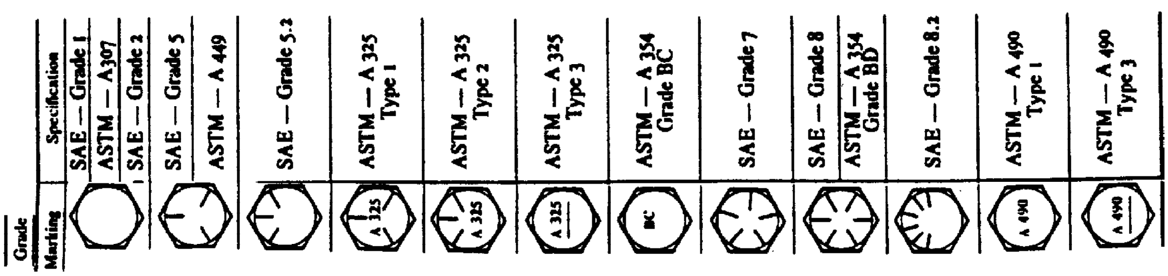


Fig 5-16

Hex head bolts and hex head screws appear identical. Usually, the differences aren't significant. (See Fig. 5-16)

Nuts don't come in grades, because the nut has to be softer than the bolt to work properly. Nut strength depends on thickness and material. The common nuts are jam nuts, heavy jam nuts, hex nuts, and heavy hex nuts. To be able to carry the full bolt capacity, at least a "hex nut" size is required.

Threaded rod from the hardware store is usually not bolt grade. It is made for holding shelves and bicycles, and is often of unknown strength, hardness, or manufacture. Never trust it for your stirrup.

The best way to ensure dependable bolts and connection hardware is to order it from a reliable scaffold dealer or rental company. The **grade 5 bolt you need** for a particular hoist will not only have the strength, but the toughness, surface, and length recommended by the manufacturer.

Allow for some thread sticking out of the nut. Some codes require three threads. You need to be sure that the nut is fully engaged on the bolt or rod, and torqued per the stirrup manufacturer's instructions.

4.3 Wire Winders

Wire winders are small rotating cages that collect and store wire rope. They are also used to store rope that will be lowered to a ground-rigged working platform so that the rope can be easily carried to the upper support.

Wire winders are basically free-wheeling cages within cages. The outer cage protects the inner cage and keeps feet, cables, and other objects away from the inner cage. Wire winders can be powered or manually operated. Powered winders use electric motors and clutches to spool the rope. They are most often found on permanently installed platforms and are covered in Chapter 6. This section covers the operation of manual wire winders. (See Fig. 5-17.)

Fig 5-17

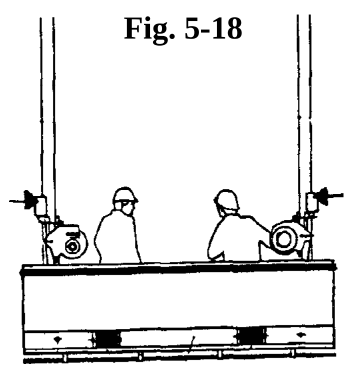
The inner cage rotates as the wire rope pushes through a feed tube aimed at an angle. The stiffness of the rope and the tube length are designed to make the rope lie along the outside of the cage. The cage rotates and spools the rope. When the rope stops, the cage stops. When rope is removed, the cage rotates in the other direction. The resistance is very low, and with stiff rope, so the inner cage rotates rather than jamming the rope around the center post.

Winders are designed for a limited amount of rope, and usually for a certain kind and size of rope. If you put in too much rope, or too loose a rope, or if the bearing is stiff, the winder will not work well. It is a good idea to look at the winder every few seconds to be sure it is spooling properly, especially as it fills, because it becomes harder to rotate and takes longer to start and stop. A winder that doesn't work properly can cause rope jams which can create problems when they occur in the air.

4.4 Auxiliary Brakes

Some hoists are equipped with auxiliary brakes to accept secondary ropes. A **secondary rope** is a rope that is used to support the end of the work platform when the primary support rope fails. The secondary rope is free-sliding through the auxiliary brake. In some auxiliary brakes, a governor is used to detect wire rope speed. Others simply lock when the primary wire rope becomes slack. Then the auxiliary brake grabs the secondary rope, holding the hoist and its load.(See Fig. 5-18.)

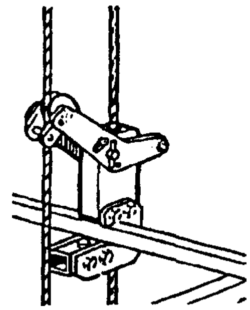
Fig. 5-18



Some auxiliary brakes are built into the hoist. Others are in small metal boxes bolted to the stirrup, the hoist, or the platform mount.

Auxiliary brakes with governors trip at slightly higher speeds than secondary brakes. This prevents them from setting before the secondary brakes acts.

Fig. 5-19



4.5 Slack Rope Brakes

Many hoists have slack rope brakes, also called lever brakes or cam brakes. These brakes grab the rope when the primary support rope goes slack, such as when the platform '"hangs up" on an obstruction while going down. Some are automatic. Others grab when the operator releases the brake. Usually the jolt of stopping moves the hand or arm, and releases the slack rope brake. These brakes also help keep the hoist from unreeving too much wire rope when the platform is on the ground. (See Fig. 5-19)

Automatic slack rope brakes sense the tension in the support rope, and set when the primary rope goes slack or the hoist tilts. Some hoists use the slack rope brake on the secondary, or extra rope, and lock on the second rope when the primary rope goes slack.

4.6 Power Cables

The power cable (or power cord) may seem like a strange thing to consider as an accessory, because the hoist certainly needs it. The hoist often runs poorly with a bad or undersized power cable.

In Chapter 2, we talked about the reasons why a motor doesn't perform as well with a '"light" electrical cable. Here we will talk about the cable itself.

An electrical cable has strands of tiny copper wires in its centre. Each copper conductor, as it is called, has insulation around it. The insulation prevents the electrical charges from getting to the adjacent conductor. Several insulated conductors are wrapped together in a second insulator, known as the cover/jacket/sheath. The cable you will usually use has a rubber or neoprene sheath.

The cover protects the conductors from sun, water, oil, and other damaging elements. The insulation keeps the charges in the conductors, and the conductors carry the charges.

Cables are rated in amperage and voltage. The cable rating is concerned only with protection of the insulation, not with how the motor works.

The cable voltage rating is the voltage that the cable insulation can withstand. A higher-than-rated voltage in a cable or cord can push charge right through the insulation, shorting out the cable. You must use a cord with a voltage rating greater than the outlet voltage. A common cord used with swing stages is 600V.

The amperage rating is how many amps (charge moved per second) the conductor can carry without getting the insulation hot enough to let the charges get to the next conductor. When you have long cords, the cable amperage rating is not very useful, because you need bigger conductors, based on voltage loss and current.

Remember that it takes voltage to push the charges along. The longer the conductor, or the smaller the conductor, the more voltage is used for pushing and the less there is for the motor. So what you want are big conductors, short cables, and no nicks in the conductor.

To make the hoist work well with the available voltage, you use the biggest conductors you can reasonably get. Single phase hoists with a rated load of 1000 pounds (453kg) usually use 10/3 (3 conductor, 10 gauge). Bigger conductors, of course, weigh more. Conductor size is rated in gauge. The smaller the gauge, the bigger the conductor. If you need more amps and less voltage, "upsize" your cable at least one gauge from the amp charts, if not more. (See Fig 5-20.)

Copper Conductor Sizes for 5 Percent Drop in Potential on 110-120 Volts
Single Phase — 2 Single Conductors

Current	Approximate Distance in Feet to Centre of Distribution																				
(Amperes)	20	30	40	50	60	70	80	90	100	120	140	160	180	200	240	280	320	360	400	450	500
1	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
2	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	14	14	14	14	12
3	16	16	16	16	16	16	16	16	16	16	16	16	16	14	14	14	12	12	12	12	10
4	16	16	16	16	16	16	16	16	16	16	16	14	14	14	12	12	12	12	10	10	10
5	16	16	16	16	16	16	16	16	16	14	14	14	14	12	12	12	10	10	10	10	8
6	16	16	16	16	16	16	16	16	14	14	14	12	12	12	12	10	10	10	8	8	8
7	16	16	16	16	16	16	16	14	14	14	12	12	12	12	10	10	10	8	8	8	8
8	16	16	16	16	16	16	14	14	14	12	12	12	12	10	10	10	8	8	8	8	6
9	16	16	16	16	16	14	14	14	14	12	12	12	10	10	10	8	8	8	8	6	6
10	16	16	16	16	14	14	14	14	12	12	12	10	10	10	8	8	8	8	6	6	6
12	16	16	16	14	14	14	12	12	12	12	10	10	10	8	8	8	6	6	6	6	6
14	14	14	14	14	14	12	12	12	12	10	10	10	8	8	8	6	6	6	6	4	4
16	14	14	14	14	12	12	12	12	10	10	10	8	8	8	6	6	6	6	4	4	4
18	14	14	14	14	12	12	12	10	10	10	8	8	8	8	6	6	6	4	4	4	4
20	14	14	14	12	12	12	10	10	10	8	8	8	8	6	6	6	4	4	4	4	2
25	12	12	12	12	10	10	10	10	8	8	8	6	6	6	6	4	4	4	2	2	2
30	10	10	10	10	10	10	8	8	8	8	6	6	6	6	4	4	2	2	2	2	2
35	10	10	10	10	10	8	8	8	8	6	6	6	4	4	4	2	2	2	2	1	1
40	10	10	10	10	8	8	8	8	6	6	6	4	4	4	2	2	2	2	1	1	1/0
45	8	8	8	8	8	8	8	6	6	6	4	4	4	4	2	2	2	1	1	1/0	1/0
50	8	8	8	8	8	8	6	6	6	6	4	4	4	2	2	2	1	1	1/0	1/0	2/0
60	6	6	6	6	6	6	6	6	6	4	4	2	2	2	2	1	1	1/0	1/0	2/0	2/0
70	6	6	6	6	6	6	6	4	4	4	2	2	2	2	1	1/0	1/0	2/0	2/0	3/0	3/0
80	6	6	6	6	6	6	4	4	4	2	2	2	2	1	1	1/0	2/0	2/0	3/0	3/0	4/0
90	4	4	4	4	4	4	4	4	4	2	2	2	1	1	1/0	2/0	2/0	3/0	3/0	4/0	4/0
100	4	4	4	4	4	4	4	4	2	2	2	1	1	1/0	1/0	2/0	3/0	3/0	4/0	4/0	
125	2	2	2	2	2	2	2	2	2	2	1	1/0	1/0	2/0	2/0	3/0	4/0	4/0			
150	1	1	1	1	1	1	1	1	1	1	1/0	1/0	2/0	2/0	3/0	4/0	4/0				
175	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	2/0	2/0	3/0	3/0	4/0						
200	2/0	2/0	2/0	2/0	2/0	2/0	2/0	2/0	2/0	2/0	2/0	3/0	3/0	4/0	4/0						
250	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	4/0	4/0								
300	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0									

See Notes

Fig 5-20

Of course, the cable should be protected with **strain reliefs (**Fig. 5-21) at the plug and sockets, which is attached to the platform, or when two cords are connected together, to take the load off the plugs. Remember, if wires are broken inside the cable, there are weaker conductors to carry the charges, so less voltage is delivered to the hoist. Check regularly for cord damage at the strain relief device.

One further word of advice. The electrical code doesn't require it, but a good practice is to use "pigtails" of different lengths. Pigtails are the ends of the conductor inside the plug housing. Leave the ground "pigtail" longer than the others, and if the cable should ever pull

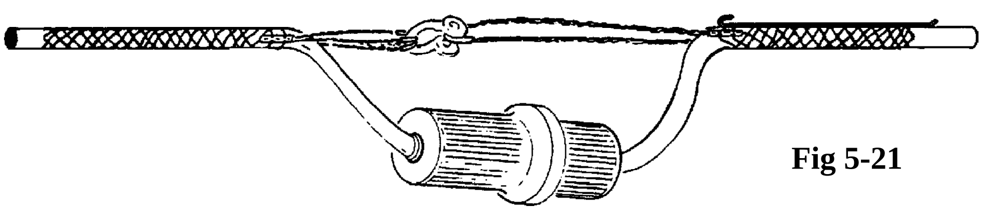


Fig 5-21

out of the plug, you will have the connected ground protecting you until the other wires are torn completely loose.

4.7 Hand Cranks

The hand crank lets the operator substitute manual power for motor power. It is practical for travelling a short distance or as a last resort, because most electric motors run at 1800 rpm, and most hoists run between 15 and 35 feet per minute. That means 1800 turns of the hand crank are needed for every 15 feet of hoist travel.

In an emergency, don't even think about climbing the rope. It is lubricated, rigid and small in diameter. Stay with the platform.

Refer to the manufacturer's instructions to operate the hand crank on the hoist you are using.

4.8 Controlled Descent

The control descent feature allows the hoist to move down at a controlled speed without power by releasing the primary brake. It is basically a one-way release and an overall safety feature.

A hoist equipped with controlled descent has controls and devices built into the motor and drive which keep the hoist from moving down faster than a percentage of normal speed. If you lose power, control descent still lets you descend. If the primary brake completely fails, but the drive and motor are intact, the hoist descends no faster than a set speed.

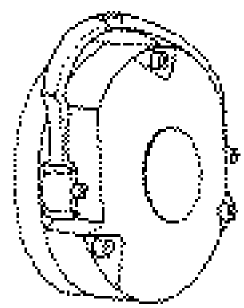


Fig 5-22

This feature is required in some industries, such as petroleum and grain handling, where quick non-powered exit by the worker from a dangerous environment must be guaranteed.

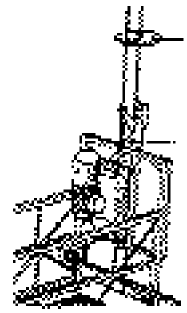
In most equipment, the descent control is automatically engaged when power is removed and the primary brake is released. Both hoists on a two-point suspension working platform must be operated together to keep the platform level during descent. Refer to the operating instructions of the hoist you are using. (See Fig. 5-22.)

Air motors equipped with exhaust restrictions (such as orifices or throttle valves), can descend without power in a controlled manner by using motor back pressure. The power vanes inside the motor trap air and push it against the exhaust restriction, slowing descent. Consult the hoist instruction manual for directions on the use of non-powered descent.

4.9 Top Limit Switches

Some hoists are equipped with top limit switches. A **top limit switch** interrupts power to the motor when the hoist moves up into a stop or obstruction. The stop pushes or engages the top limit switch. (See Fig. 5-23.)

Fig 5-23



These switches are required in some applications. When used with a proper stop, they prevent the hoist from stalling on the rope termination or possibly running the operator into an overhead obstruction.

To release a hoist that has been stopped by the top stop limit, it is necessary to drive the hoist in the down direction. Some hoists have a special button which also must be pushed in order to move away from the stop.

These switches are to stop you in case of error or other problems. They are not meant to be the normal stop, so don't run the hoist up until it hits the stop. Use the equipment properly.

4.10 Mechanical Overload Switches

Overload switches detect the lifting force of the hoist, and stop the hoist when the pull has gone beyond safe limits. These switches usually engage because there is too much load in the platform or the platform catches on an obstruction while moving up.

The over-current limits, thermal protector ("heaters") in the motors or in the control box are **NOT** force overload switches which sense current. The overload switches we are talking about here sense the stress of the hoist. As we learned in the electrical section, for a given load on the hoist, the current which operates the over- current sensors can vary dramatically with voltage, motor type, and individual motor efficiency. Do not use the tripping of the "heater" in the motor as a way to check your load against the rated load of the hoist.

5.0 Hoist Loads

Testing agencies and regulations limit hoist pull or its "stall capacity," to no more than three times the hoist rated load. This means the motor and the gear reducer of a 1500-pound (680 kg) rated hoist can generate forces sufficient to pull more than two tons (1814 kg). The loads from a hoist must be respected.

A characteristic of many electric motors is that higher than normal torque load occurs each time the motor starts. The motor tries to deliver that load to the rope and the rigging.

For example, a hoist rated for 1000 pounds (454 kg) has a typical electric motor which can deliver three times its normal output when it starts (and also when it stalls). Regulations limit hoists to no more than 3000 pound (1360 kg) maximum pull.

If your rigging is properly set up for a 1000-pound (454 kg) load, your rigging will hold a pull of at least 4000 pounds (1814 kg)(because of the four-to-one margin).

So, the real load from the 1000-pound (454 kg) rated load hoist is up to 3000 pounds (1360 kg), and the 1000 pound (454 kg) rated properly set up rigging can hold 4000 pounds (1814 kg). This is a safety factor of 1.3. A factor of one or less means it fails. That .3 margin is all you have between you and a fall when you load the platform beyond the maximum allowable hoist load.

There are many factors that can additionally affect the margin of safety:

- Overloading the hoist.
- Using too few counterweights.
- Assembling the outrigger incorrectly.
- Using the wrong tie-back cable or no tie-back at all.
- Extending the outreach or cantilever too far.
- Constructing a modular platform with multiple hoists without a hinged section.

Use the tieback. Keep the load as light as possible. Don't push it all to the limit, because that four in the four-to-one is a life-saver.

5.1 Hoist Maintenance And Operation

Each hoist has its own maintenance and operating procedures. Manufacturers regularly update their instructions, and they want you to have the latest information available.

Nearly all hoists must be inspected daily before use, and some more often. Consult the manufacturer's instructions regarding inspections.

As a general rule, a hoist should go in to a service technician at least once per year for an in-depth maintenance inspection. Hoists in regular service require maintenance based on hours of use and operating conditions during use. Consult the instruction manual for your equipment.

Each make and model of hoist has different requirements. Leave service and repair to the qualified technicians available to keep hoists in proper working order.

If the hoist is not working, if it has an obvious problem, or if its performance is questionable, take it to a qualified repair shop. Scaffold rental companies can direct you to one.

Before you operate a hoist, review the manufacturer's instruction manual. Follow the instructions.

5.2 Storing The Hoist When Not In Use

For overnight storage, take the hoist inside to a dry secure place. If that is impractical, then cover the hoist and rope.

When a hoist has been caught in the rain, follow the manufacturer's instructions to remove any water.

If you are storing the hoist for some time, have it lubricated for storage. Then, cover it to keep dirt and water off, but leave a small space at the bottom and near the top for air to move through. Run the rope through the hoist for about five minutes each direction, every thirty days, and inspect for corrosion. Follow manufacturer's instructions for long-term storage.

5.3 Hoist Problems

As an operator, you need to know some of the things that can signal a problem in the hoist. Problems may arise between regular scheduled maintenance. Many of the more common signals are listed in the operator's manual (or manufacturer's instructions) under the "Troubleshooting Guide." We will only mention a few here. Your handbook has a review list with many of the manufacturer's precautions.

1. One of the first signs of a problem is a hoist that is slow starting or occasionally "pops" the circuit breaker or fuse. The motor could be trying to overcome low voltage, it could be damaged, the drive could be damaged, or the brakes may drag or be overloaded.
2. Another good indication of a problem is noise. Most gear reducers are made to run quietly. Grinding in the gear reducer might mean a bad bearing or chipped tooth. If the sound from the hoist gets louder while operating, or if you hear noise when you are doing your tests, do not use the hoist. It might be a bearing or a gear, or it might be a damaged gear eating another gear. Stop the hoist and report it. Make no further attempt to operate the hoist until the problem has been identified and corrected.
3. A hot hoist is also a sign of trouble. Many gear reducers do run hot to the touch. The manufacturer's manual should be checked as to whether your hoist is to run warm.
4. Difficult reeving or rapidly wearing rope is another sign of internal trouble. Return the hoist to a qualified service center for repair. "Nursing" the hoist along risks rope damage and costly internal damage.
5. It's a bad sign if the brakes are not working, or the governor wheel is not turning. You may be without brakes. Shut down the hoist immediately!
6. Any sticking, jumping, cogging, or jerky action tells you to shut down the hoist and have it repaired.
7. Many problems are caused by low voltage, so power cord length and supply are often the first place to look.

6.0 Manually Powered Hoists

There are applications for Manually Powered Hoists that suit some hoisting requirements. These fall into the category of using Block & Tackle that uses fiber rope or steel wire rope for lever or rotating handle arrangements.

6.1 Manual Block & Tackle Using Fiber Rope

These are being used less and less for suspended scaffold applications, but when used, extra precautions must be followed for safe operations. (See Fig. 5-24 on next page.)

The wood shells of the block add no strength to the block but merely serve as an enclosure for the sheaves. The quality of the bearings dictates the mechanical advantage.

This will also govern the number of parts of line needed to lift the required load.

Every Rigger must know the important calculations required:

- How to determine the number of parts of line to make a lift.
- How to determine the maximum load that can be lifted with a given reeving arrangement.

- How to determine the line pull needed when the weight and number of parts of line are established.

It is important to follow the manufacturer's instructions for maintenance and safe use.

6.2 Manual Hoists Using Steel Wire Rope

There are two main types:

Those operated by a handle (see Fig.5-27); and

Those operated by a crank (see Fig.5-28 on next page).

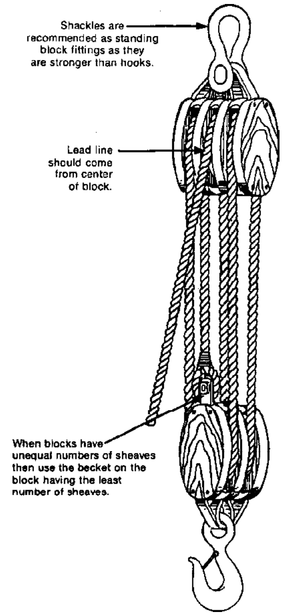


Fig 5-24

FACTORS TO ACCOUNT FOR SHEAVE FRICTION LOADS
FRICTION FORCE = 3% of Sheave Load
Typical of good roller bearing sheaves

Number of Parts of Line N	Multiplication Factor F	Ratio R (R = N/F) = Actual Mechanical Advantage
1	1.03	.97
2	1.06	1.89
3	1.09	2.75
4	1.13	3.54
5	1.16	4.31
6	1.20	5.00
7	1.23	5.69
8	1.27	6.30
9	1.31	6.87
10	1.35	7.41
11	1.39	7.91
12	1.43	8.39
13	1.47	8.84
14	1.51	9.27
15	1.56	9.62
16	1.61	9.94
17	1.65	10.30
18	1.70	10.59
19	1.76	10.80
20	1.81	11.05

Fig 5-25

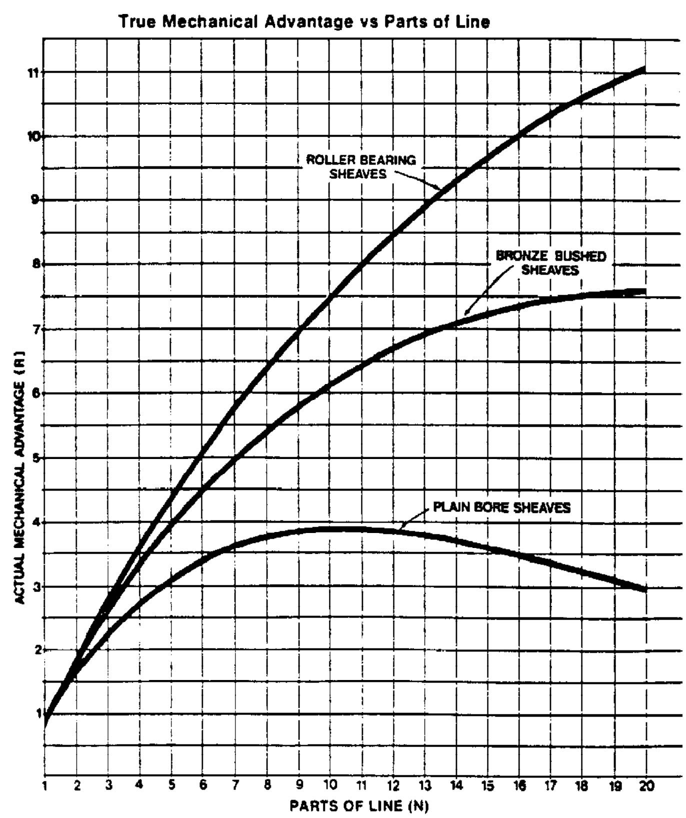


Fig 5-26

Those with the handle operation have internal jaws that grip the wire rope (that passes straight through the hoist), one after the other as the handle is positioned and moved in one direction or the other.

Those with the hand crank have the wire rope wrapped around the drum (which is locked by a lever that is released to operate), and the hand crank is rotated to provide movement in one direction or the other.

Speeds are reduced greatly from those of power hoists. Manufacturer's instructions must be followed for correct maintenance and safe use.

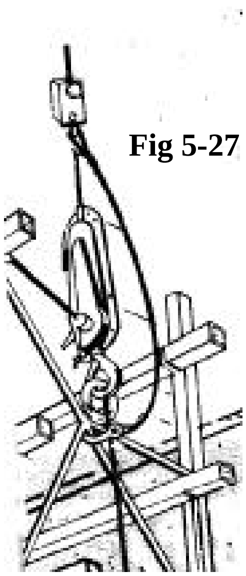
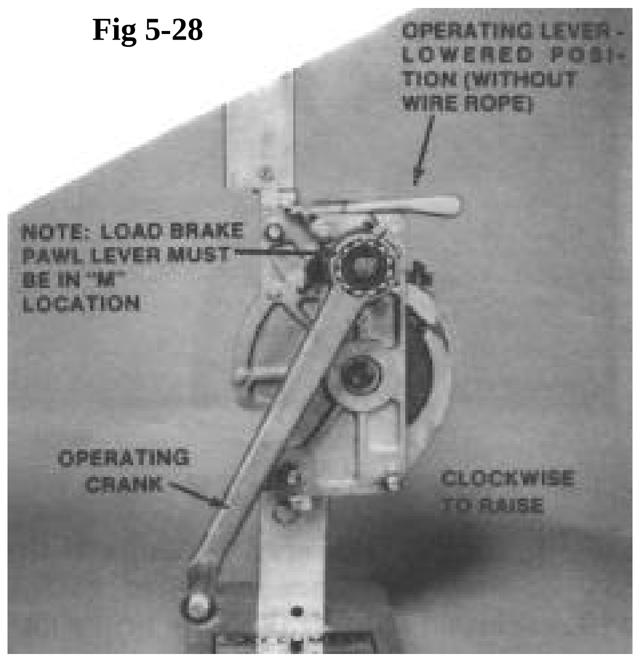


Fig 5-27

Fig 5-28



CHAPTER 6

PERMANENT INSTALLATIONS

Contents

CHAPTER 6: Permanent Installations

1.0 Introduction

Permanently Installed Systems are suspension equipment that has been engineered, designed and dedicated for use on a particular building for access to areas that need window cleaning and other usual building maintenance. They may be for use on the outside of the building or for use on the inside, like reaching areas in a skylight or atrium.

Some equipment is never removed from the area that it will be used in, like units that are stored on the roofs of the buildings they work on, and some of them are assembled and rigged only when they are to be used and are dismantled and stored when they are not in use.

Permanently Installed Systems, often called PI's (as we will call them) share many things in common with the other scaffold systems that you have already read about and will read about in Chapters 1 through 12. This chapter will refer you to items in those chapters and will explain to you some differences, a little more about some of their common features, and the things that are only to be found on a PI System.

Note: In this chapter when we say building owner it can mean the owner, an agent or any other person that represents the building owner, such as a superintendent. This person may or may not be at the actual building site.

2.0 Codes

The codes that affect the construction and use of PI Systems are different from the codes that cover the equipment you have already learned about. There is a Federal OSHA Code called 1910.66 that has broad coverage over them, but many States, like California, New York, Massachusetts and Washington, among others, have their own codes that go further than the Federal one. Your local OSHA Compliance Office will be your best source for further information about local codes.

Additionally, The American Society of Mechanical Engineers has two codes that PIs also should adhere to. They are called The ASME A120.1 Standard, *Safety Requirements for Powered Platforms for Building Maintenance* and The ASME A39.1 Standard, *Safety Requirements for Window Cleaning.* Both of the ASME Codes are also recognized ANSI Standards.

3.0 Basic Characteristics of Permanent Installations

A PI System is designed by an Engineer for the building that it will be used on. The support equipment and suspended equipment as well as the safety system are all made to work together and must be used together. There is a written plan for the system and how to use it.

The suspension loads are supported directly to the building through socket and davit systems, outriggers, roof carriages or trolleys that roll on tracks. There are also electrical and safety features and ways to get to and from the equipment to make its use easy and safe. PI's are used in areas where the public is not aware that the PI System is being used near them. In other words, buildings with PI Systems are finished, occupied and are not construction sites.

The platforms, work cages or other suspended items have either rollers, guides or tie-in devices that will keep them against the building and stabilized. Some buildings whose heights are less then 130 feet have PI Systems but do not use guides or tie-ins. The work suspended platform used on these buildings must rely on *angulated roping* to minimize wind sway.

3.1 Items in common with other Suspended Scaffold Systems

The topics learned earlier such as rigging, stabilization, hoist and wire rope use and care, and user fall arrest safety all apply to PI installations. Each lesson, item, and concern that you have learned in the previous chapters must be considered when using a PI System.

Do not think that because a PI is an engineered system that good work practices, care and safety are concerns you need not worry about. You are still the one on the platform, the one who can be hurt and the one who accepts the additional responsibility to protect the general public that may be below where you are working.

4.0 Types of Permanent Installations

There are several different types of Permanent Installations and many reasons why one type is chosen over another. The decision may be based on the shape of the building; the type of windows that will be cleaned; the areas to be serviced; the height of the building; or the budget of the building owner.

4.1 Single Point Suspended Units

The platform or work cage is suspended by one support point (davit, etc.) with at least two lines: a primary rope suspension to support the work cage and a secondary rope for safety. The second wire rope is provided so that if the primary wire rope or hoist fails, the platform remains suspended.

Cages often have an overhead support or a roof that is over the work platform. Therefore, your fall arrest harness's lanyard is attached to a structural part of the platform, (see four wire unit safety lines).

Cage rotation and stabilization is a concern and unless the cage or platform is continuously attached to the building either by a track and guide or building rollers and an intermittent stabilization system, a requirement if the suspension of the unit is over 130 feet high; extra care must taken in its use. Comparing single point PI units with portable units, the main differences are that the optional equipment discussed in Chapter 4 is now mandatory.

4.2 Two Point Suspended Units

The platform is suspended by two wire ropes; one rope supporting each end of the platform. The failure of one rope may not permit the platform to fall to the ground; it could be supported by the remaining rope and its suspension. However, in this case the stage will be nearly vertical. The power system for raising and lowering the working platform may be a roof mounted drum hoist or platform powered by either a drum or traction hoist. When using a two point suspended unit each use must be attached to an independent safety line. (These units were once called *Type 'T' Systems*.)

4.3 Four Wire Suspended Units

The platform uses least four wire ropes; two or more ropes supporting each end of the platform. Failure of any one rope will not substantially change the position of the platform. The hoist for the system can be mounted on the platform or on the roof. If it is a winding drum mounted on the roof it may have only one layer, or winding, of rope on the hoist drum, (no rope on top of rope). Other roof-powered hoists use a multi-layered drum hoist to raise and lower the platform. (Note: These four wire roof mounted hoist systems were once called *Type 'F' Suspension Systems.*)

5.0 Support Systems

5.1 Sockets and Davits

Sockets and Davits are the most common type of PI support systems in the United States. As you will learn in Chapter 8, these systems transfer their loads to the structure through Davit Sockets and their Bases, which are fastened to the building. A Davit can be used to suspend a single-point system or used in pairs to support a two or four wire rope suspended platform.

A Davit Base Pedestal or Base Plate with its removable Davit Socket is called a "Mobile Socket System." Davit Sockets can also be permanently installed to the building at the predetermined platform suspension point. Socket systems can be anchored to the roof, the parapet or to a track that is attached to the building. Some systems have a davit socket on a roof carriage as well.

Davit systems used to support roof rigged, suspended platforms (platforms launched from the roof) are tall and rotatable so that the platform can be mounted inboard of the roof and swung, by using turning handles, over the side of the building for its descent and return for landing back on the roof. Roof or ground rigged suspended platforms using Davit Systems are self powered by either platform mounted winding drum hoists or traction hoists.

Davit Sockets, if in a Mobile Socket System, are made to clip, bolt or snap onto their Pedestal Units and be moved from suspension point to suspension point. It is important to be sure that the Mobile Socket is properly fitted to its Base. Cleaning of the Base and its roof area may be required to allow proper fit up. After fit up be sure that the clips, bolts, pins or other devices are fully engaged to ensure that the socket is secured to the pedestal.

The Davit Sockets prior to 1989 where fixed to the roof required that the davit be lifted and placed into the socket. The most common ones used today are the type. Tilt-up Davits allow the davit to be inserted into the socket at parallel or close to parallel of the roof level and then be tilted up. When the Davit is fully erected (tilted-up) you must be sure that the clips, bolts, pins or other device that locks it in its upright position are fully engaged to be sure the davit is securely fastened and can not fall backwards.

Davits that are long or heavy will have a hoist to lift them. Be careful when raising a davit not to strain yourself. Davits, due to their length and shape, can be awkward and hurt you or damage a building if not handled properly.

Some systems require a Davit to be moved from one roof level to another to re-rig the platform. Care must be taken when carrying davits through the building, using a building elevator or stairway, and when raising or lowering the davit on the outside of the structure. Be sure you have read and understood the system’s plans as to how all this should be safely done, including where, using what, and how many people are needed.

Davits and their bases and components should be cleaned before using to allow easy rotation and assembly and always elevated or tilted with all of its parts inside the roof. Davits, unless specifically called for, shall not be tied back to a roof anchorage.

5.2 Transportable Non-counterweighted Outrigger Beam Suspensions

In Chapter 8, Support Systems, you will be introduced to Outriggers. In this Chapter we address two variations of Outrigger Beams. This first type differs from what you have already learned in that there are no counterweights. The beams or outriggers, either of aluminum or steel, may be low on the roof or on a frame to get them clear of the roof’s railing or parapet. Transportable Non- Counterweighted outrigger beams must be fastened to the roof structure prior to rigging. If you use these beams without fastening them down you could be killed.

Tie down methods may differ from job to job: some tie-downs use a threaded clevis rod and fittings to prevent beam uplift and movement; others may use loops or some other device to hold it down and do the job that a counterweight would do. **The same care must be taken when using these outrigger beams as you would use with the counterweighted type outrigger beams.** The big difference is that you will not have to calculate the amount of weights that will be needed. Even though tying back to an anchorage may not always be required, it is a good practice to do so..

5.3 Transportable Counterweighted Outrigger Beam Suspensions

Here you can use much of the lessons learned about counterweighted outriggers that are covered in Chapter 8. The system's instructions will advise you as to what beam to use, which and how many weights to use and how to tie the outrigger beam back.

Here it is important to use the skills that you have already learned: look over the outrigger you have set up before you suspend the platform; does it look all right to you? If it were a support system and you were doing the rigging formulas for it would you be comfortable in riding the platform? If your answer is yes, then continue; but if you are in doubt at all, **stop**, and check it out to be sure that you have all the required weights or parts in place. You know the *drill.*

5.4 Trolley and Track Suspensions

On some buildings you will have to rig your primary suspension ropes and life lines to a trolley system that is mounted on a track or beam that is attached to the building. The trolley is a rolling support that will have a ring or eye for the support ropes, lifelines and sometimes the power cable. Usually each supporting end of the platform will have its own trolley, but sometimes they are all on one unit. Some of the jobs are easy to use as the platform with its hoists and suspension is all ready attached to the trolleys. Trolleys may be powered, or positioned by hand cranking or "muscle." Many units have locking devices to keep them from rolling on the rail. Follow the manufacturer's instructions for movement and use of the equipment and use a fall protection system.

5.5 Roof Car or Carriage Suspensions

These are the "Limos" of the business designed for ease of movement, generally by *push-button* control. They come in several styles and are either track mounted (that is, roll on a railroad type rail or a steel structural shape such as an angle), or they have regular wheels and roll on a runway made for their movement. They can move under their own power or they may require manpower to move them from drop to drop.

Some of the roof cars are simple with one or more davit arms mounted on them and the scaffold supported from the arms; some are very complicated with powered telescoping arms that move in and out, up and down and have the hoists with their winding drums mounted on them like large cranes. Some are called "Crane Style Machines" as they look like a crane, often extending over 100 feet beyond the roof's edge to allow the platform to reach all areas of a building below them.

The platforms that are attached to these roof cars and their suspensions may be a two-wire rope system or a four-wire rope system. Although these types of systems are highly engineered with many features to make using them simple you must learn how to use each one. The instructions, the person or company that services it, and the manufacturer are resources for you to use. Improper use of these units can not only hurt you but do a lot of damage to the building. Once you are familiar with the unit, it will be an easy and fun platform to work from.

5.6 Drop Through Suspension Points

Once in a while there will be a need to suspend a platform from above an overhang or balcony where the suspended scaffold is inside the edge of the roof. On these types of installations provisions are made in the overhang or balcony to drop the suspension wire ropes through them. Platforms used in this manner are usually ground rigged.

6.0 Suspended Platforms

Looking at the platform for a PI Unit will immediately tell you that it is different from a typical construction scaffold work platform. The handrail fully surrounds it and there is permanent screening to keep objects from falling on persons or property below the work area. There often is a central control with an Emergency Cut-Off Switch as well as other features that are not available or required on transportable platforms. The main features are as follows:

- Upper and Lower Limit Switches: These switches will stop a hoist from going too high or too low on its suspension rope. When you reach that point the hoist will stop.
- Leveling switch: This device prevents the platform from moving more then 15 degrees out of level. When this occurs the platform will stop and the operator must energize one hoist to correct the problem.
- Drum hoists must have rope winders to keep the rope from overlapping on itself and jamming.
- Traction hoists require wire rope winders to collect the rope. Suspension ropes can not hang below the platform.
- A central control emergency box for stopping all the hoists in case of an emergency.
- A method of communicating with others not on the platform in case there is an emergency and/or assistance is required.
- Each platform will have a Fire Extinguisher attached to it. It should be fully charged and have a current inspection certificate.
- On any platform that is suspended over 130 feet and sometimes on suspensions that are less there will be a means to stabilize the platform. The devices for stabilization will be on the platform. See the Stabilization section.
- Some installations require that platform’s length be increased or decreased by either adding or subtracting platform sections or by using drop down type ramps to get closer to the building for some of the drops on the structure. Refer to Chapter 3, Modular Platforms.

- Four wire systems may have provisions on the platform for attaching your harness's lanyard. The lanyard should have a two way acting rope grab to prohibit sliding down the platform should it reach an unstable angle.
- On systems with Intermittent Stabilization there will be a power interrupt switch to halt the platform's upward movement if an obstacle is meet. Some manufacturers incorporate this with the upper limit switch.

7.0 Stabilization Systems

On any building that is over 130 feet high and on some buildings of lower height a method of stabilization is provided. The operators of the scaffold must apply the system as the platform goes up and down the building. Four basic stabilization systems are as follows:

7.1 Continuous Building Track Systems

These systems use channels or "T" sections that are part of the building's wall system.

Shoes are attached to the platform and fit into the channel or around the "T." They slide as the platform moves up or down, keeping the platform positioned against the Building. The shoes are inserted into openings that are at the top and or bottom of the channel (sometimes called *rat holes),* or snap into the guide channels or around the "T" sections.

The channels must be clean and smooth to allow the shoe to slide up and down easily. Be sure there is nothing in the channel or for some reason it has not closed up or opened. If the platform shoes are binding in their tracks the hoist will want to keep lowering or raising the platform, causing a very dangerous situation. Be alert to this potential problem. The opposite problem where the track has opened and the shoe could come out allowing the scaffold to swing is also dangerous. If either event should occur, stop the platform and use your emergency communications for assistance. If there is excessive chattering of the slide in the channel during movement report this to the building representative.

Be sure that you remove the shoes before you attempt to return the platform to the roof top.

7.2 Track Systems using Building Anchors

This is the reverse of the Building Track System. This method puts the track on the platform and a line of guides or anchors often called "buttons" on the building. As the platform ascends or descends the track slips over the buttons and keeps it stabilized against the building, or in some cases, like where there are signs on the building, off the building. Usually three buttons per track are in each rail as the platform moves up and down.

The tracks are usually attached or set up on the platform after it is on the side of the building. This method is often used when the platform is ground rigged on a building that is over 130 feet high.

Use caution so as not to put your hands near the channels when the platform is in motion.

A variation on this method for ground rigged systems is to use removable buttons that are installed using a device like a ball-lock-pin, (you will learn about these shortly), before the platform guide reaches the ***button*** location. The button is removed on the descent and stowed. The tracks for these installations extend below the platform. This allows access to the uppermost button for insertion and removal. Care must be taken with the buttons so as not to drop them.

7.3 Intermittent Stabilization Anchor Systems

Many of today's buildings do not have straight up down lines, so another type of stabilization was developed to keep a platform against the building. This Intermittent Stabilization System has rows of anchors on the building spaced no more than every third floor or 45 feet apart in line with the suspension ropes. A device with a lanyard attached to it hooks on the anchors and is fastened to the suspension rope pulling the rope towards the building and pulling the platform against it as well. This acts as the Angulation Force that you will read about in Chapter 8.

The anchors used on buildings either stick out and are about 3/4" in diameter (also called buttons) and have a yoke that snaps over them; or they may be a flush type that is only a small 3/4"± diameter cylinder with a smaller hole in the center. A pin with balls on its end is inserted and locked into the hole. To insert or remove the pin, called a Ball-Lock-Pin, you push a button on its rear. When using either device be sure that it is fully engaged, yank on it, and then snug the lanyard to the rope.

If possible, loop the lanyard around the rope before engaging the anchor; this helps in keeping from accidentally dropping the stabilizer overboard.

The stabilizer units are installed as the platform travels down to each anchor location, tightening the lanyard to angle the rope. When the platform reverses its direction, as each stabilizer is encountered it is removed and stowed on the platform. There should be a switch on the platform that will stop the hoist if a non-removed stabilizer is met; this will not allow a pull on the anchor by the hoist. You must pay careful attention to their removal as well as their installation.

Failure to use the stabilizer anchors will permit the platform to swing or pull away from the building causing a dangerous unstable condition for you on the platform and possible damage to the building as well.

7.4 Standing Line Systems

These stabilization systems need special attention when being used. The system requires an independent wire rope to be rigged from the ground level to a support on the roof and then tightened. The platform will be guided by this wire rope line, called the standing line, much like a building guide except that the line needs to be intermittently stabilized. This is most important; the standing line if not tied back to the building can create very big forces on the ends of the line, forces much greater than the supports can hold. This can be very dangerous.

At locations along the standing line there are tie back anchors, much like those used for intermittent stabilization. They will pull the line into the building and minimize the bow effect created by the swinging platform. **Be sure to use these tiebacks.**

Standing line systems are almost always used on ground rigged platforms and should be treated with care not only in their tying back but when rigging the standing line itself. **If an installation does not have any stabilization system do not, on your own, make a standing line installation.**

NOTE: For any of these systems to be effective it is important to be sure that the platform's building face rollers are clean and properly inflated and spaced. This is a good practice for any building face roller.

8.0 Safety Systems

Just as for every other scaffold or elevated working area, you must use a personal fall arrest system while on the platform or while rigging or servicing the system, unless you are always within a properly protected area. Chapter 9 deals with this topic at great length; however, there are a few situations that are different.

Many PI Systems require an independent lifeline for each person on the platform. If an independent lifeline is to be used, there will be a designated anchorage to secure it to. The line should, as mentioned in the earlier chapter on fall arrest systems, be protected from any edges and the protection should be secured so that there is no chance that it will fail. The lifeline must be attached to the anchorage before proceeding onto the platform or over the side of the building. Lifelines should never be connected directly to a davit or outrigger even if the reason is just to keep the line off the parapet of the building.

You have been taught to always, while on a platform, use an independent lifeline; this is true except for the following conditions:

Often where PI equipment is used the buildings are very tall and have installed on them four wire rope systems to prevent upset of the platform if one support rope fails. On these types of buildings it would be impractical to use a very long independent lifeline. The wind would pull at it, trying to lift you off the platform. Using a rope grab over a long distance would be cumbersome and collection and weight of the lifeline would be a problem.

For these installations the occupants of the platform, at times called a cradle or gondola, attach their lanyards to an anchor or a horizontal trolley line on the rear of the platform, often called a dog line. A horizontal wire robe grab should be used. Only fasten to what has been designed for that use with the proper length lanyard.

This same special condition applies to single-point suspension systems as well, an item that you read about earlier in this chapter. Additionally, every 200 feet independent lifelines and the electrical cable must be tied back to the building or to another support to stabilize the system. The electrical cord must be secured to an anchor near the outlet receptacle (power source) before plugging it in, to protect it from unexpectedly disconnecting or tensioning. Your equipment manufacturer's instructions should tell you how this should be done. Lifelines must not hang below the platform and must be collected to prevent a tripping hazard.

Buildings with PI units have, on their roofs, an anemometer, which is an instrument to measure the wind speed. If the wind speed is over 25 miles per hour the platform is not to be in use. It is important to be aware of the wind and watch for gusts or other adverse weather. If the forecast is for even lower speed winds you must be aware that the shape of the building and where it is located could make the winds much worse. This is important when you think about how long it may take to go up over fifty stories on the platform and then secure it on the roof should the weather change for the worse.

All roof-stored equipment must be secured. There should be a place to store it and a system for holding it in place. Take care not to leave any unsecured objects on the roof like a pail or tools. The wind could blow them over the roof and hurt someone. The suspension equipment and the safety lines should be protected and not allowed to sit in water or be exposed to the weather, including the sun. Make sure that all instructions are followed for this procedure.

As a safety measure, all power to PI Systems must be turned off when they are not in service and access to them secured.

9.0 Auxiliary Systems

9.1 Horizontal Life-Line Systems

On buildings where railings or a parapet are not installed, or where there is a building feature such as a sloped roof, a Horizontal Life-Line System may be installed to prevent you from slipping or falling.

This system consists of a horizontally mounted wire rope which is attached to the building and runs along the area that you are to walk and work. Your harness lanyard is attached to the lifeline using a device that allows you to move along it. It may be either already attached to the rope or you may have to attach it yourself. The device will pass the lifeline supports and allow you to travel around the work area freely.

9.2 Self-Retracting Lanyard Systems

There are other systems that may be used, such as *Self-Retracting Lanyards.* Lanyards used with these systems can be either wire rope or a nylon strap that will stop a free fall. It is important to be sure that the device is available and that you use the proper lanyard for the system that you are hooking to. Each system is designed differently and the equipment for its use is different. Be sure that the building's representative has provided you with the information and supplies to use the system.

9.3 Rolling Ladders and Platforms

Atriums and ceiling glass are usually not accessible from suspended scaffolds. In order to obtain access to these areas the building may be equipped with a movable ladder or platform system which is moved by power or manually. When working from these systems treat them like a scaffold, taking the same safety precautions.

9.4 Fixed Ladders and Platforms

These are work areas that are part of the building. Often they are used to reach a roof carriage, or a part of a suspension system, like a track, where a platform is suspended. They may be “cat walks” (fire escape looking platforms) or ladders. There may be a fall arrest system or cage provided to protect you while on them. Before using one of these units check to see if a fall arrest system is provided and, if so, that you have the correct piece of equipment to attach your harness to. When climbing any ladder be sure that your hands are free so you can grip the rungs with both hands.

10.0 Automatic Window Cleaning Systems

Although there are very few Automatic Window Cleaning Systems in the United States you should be aware that they do exist. Some travel only up and down and some also left and right. They have heads on them for washing and drying the building’s windows. Their suspension is not much different than a PI System.

Currently all automatic window cleaning systems installed in the United States can be manually operated. When working on one, treat it like any other PI Scaffold System but remember that the unit, due to its automatic equipment, is much heavier then a non-automatic one and will require special care and consideration when using it.

11.0 Inspection and Servicing of PI Equipment

Permanently Installed Equipment, by its dedicated nature, requires on site servicing and testing as opposed to transportable equipment which is returned to the shop after use. In addition, PI systems are more complicated and need their own qualified people to maintain them.

A maintenance inspection of each installation is required no more than 30 days prior to each use. This is to be done by a competent person who is qualified to work on the system. The building owner is required to have a written record of this maintenance inspection including the day it took place, the person who did the inspection, and a statement that the unit is fit for use. As a user ask to see this report and any other service records before you use the system. You should also make sure you have a copy of the operating instructions and any other information needed to properly use the unit. There may be things that you must do to the unit before or during its use.

Any problem that you encounter with the unit, no matter how minor, must be reported to the building owner by written notification in addition to speaking with him or her.

12.0 Emergency Plans and Procedures

Each PI Installation will have an Emergency Plan with information and procedures for what to do when a serious problem arises. Before using any system you must read and be familiar with the plan. The plan should be a part of the instruction manual; in addition, the building owner should also have a copy available. Don't take the only one - have a copy made.

Remember, these buildings are occupied and often sealed so rescue is more complicated.

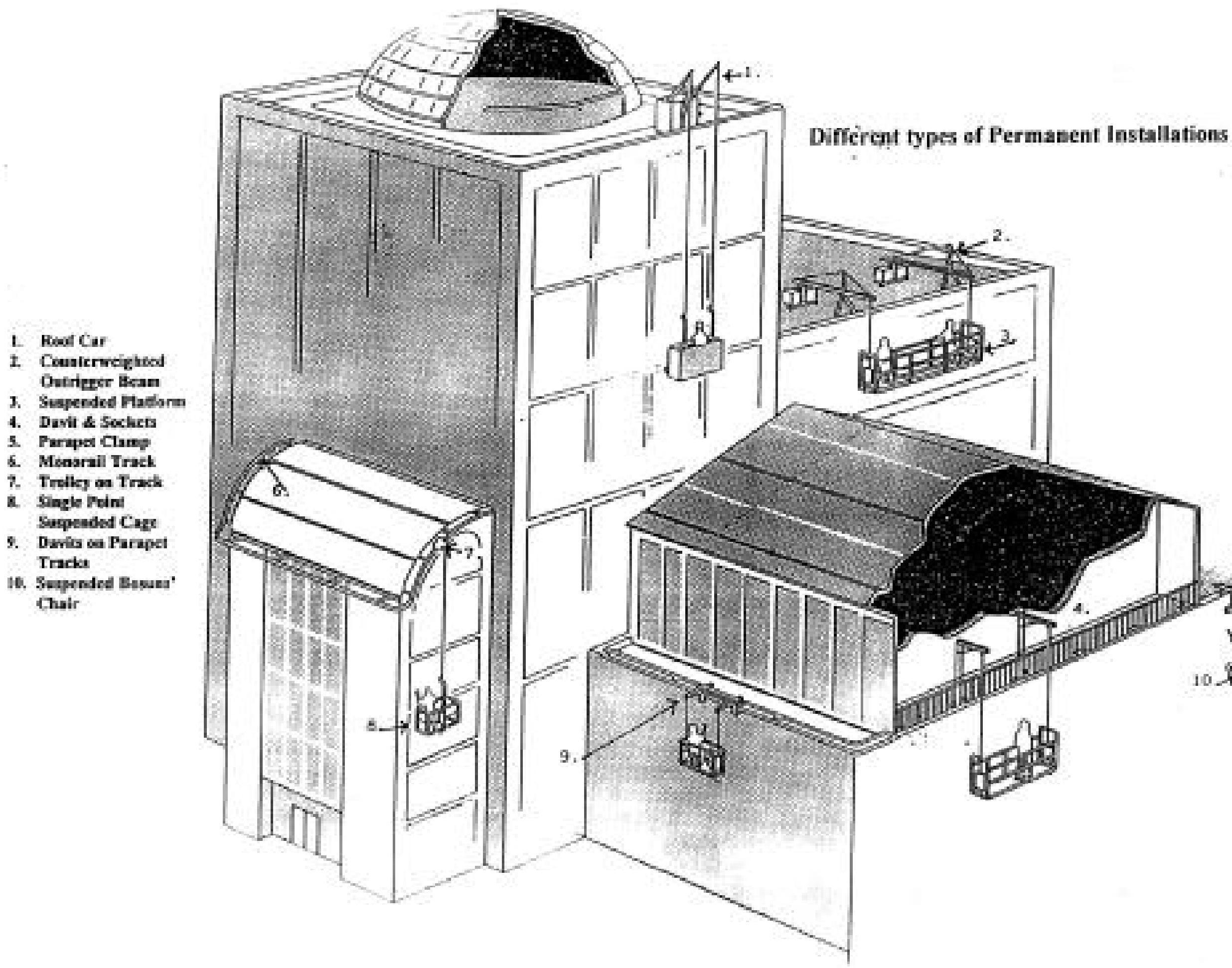
There should be procedures for what to do in any emergency while you are either accessing, rigging or using the equipment. The list can go from a simple problem like what to do if you should lose your power to what to do if there is a suspension failure. The plan is as important to you as your safety harness and should be treated with the same respect.

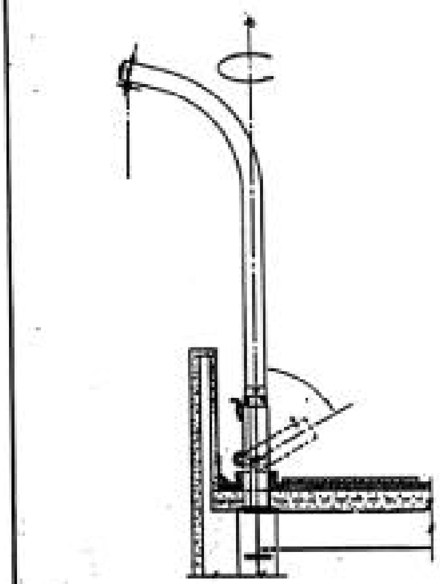
13.0 Operator Responsibilities

Although it is not a Federal regulation that a building be equipped with a permanent system the proper use of a PI System is mandatory. Federal OSHA Regulation 1910.66 states, "Working platforms shall be operated only by persons who are proficient in the operation, safe use and inspection of the particular working platform to be operated." This statement is important to you as the operator and to your employer as it is his or her responsibility to be sure that you have trained for the equipment.

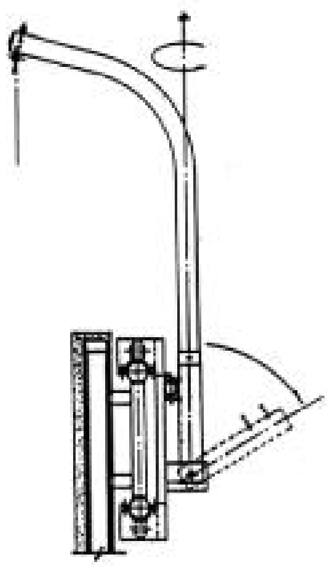
Taking this SIA course with this chapter has made you familiar with scaffolding and given you an overview of what PI Systems are all about, but each installation must be approached as a new system.

Regardless of the precautions taken by the manufacturers and installers of PI equipment, the building owners, and the regulatory agencies, the final line of defense is in the hands of the user of any access equipment. It is your responsibility to your employer, your customers, the public, and you and your family to operate the equipment in a safe and sane manner. Follow the manufacturer's instructions; be familiar with the operation procedures; and when in doubt, err on the side of caution. Be sure of the results of every action you take before you proceed.

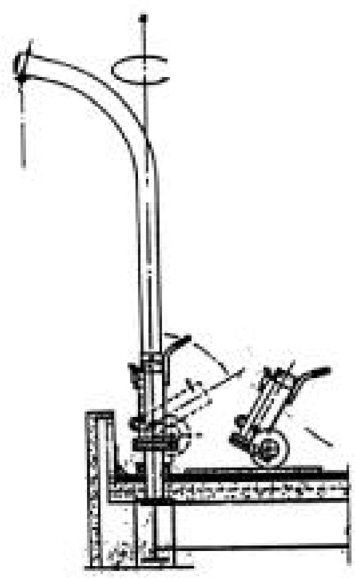

Different types of Permanent Installations
1. Roof Car
2. Counterweighted Outrigger Beam
3. Suspended Platform
4. Davit & Sockets
5. Parapet Clamp
6. Monorail Track
7. Trolley on Track
8. Single Point Suspended Cage
9. Davits on Parapet Tracks
10. Suspended Bosuns' Chair



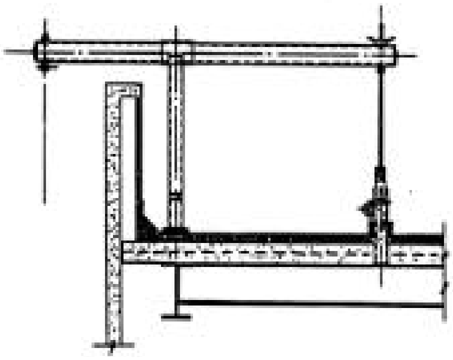
Stationary Tilt Up Socket



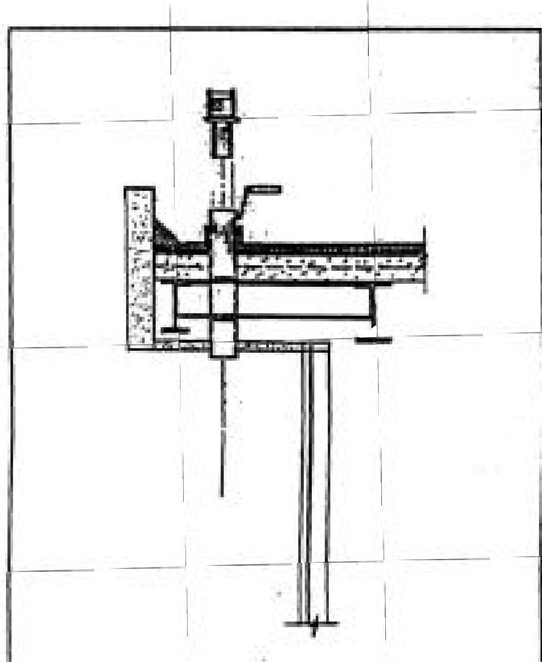
Track/Rail Mounted Tilt Up Socket



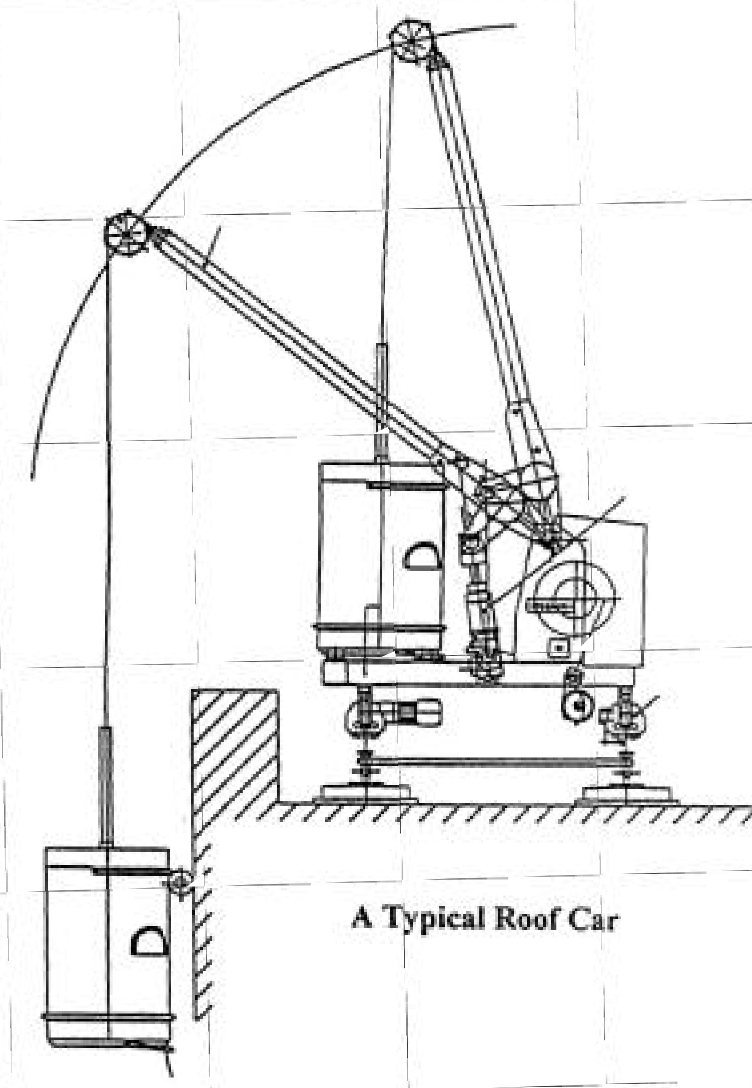
Transportable Davit Socket on Pedestal



Non-Counterweighted OutRigger

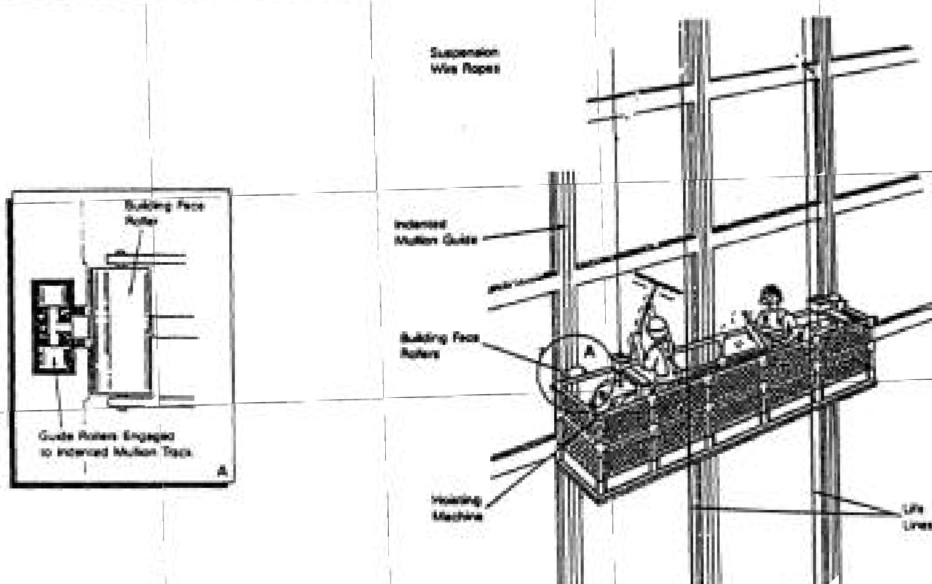


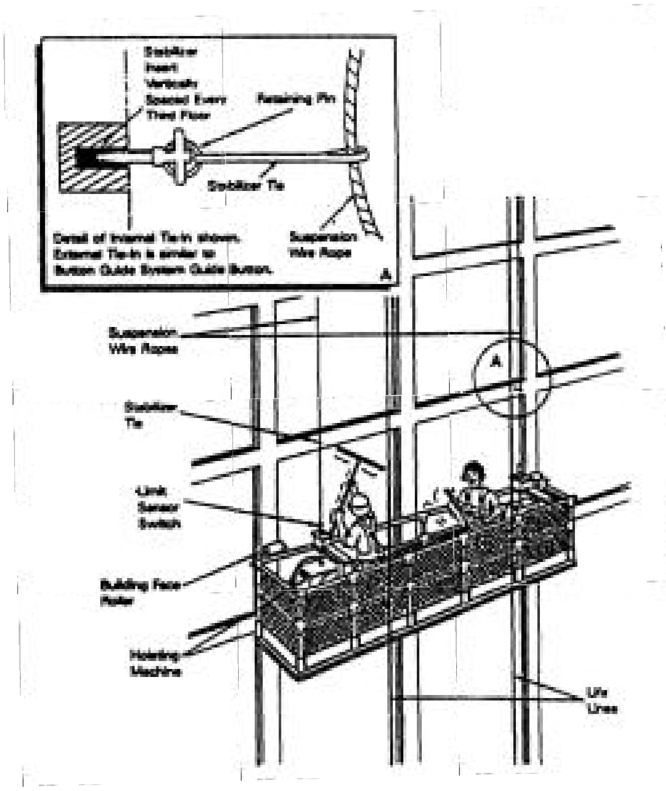
Drop Through

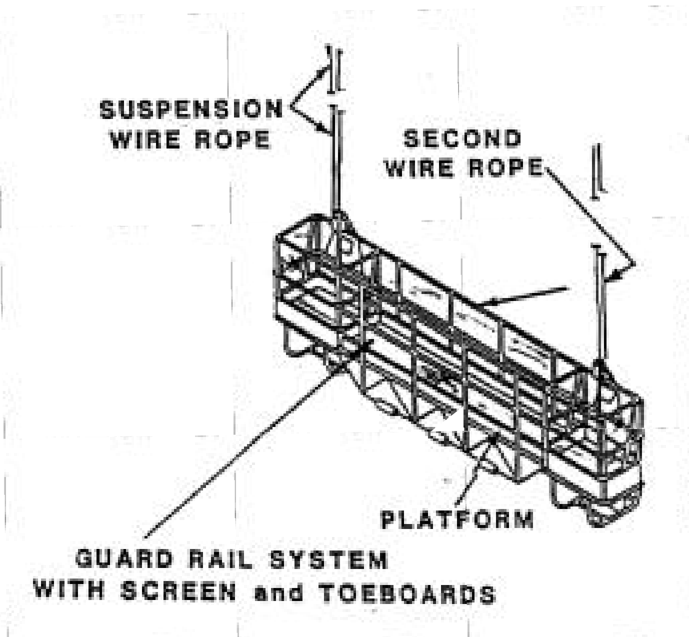


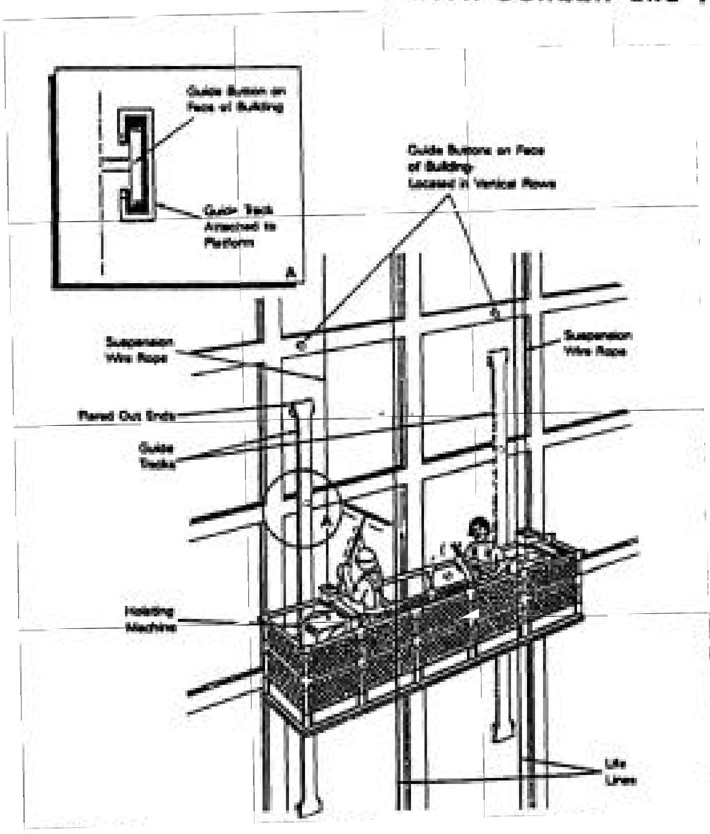
A Typical Roof Car

Drop Through Suspension Points




Stabilizer Insert Vertically Spaced Every Third Floor
Retaining Pin
Stabilizer Tie
Detail of Internal Tie-in shown. External Tie-in is similar to Button Guide System Guide Button.
Suspension Wire Rope
A
Suspension Wire Ropes
A
Stabilizer Tie
Link Sensor Switch
Building Face Roller
Hoisting Machine
Life Lines


SUSPENSION WIRE ROPE
SECOND WIRE ROPE
PLATFORM
GUARD RAIL SYSTEM WITH SCREEN and TOEBOARDS


Guide Button on Face of Building
Guide Track Attached to Platform
A
Guide Buttons on Face of Building Located in Vertical Rows
Suspension Wire Rope
Suspension Wire Rope
Flared Out Ends
Guide Tracks
Hoisting Machine
Life Lines

CHAPTER 7

SUSPENSION ROPE

Contents

CHAPTER 7: Suspension Rope

1.0 Introduction

The suspension rope is a strong, flexible line that connects the support system to the rest of the suspended system. It is one of the most important parts of the system.

The suspension rope holds the suspended platform. The rope grips the hoist drum, providing the friction necessary for the hoist to hold and move the platform. Also, the rope transfers the load from the rest of the suspended system to the support system.

There are many types of rope. The type you will need is usually specified by the hoist manufacturer. Follow the manufacturer's instructions.

Ropes are made from many materials. The two main types most often used in suspension rope are synthetic and metal. Synthetic material consists of fibers such as nylon or polypropylene plastic or from a combination of these materials. If the outside of a rope has synthetics in its construction, it is usually referred to as synthetic rope. If the outside of a rope is all metal, it is called wire rope.

Wire rope is made from steel, stainless steel, bronze, or special metal alloys such as monel (a special resistant metal). Wire rope can be coated or bright. Bright wire (sometimes called black) rope is uncoated wire rope. Steel rope may be coated with zinc (galvanized) for corrosion protection. Steel and corrosion resistant ropes may be coated with plastic (nylon coated) for abrasion protection. Almost all wire rope is eventually coated with some type of protection compound, either contained in the lubricant or as a "permanent" coat.

Fig 7-1

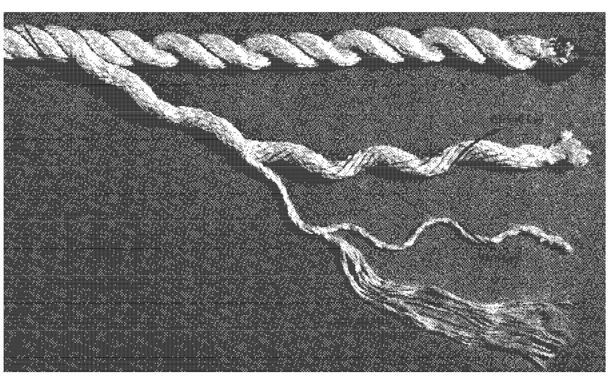
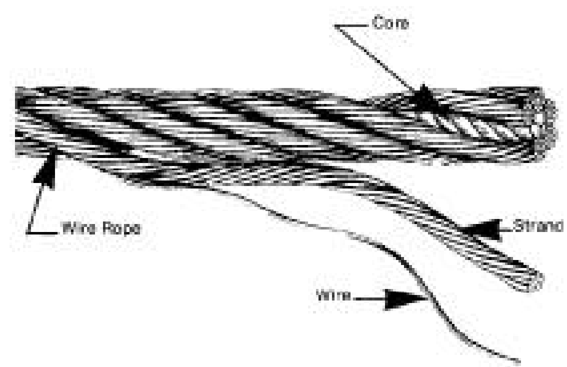


Fig 7-2



Wire rope and synthetic rope (Fig. 7-1 & Fig. 7-2) are similar in construction. Small thin lengths of material are woven, twisted, or braided together into larger strands which are in turn, twisted or braided together to make the **rope**. Some synthetic ropes have fibers which are very long, and others have fibers which are short and spun together to make a yarn. Some synthetic ropes have finely woven covers while others are braided from three big strands. Some have many small wires or fibers, while others have a few big strands or wires. Some ropes are twisted (or laid) to the right, while others are laid to the left. The material, the cost, and the application are all considered when designing the construction of a rope.

The most obvious difference in rope is the diameter, or thickness of the rope. The larger the diameter of a rope of a given construction and material, the stronger the rope. For example, a new “two-inch” diameter nylon rope is four times stronger than a new “one-inch” diameter nylon rope.

All ropes are machines. They have moving parts which rub against each other, transfer energy and force, require maintenance, wear out and need replacing. Some ropes require lubrication to minimize wear and corrosion. Other ropes use the natural lubrication of their fibers for lubrication. Each rope application requires slightly different maintenance and protection, so check with your rope distributor to determine the care requirements.

2.0 Fiber Rope

The primary uses of fiber rope (also known as cordage) in suspended platform applications are in the suspension ropes used in rope falls (the block and tackle type of hoist), and in personal protection devices such as lifelines and emergency escape applications. They are often used for manual Bosun Chair support. In this section, we will cover the ropes used in life lines and hoists.

2.1 Natural Fiber

There are other types of rope material that could be used in suspended scaffolding. One of the ropes most commonly used in rope falls is manila rope. Manila is a natural fiber. Like wood, it comes from a plant. Also like wood, there are different grades of manila. Some manila fiber is strong and long, and makes light yellow premium rope. Some manila fiber is short, weak and dark, and made into twine and low-grade rope. The best and strongest fiber goes into yacht and bolt rope, and into No. 1 manila rope.

Sisal is another plant used in making rope. Sisal rope has shorter and weaker strands, and must never be used in suspended platforms. Often, some sisal or the weaker manila fiber is mixed with premium manila to make cheap rope. The result is the unmarked rope you find in the discount store at a cheap price.

These types of rope are prohibited for use with fall protection systems.

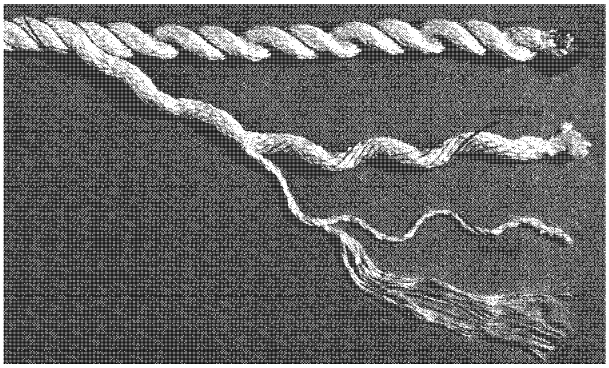


Fig.7-3

2.2 Synthetic Fiber

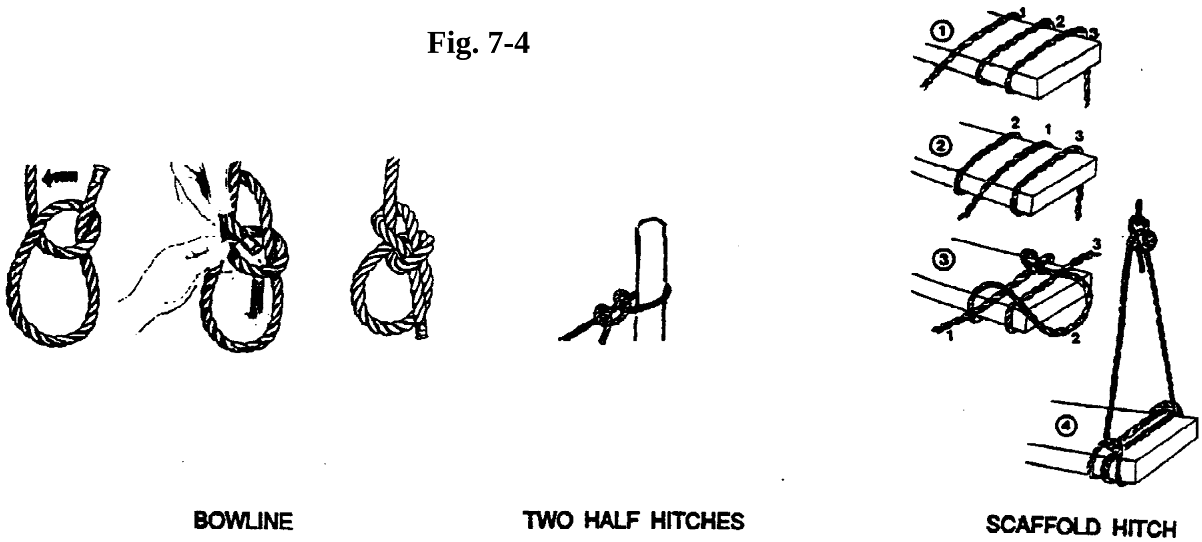
Some rope falls use synthetic rope (Fig. 7-3). There are two basic kinds of synthetic rope fibers, continuous filament and spun. Continuous-filament rope is made from a series of long single strands of plastic which have been woven or braided together. Continuous filament rope is stronger and usually stiffer than spun rope. An example of a continuous filament is a monofilament fishing line.

The other kind of fiber is spun fiber. The strand of a spun fiber is made of very fine short fibers “spun” together. An example of spun fiber is wool yarn. Spun fiber rope is very flexible.

2.3 Knots

Fiber rope often is attached using knots (Fig. 7-4). When you tie a knot, you bend the rope and pull the fibers on the outside of the rope, stretching and loading the rope fiber. A knot reduces the rope pulling strength by about half. For example, if you use a 5400-pound (2550 kg) rated rope, you really may only have about 2700 pounds (1125 kg) of that rating available once you make a knotted connection.

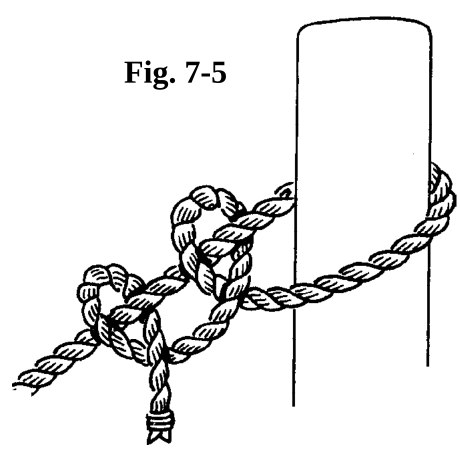
Fig. 7-4



Knots rely on the friction of the rope against itself to stay fast. Synthetic fiber rope often has less friction than material fiber rope, and does not hold some knots well.

Some knots are better than others in holding under load and yet, still releasing easily. There are probably as many knots as there are old sailors, but we are only interested in three holding knots. They are the bowline, the double-half hitch, and the scaffold hitch. **Caution: some synthetic fiber ropes may slip in a double half hitch** (Fig. 7-5).

Fig. 7-5



Another way of joining rope is called a splice. In a splice, the rope is tucked into itself or another rope to make a connection. Although the splice is strong and better than a knot, the only place a splice is appropriate in the suspended platform setup, is as an eye splice on a thimble (the metal or plastic sleeve inside an eye), or to keep an end from unraveling. Splices used to join lengths of rope are not used because joined ropes are not permitted in suspended scaffold work.

The number of tucks and the method of tucking varies with rope material, so splices should only be done by experienced persons.

2.4 Terminations.

There are other methods to terminate or anchor a lifeline other than traditional knots or splices (Fig. 7-6). A lifeline anchor device as shown is an example. It gives you the additional capability of lengthening or shortening the line.

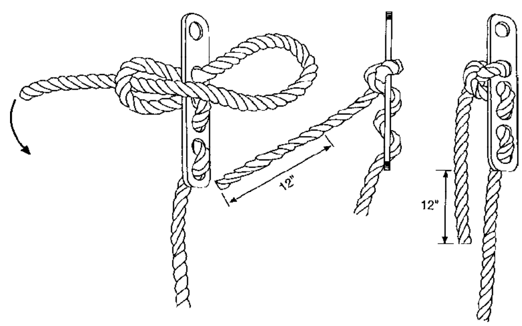


Fig. 7-6

2.5 Stretch.

Synthetic ropes will stretch depending on the material it is made from and whether wet or dry. Polypropylene will stretch about 9%. Standard nylon will stretch about 21% (See Fig. 7-7). A good reason for not using standard nylon for a lifeline.

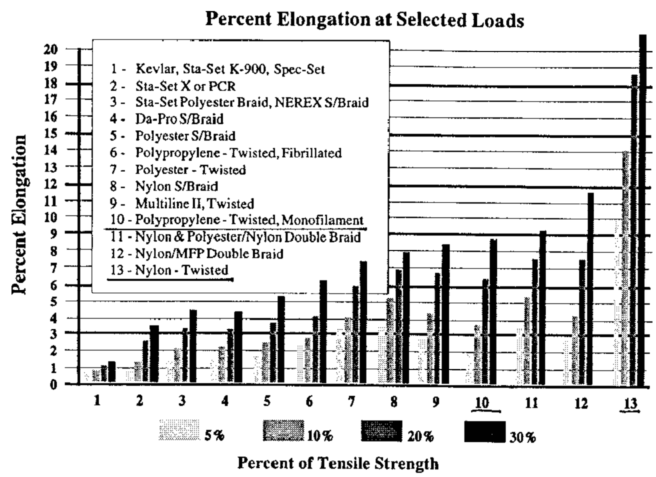


Fig. 7-7

2.6 Rope Falls

A rope fall should specify the size and type of rope required. Always use the rope suggested by the rope fall manufacturer, but never choose less than a 3/4 inch No. I manila or equal strength rope (Fig. 7-8).

Only a few rope falls require manila rope. Most use synthetic rope. If you have a rope fall that specifies manila rope, consider replacing it with synthetic rope. Only use manila rope if the manufacturer requires it. If you use a natural fiber rope, use at least No. 1 grade manila rope.

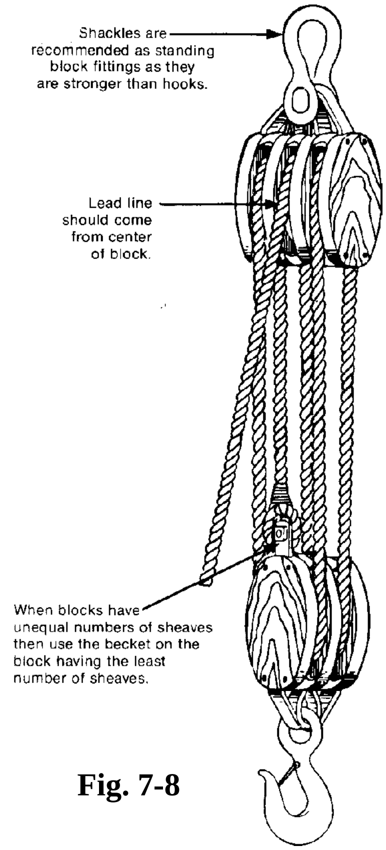


Fig. 7-8

2.7 Care of Fiber Ropes

The variety and combination of materials used in modern ropes can resist different things, and be damaged by different elements. Sunlight, mildew, moisture, rot, heat, rodents, extreme dryness, and overloading can damage and weaken fiber rope.

Fiber rope will deteriorate through normal wear and abuse. Fibers weaken as they bend over sheaves and knots. Dirt cuts and abrades the moving fibers. Sharp edges reduce rope strength because of the pulling and crushing of the fibers.

Rope thimbles spread out the concentrated load at an edge. Always use a proper rope thimble to protect the rope at a connection. Always protect the rope from any sharp edges. A piece of thick rubber garden hose slipped over the rope and taped in place, or a softener, is often used to protect the rope at an edge.

Rope also deteriorates in storage. Dirty ropes must be washed and thoroughly dried before storing. Keep the rope coiled in a cool, dry, ventilated place, off the floor and far away from oil and acids.

Never store ropes on concrete or dirt floors. Leave plenty of air space above the rope in the presence of galvanized metal.

Don't leave the rope outside, because the powerful rays of the sun can change the strength of the rope by weakening the molecules that make up the fiber. Always thaw frozen rope before bending, to prevent the fibers from breaking or cracking.

2.8 Rope Inspection

Fiber rope will deteriorate in service. Some deterioration is obvious, while other deterioration is not.

The best check is to twist the rope,synthetic or steel, and pull out some of the core (Fig. 7-9), which is

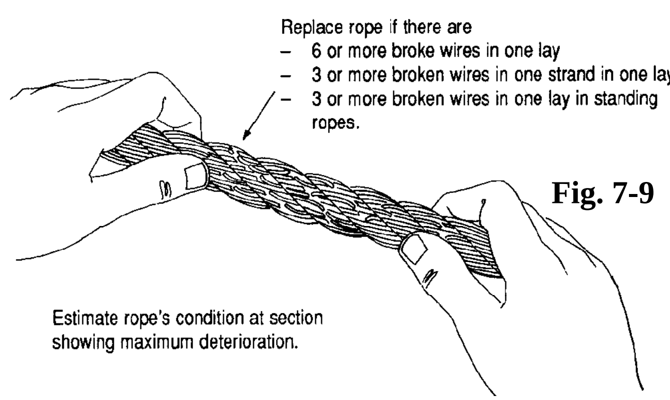


Fig. 7-9

usually the first part to fail. If the core is broken, deteriorated, or shows white powder, remove the rope from service.

Never leave a rope **in service** more than two years. When in doubt, always replace the rope.

3.0 Wire Rope

The most common rope used in a suspended platform setup is wire rope. Wire rope comes in different diameters (metric and imperial), strengths, constructions, lays, cores, and lubrications. Follow the hoist manufacturer's recommendations and use only the rope specified for the hoist.

6x31 Seale, Fibre Core   6x31 Warr. Seale, IWRC

Fig. 7-10

Let's look at a typical identification for wire rope and see what the terms mean. We will order a typical wire rope for a traction hoist. Let's assume it's a 5/16 (8mm), 6 x 31 (Seale) fiber core drawn galvanized right regular lay preformed improved plow steel wire rope (Fig. 7-10), 100 feet (30m) long.

3.1 Size

5/16 (8mm) means the diameter of the wire rope is 5/16 (8mm) of an inch, measured across the widest part of a round rope (Fig. 7-11). You need the proper diameter so the grip and wear are correct, and the hoist brakes work correctly.

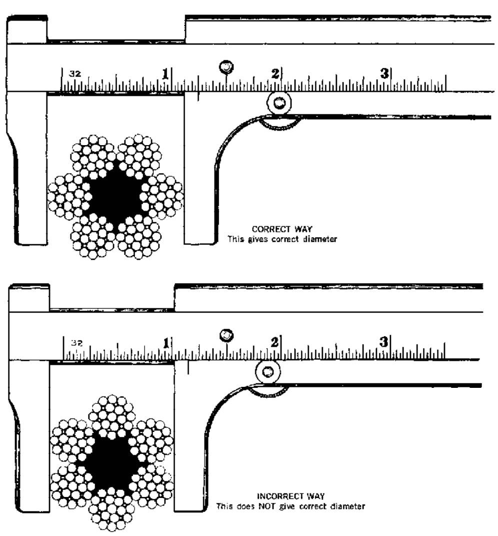


Fig. 7-11

3.2 Strand Construction

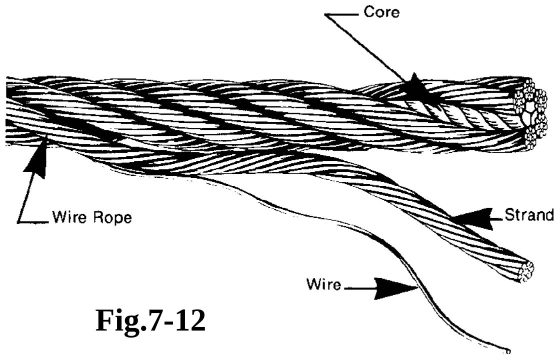


Fig.7-12

6 x 31 (read 6 by 31), indicates the type of wire rope strand construction. The 6, means that there are six strands of wire wrapped around the core of the rope (Fig. 7-12). The 31 means there are 31 wires in each strand. Usually, the more wires per strand, the more flexible the rope is. The fewer wires per strand, the stiffer it is, and the more resistant to abrasion the rope is. Note: Wire rope constructions are grouped into similarly named general classifications for pricing. Order rope per manufacturer's specification, which is by strand construction and use suspended scaffold quality only. You may find 4,5,6 strand ropes specified by the manufacturers for many of today's hoists.

3.3 Seale Arrangement

Seale indicates a special kind of construction in which the outer wires of a strand are bigger than the inner wires. The rope strand has bigger wires on the outside to make the rope more abrasion-resistant, while keeping some of the smaller wires inside for flexibility.

Seale and Warrington-Seale construction are the two most common traction hoist constructions. They are also sometimes recommended for drum hoists used in abrasive environments.

3.4 Core

In our example, we specified that our six strands of 31 wires each are to be wrapped around a **fiber core** (FC) (Fig. 7-10). The core of a wire rope may be wire rope, fiber rope, polypropylene rope, or electrical cable. **FC** is Fiber Core, and now most FC is **PFC** (Polypropylene Fiber Core). IWRC means an Independent Wire Rope Core. IWRC is chosen for crush resistance and additional pull and bending strength, while FC is less expensive, more flexible, and often has a more efficient design.

Electrical core is common in many roof hoists where the conductors carry control signals and sometimes power. These are used in permanent installations (P.I.'s).

All of these cores are used in suspended scaffolds. Different cores have different purposes. Order the correct core.

3.5 Galvanizing

Galvanized wire rope has zinc on the steel wire to help protect against corrosion. For suspended platform rope, all galvanized wire rope should be **drawn galvanized** (DG). Some galvanized wire rope is weaker than bright rope of the same size by about 10%, because zinc has replaced part of the steel. Always check the rated strength of the galvanized rope, and follow the manufacturer's instructions.

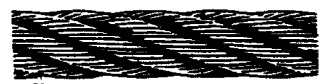
3.6 Rope Lay

Wire rope can have a twist (or **lay**) to the right or to the left. Wire rope is made by carefully “twisting” the wires into a strand, then “twisting” the strand into a rope. How you lay the wire and how you lay the strand will determine the wear and coiling characteristics of the rope.

The distance along the rope before a strand is wrapped all the way around the rope once, is also called the lay length of the rope. An increase in lay length, or stretch, is one warning that the rope must be immediately removed from service.

Regular lay means the twist of the wire in the strand is (See Fig. 7-13) opposite to the twist of the strand. Lang lay means the twists are in the same direction. **Right lay** means the strands are laid to the right. If you dangle a free end of right lay rope; it will coil to the right. If you dangle a piece of left lay, it will coil to the left. This is important when spooling rope onto a drum. Left lay wants to fill up one side first, and right lay wants to fill the other side first.

Fig.7-13



RIGHT LAY REGULAR LAY

Almost all rope used in suspended scaffold work is right regular lay. Use the correct lay for your support and suspension systems.

3.7 Preforming

Preformed wire rope has the strands permanently shaped during manufacture. Non-preformed rope does not have the strands permanently set during fabrication. Preformed rope is less stiff, and the wires are less likely to spring out when they break or are cut. This is the type used in suspended scaffolds.

3.8 Strength

Improved plow steel indicates the strength grade of the rope. The strength categories of steel wire rope are:

- Iron
- Traction steel
- Mild plow steel
- Plow steel
- Improved Plow steel
- Extra improved plow steel

Each category is from 10 to 15% stronger than the previous category.

The strength of a wire rope is determined by measuring the force necessary to pull apart the wire rope. This is called the **breaking strength.** In new rope, the guaranteed minimum breaking strength is called **rated strength, nominal strength or catalog strength.** After wire rope has been used, it is weaker.

Hoist manufacturers require improved plow steel or better.

Regulations require that wire rope for hoists used in suspended scaffold work meet certain strength ratios, called the **design factor** or the **safety factor.** It is important to remember that the ratios are not true engineering safety factors, and the actual safety factor is much less.

Most suspended scaffold hoists used in construction and general temporary work are required to use wire rope with a strength six times that of the rated load of the hoist. In Canada it is ten times.

Use only the manufacturer's recommended wire rope strength which meets the approved ratio.

3.9 Other

Powered scaffold hoist in the manufacturer's specification for wire rope often indicates what wire rope manufacturer or distributors must use in a traction hoist. Some wire rope manufacturers lubricate these ropes differently to provide better performance and may request that **use** be specified in the order. If asked, say **powered scaffold hoist.**

Remember, specify the rope completely and according to the hoist or grab manufacturer's recommendations for proper operation of equipment.

Choose your wire rope supplier carefully. Quality can vary. The diameter may not be constant. The construction is critical.

3.10 Rope Damage

The wire rope performs many functions in the system. It has to pass through a hoist, grip the drum or sheave to raise the load, and support other ropes wrapped onto the drum.

Guides and fingers hold the hoist upright and also direct the rope through the proper path inside the hoist. What might seem like a small problem can seriously jam the machine. Broken wires can catch on the guides. The rope spooling on the top layer of the drum type hoist may slip, cross over and tangle on the other wraps because of a damaged rope below. On traction type hoists the rope may jam or slip on the sheave. Any one of these can turn an incident into an accident.

Like fiber rope, wire rope has less strength when knotted or bent over sharp edges. Other damage from chemicals, corrosion, and heat (especially from welding), can also reduce strength. Reduced strength means failure, or at best, less margin for error in the rest of the suspended system.

Let us consider some common types of damage to wire rope.

3.11 Wear and Abrasion

The rope can wear inside or outside. Remember, the rope is a machine, with wires rubbing on each other every time the rope moves.

If the inner wires are not adequately lubricated, they will wear, leaving less metal in the rope. Less metal means less strength. Check for internal wear by carefully measuring the rope diameter when it's new, and measuring it regularly while in use. The diameter will shrink slightly as the internal wires wear. Proper lubrication can minimize internal wear.

Wear on the outside wires is called **abrasion** (Fig. 7-14). Abrasion can be the result of rubbing, poor handling, slipping, or poor lubrication. The metal on the outside wires is rubbed or cut away, and less metal means less strength. When a wire under load loses enough metal, it will suddenly break.

Fig.7-14

3.12 Localized Bending And Trauma

Wire in the rope stretches and twists to store the energy of its load. If you let all of that energy go at once, or if you add energy suddenly, the energy can't distribute itself through the rope fast enough, so it bends the closest wires.

Remember: give the rope time to handle the energy, watch out for the little wires, lubricate the rope, change the rope terminations and the rope regularly.

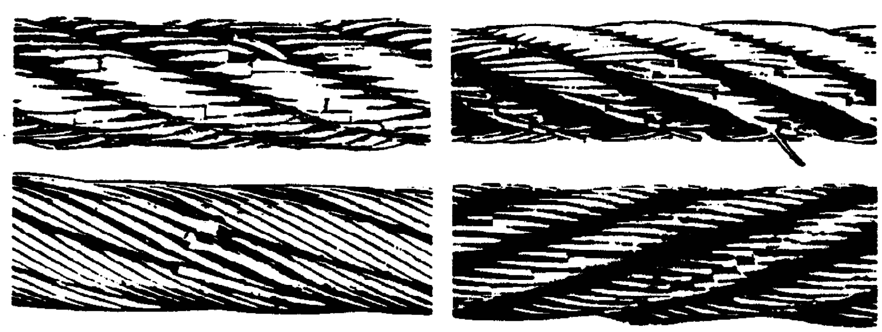
Never pull so hard on coiled rope that it **kinks.** Never put a sudden load on the rope, causing the strands to open and unwind into a **birdcage.** Also, never try to straighten or smooth out a bent, kinked or birdcaged wire rope by pulling, stretching or drop-loading it. The result will only be further damage. Cut the rope up so that it won't be used by mistake by someone else.

It's very easy to bend a small wire, and wire rope is made up of small wires. Do not bend over sharp corners. Kinks can jam in the hoist.

3.13 Fatigue

Wire rope is subjected to many types of loads, which try to bend, twist, shake, and whip the rope and its termination. One result of these loads on the wire rope is called **fatigue.** Although

Fatigue



THESE ROPES EXHIBIT BREAKS CAUSED BY FATIGUE AFTER REPEATED BENDING OVER SHEAVES OF THE PROPER SIZE AND UNDER MODERATE LOADS

Fig.7-15

this type of problem is unusual in the main length of wire ropes used in suspended scaffold work, the wires just below the termination can see higher loads than the rest of the rope and be worn and fatigued as a result.

Broken wire, wires showing improper twist (Fig. 7-15) or opening, core sticking out of the other strands, or any unusual condition near the termination are reasons for taking the rope out of service and re-terminating it.

Be particularly alert for broken wires in the valleys between the strands since these indicate serious weakening.

3.14 Heat and Corrosion

Fig.7-16

A wire rope can be affected by acids and other chemicals. Certain acids or alkalis can make wire rope as brittle as glass. The outer wires will break as you bend the rope. Any rope exposed to these conditions should be removed.

Heat is another enemy of wire rope (Fig. 7-16). It changes the metal from being strong and flexible to being weak and brittle. Any burning, discoloration, or other signs of heat are reasons to take the rope out of service.

A hoist needs good rope to do its job. Don’t ask the hoist to climb a damaged wire rope.

4.0 Terminations

Wire rope transfers the load of the suspended equipment to the support system above. The point of transfer is the **wire rope termination.** Several kinds of wire rope terminations are available today and choice depends mostly on your preference.

How well a fitting holds the rope is measured by comparing the holding power of the fitting to the design strength of the rope. It is a percentage called the **efficiency** of the fitting.

Fittings with efficiencies of less than 100% let go of the rope, break before the rope breaks, or break the rope before its full strength is developed. For example, a 90% efficient fitting on a 10,000-pound (4536kg) rated strength rope will fail at 9000+ pounds (4082kg) pull, that is, at not less than 90% of the actual strength of the rope. A fitting that is 100% efficient will allow the rope to break at its rated load.

It is not recommended that a fitting of less than 80% efficiency be used in suspended platform work.

It is important to note that while rope strength varies, the holding strength of some terminations remains about the same no matter what the strength of the rope. All of the wire rope terminations mentioned here will be satisfactory up through the improved plow steel strength category, unless otherwise noted.

Termination strength can change with time. Materials age, parts wear, and clamping stresses lessen. Terminations should be renewed periodically. Most suspension rope terminations should be replaced at least every three years.

Any bolt, nut, and most terminations will loosen if enough of the right kind of vibration is present. Take care to prevent excessive vibration on the rope or termination.

Handling and cleaning during the terminating process often removes lubrication. Be sure to lubricate the area where corrosion protection is most important. Always re-lube both the termination and the wires near the termination once the rope has been refitted with a new eye socket.

The main types of wire rope terminations available are:

- hand-tucked eye splice
- swage fitting
- mechanical eye splice
- “Flemish eye” or return loop
- wedge socket
- spelter, babbitt, or resin poured socket, and
- J-clip
- not all are used in swing stage applications, so you must follow the manufacturer’s instructions.

In some terminations, the rope is wrapped around a metal collar called a **thimble** and then attached to itself. In other terminations, materials are used to hold the wire rope to the termination. For wire rope, use only the thimbles designed, sized, and rated for the rope.

4.1 Hand Tucked Eye Splice

One of the most reliable of the suspended scaffold wire rope terminations is the properly made **hand-tucked eye splice.** Although this termination is less efficient when compared to other types of terminations on the lower strength ropes, its efficiency is consistent throughout the wire rope strengths (See Fig. 7-17).

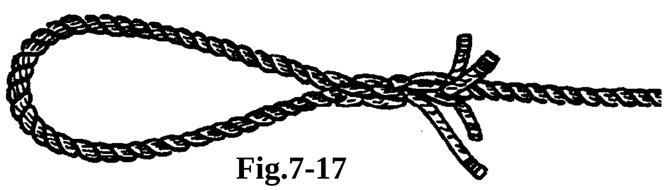


Fig.7-17

It can be easily inspected and uses the strength of the rope itself to develop its efficiency. Because it flexes where the rope connects to itself, it is less prone to rope damage due to the side loads generated by suspended platforms, although its fatigue resistance is somewhat less than other terminations. It is generally accepted and often is the only termination permitted in some jurisdictions.

The hand-tucked eye splice may be done in the shop or the field. It must always contain the proper number of tucks and be done only by experienced personnel.

4.2 Swage

The **swage** fitting uses a one-piece metal sleeve and eye or fork that slips onto the wire rope and is then “squeezed” onto the rope at great pressure (swaging). The squeezing forces the

Fig.7-18

metal into the rope, filling the valleys in the rope with the metal of the termination. Any load on the rope is then held by the squeezing action of the fitting on the rope. Swaging can be used on steel and fiber core-wire ropes if appropriate precautions are taken (See Fig. 7-18).

Some jurisdictions do not permit use of swage fittings on suspended platform rope unless the fitting includes an inspection hole. Most US regulators require fittings without inspection holes.

Swaging must be done by experienced suppliers.

4.3 Mechanical Eye Splice

The **mechanical eye splice,** also called a return loop double back splice, uses a metal type sleeve to hold the rope on the thimble. A sleeve is slipped over the wire rope, a thimble set in the eye above the sleeve, and the wire rope is brought around the thimble. The dead end of the rope is slid into the sleeve, and the sleeve is then simultaneously squeezed onto the live rope and the dead rope using a special tool or press (Fig. 7-19).

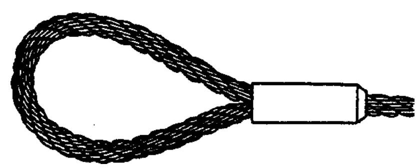


Fig.7-19

The efficiency of the mechanical eye splice is similar to that of the swage fitting. Some sleeves decrease in efficiency with increased rope strength. Some mechanical eye splices are intended for use only on IWRC wire rope.

The sleeve may be attached in the field or in the shop by qualified persons only.

The splice may also be a Flemish Eye that can be terminated with a sleeve or wrapped with seizing wire.

4.4 Flemish Eye Splice

In the **Flemish eye splice** the wire rope strands are separated and then laid back into the loop in opposite directions around the thimble. It can only be done with a preformed wire

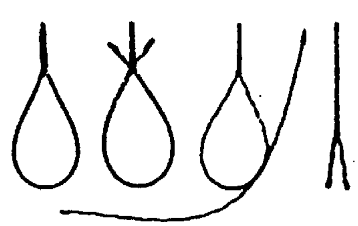


Fig.7-20

rope. This splice must be done by experienced personnel (See Fig. 7-20).

4.5 Wedge Socket

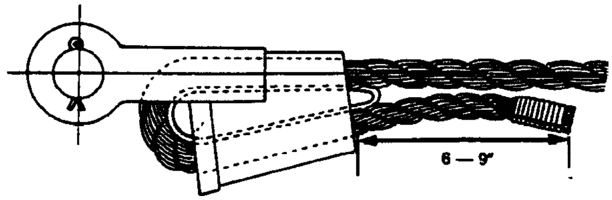


Fig.7-21

The **wedge socket** is a termination that uses the friction of the wire rope to jam the rope into a special type of fitting. The wire rope is fed through an outer sleeve called the fitting basket, wrapped around the inner sleeve or wedge, and then routed back through the outer sleeve. The wedge is pulled into the basket, trapping the wire rope and wedge against the basket (Fig. 7-21).

The wedge socket is to be installed or set up so the live end is being pulled straight to the load. Don't wrap the rope on backwards, and be sure the rope pulls straight so the wedge doesn't try to bend the rope. The live end of the rope must pull straight.

Most wedge sockets will develop at least 80 % of the strength of the rope. They may be installed in the field or in the shop by qualified persons.

4.6 Poured Socket

The **Spelter** (virgin zinc) poured socket is seldom used for the small wire rope sizes used on suspended scaffold hoists because of application problems (Fig. 7-22).

Poured Socket

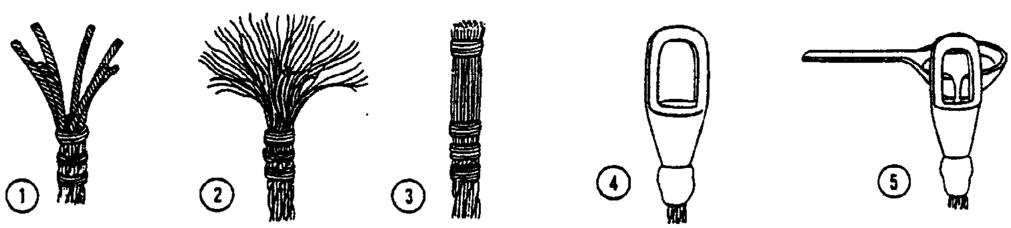


Fig.7-22

Babbitt metal is a soft metal alloy. Although widely used with elevator ropes, the **poured babbitt socket** has low efficiency and must not be used on ropes in suspended scaffold work.

Resin sockets are similar in shape to the spelter poured socket but the spread rope wires are held in the termination by resin (a type of plastic). Manufacturer's instructions should be carefully followed.

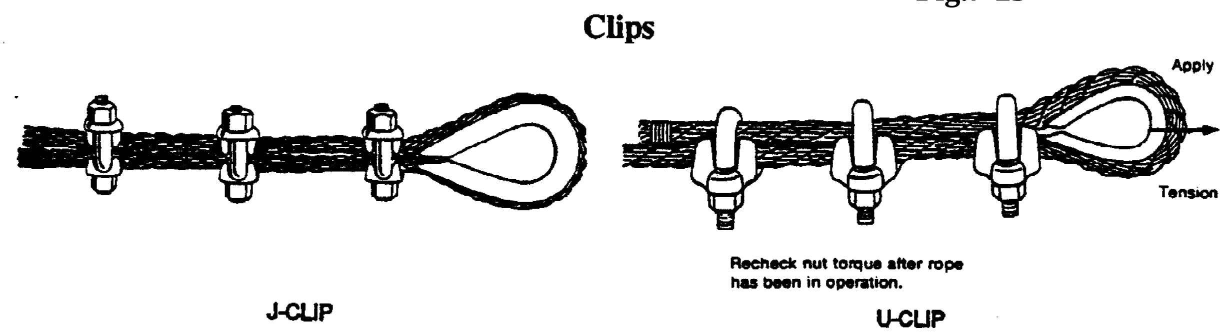
Sockets are seldom used with suspended scaffold.

4.7 Clips

A commonly used method of terminating wire rope is with bolt-on clips. There are two kinds of clips, the **U-clip** and the **J-clip.** The J-clip is recommended for suspended scaffolds.

OSHA requires J-clip type for termination of the hoist line, if clips are used.

Fig.7-23



Both the U-clip and the J-Clip hold the rope by gripping the dead end of the rope to the live end using the clamp load of nuts (Fig. 7-23).

The wire rope is brought around the wire rope thimble and the dead end is bolted onto the live rope using three or more clips spaced 6 rope diameters apart. The nuts of the clip hold the load by transferring that part of the load on the dead end of the rope to the live end of the rope.

The main difference between the J-clip and the U-clip is in the part that holds the dead end of the rope. The J-clip has two saddles, one for each rope. The U-clip has one saddle and one U-bolt. The saddle sits against the live rope (cradling the rope). In the U-clip, the U-bolt grips into the dead end of the wire rope. OSHA requires J-clips, not U-clips on hoist line terminations.

There are two basic things to remember when using clips. Firstly, **the only things holding you up are the bolts squeezing the ropes.** Not enough squeeze, not enough holding. Secondly, **the load uses the live end of the rope, and your U-bolt does not.** Don’t crunch the live end of the rope. Cradle the live end gently in the saddle of the clip, so it will be strong.

Clips are supposed to be put on with a **torque wrench**. The torque wrench checks the bolt tightness to be sure you have enough grip on the wire rope to hold you, but not so much that you break or deform the clip or the live end.

You put the clips on, tighten them up, and then check that you have the right amount of grip using a torque wrench, rechecking until each bolt on each clip is at the right torque. Remember, if too tight, the rope and clip are weakened. Too loose, and the rope may slip in the clip.

You must re-torque the nuts after the load is applied, and you must recheck them every day, more often if necessary. Do not over-tighten. Recommended torque for 5/16” (8mm) clips is 30 ft-lbs (.13kn).

The only way to maintain the grip of a nut is to torque the nut enough so it has proper clamping load. **DO NOT USE LOCKWASHERS OR LOCKNUTS ON A CLIP!!!** Lockwashers and locknuts are not a substitute for proper torque, and most locking devices loosen their grip after time.

Use only clips from reputable manufacturers. Inferior clips on the market look very much like first-quality clips. The clips you use have to hold, and not relax their grip, so don't use cheap or homemade clips. (Fig. 7-23.)

4.8 Thimble

Splicing terminations will cause wear from vibration and suspended scaffold movement. The correct size thimble used in the termination will transfer the wear point from the rope to the thimble.

4.9 Shackle

Either screw pin anchor shackles or cotter pin anchor shackles are an ideal way to terminate at an anchor point. The screw pin must be secured from backing off. The cotter pin type must be secured from coming out. Each type protects from wear at the termination.

4.10 Core Milking

When a wire rope under load runs on a drum or over a sheave, it changes shape. If the rope is large in relation to the groove, the outer wires are **"milked";** that is, they are moved in and down in relation to the core. The milking builds up until the wires continually slide on the groove, constantly releasing the built-up pressure. Overloading or shock load can cause milking. (See Fig. 7-24.)

Core Milking

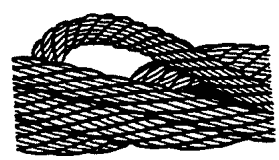


Fig.7-24

If the wire rope is terminated at both ends and the core is not free to move with respect to the rest of the rope, the outside wires "bunch up" on the core and birdcage near the end. This is particularly noticeable in steel core ropes with welded or brazed tips.

In ropes with both ends terminated, always cut back the core about five-six inches (12-15 cm)before welding or brazing the dead end. Adequate lubrication on the rope helps the rope slip in the groove, reducing the "milking."

5.0 Breaking In And Handling Rope

It is important to remember that the wire rope is a machine. It needs lubrication, maintenance, inspection, replacement, and it needs to be broken in. A new wire rope is like a new car. Just as a car needs time to seat the rings and mate the bearing faces, a rope needs time to seat the wires and mate the metal surfaces inside the rope.

It's really an easy thing to break in a wire rope on a hoist. Run it through the hoist with little or no load, and check it for any problems or marks. Rope normally comes from the factory lubricated. However, if it has a dry spot, put some lube on it.

Rope comes with a twist in it. When you handle rope, you have to respect the twist. Fighting the twist results in rope damage.

There are two methods of handling wire rope:

- reeling and
- coiling (Fig. 7-25)

Both methods use the coiling characteristics of the rope to make the work easier.

If you reel or unreel the wire rope, to put on another reel or spool, the rope taken off the top of a reel is put on the top of a drum, or bottom to bottom.

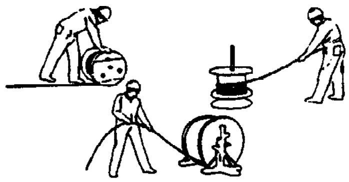


Fig.7-25

In coiling, the rope is laid on the ground. The end of the rope is wound into a coil, taking care not to cross the rope or fight the rope twist. The rope is then wound onto the coil by walking the rope coil along the rope.

Rope should never be taken off a reel that is not rotating, and should never be coiled in any manner except on a rolling or "hand-over-hand" loop.

Coiled rope is held in the coil using wire or plastic ties.

6.0 Wire Rope Sources

Wire rope so poor as to be dangerous has been available on the market. Before purchasing rope, ensure that it comes from a reputable supplier. Purchase according to manufacturer's instructions.

7.0 Wire Rope Safety Factor

Many regulations require that the rope used in suspended scaffold work has a "safety factor" of at least six, eight, or ten-to-one, depending on the code. In truth, the safety factor is based on the rated load of the hoist and the nominal strength of the rope. As you have learned, the real strength is less than the new strength, and the rated load is only part of the real load.

Also, if you lose one end of a loaded platform, the weight on the remaining rope more than doubles. The rope must hold or the platform falls. The swinging of the platform and the sudden stop of the falling end also raises the load on the remaining rope significantly.

Furthermore, the termination may be only 80% as strong as the rope. That 6:1, or 10:1 margin melts away rapidly when you need it most. Do not cut your margin even more by using rusty, kinked, defective rope.

The rope will take good care of you, if you take good care of it.

CHAPTER 8

SUPPORT SYSTEM

Contents

Chapter 8: Support System

1.0 Introduction

When installing all types of Support Systems, the workers must be hooked up at all times.

You now know the three major parts of the powered platform suspended system: the platform, the hoist, and the rope. This Chapter looks at the support system or rigging.

The **support system** carries all the weight and all the force from the rope, the hoist, the platform and its load, and brings the force back to the building or structure. The support system **reacts** to the forces from the suspended system; that is, it transfers and distributes those forces into the roof or structure. (Fig. 8-1).

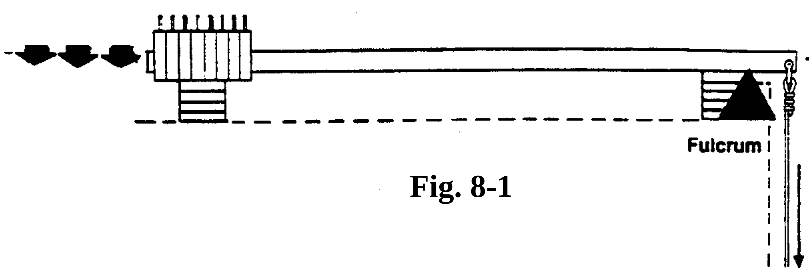


Fig. 8-1

Proper setup of the support system keeps the loads to and from the platform vertical. Incorrect spacing of the supports will cause large side loads which can overturn support equipment.

An important point is the **arm reach or cantilever** (Fig.8-1). The arm reach is that part of the support system that "reaches out" beyond the fulcrum. It is the part of the system which holds the load over the edge beyond the fulcrum. The arm reach may be the length of beam sticking out beyond the beam fulcrum, it may be the part of the roof car arm beyond the outboard wheels, or it may be the outboard part of the parapet clamp. Arm-reach distance is the horizontal distance between the rope connection and where the load is transferred into the structure.

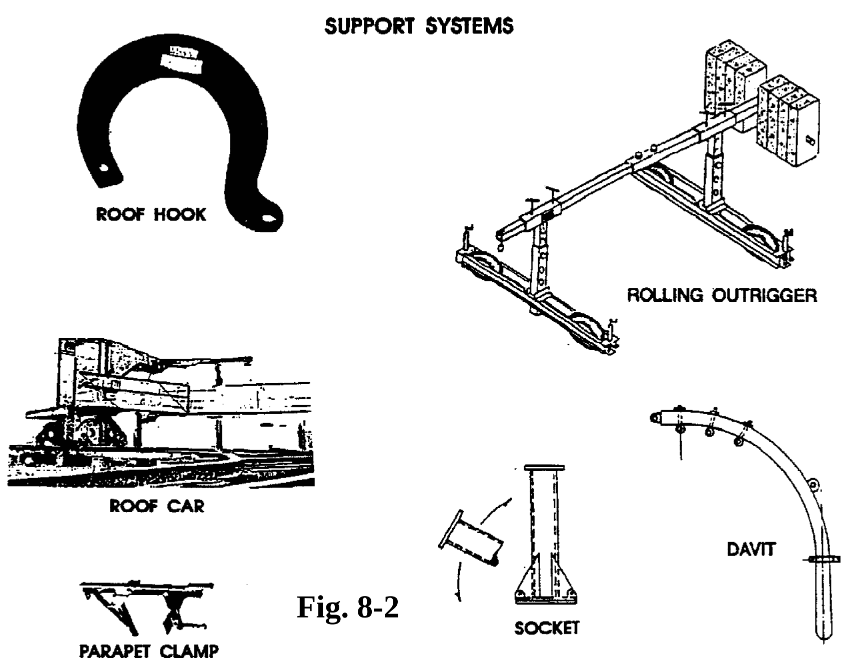


Fig. 8-2

Overhead trolleys and overhead anchors do not have an arm reach, because a pull on the rope doesn't "tip over" an overhead-mounted trolley. The reason for this is that the ropes are directly under the trolley or anchor, which are already outboard.

There are many ways to support a suspended platform. Nearly all the supports have several things in common:

- All supports have some part overhead (Fig.8-2), that is, above the platform. Some supports are **anchored directly overhead**, and some supports have arms that reach out overhead.
- All supports need a lot of **strength**, because they have to hold the full load of the suspended equipment with a safety factor of four. Some supports hold the load by getting their strength directly from the structure. Some supports hold the load by using counterweights to keep the support equipment from tipping over.
- All support equipment needs to be **maintained** like any other equipment or machinery. Nicks, saw-cuts, worn pivots, and other damage that changes the shape or thickness of the material weakens the support equipment.
- All supports have the same function, and do their job the same way. First, they handle the full load of the suspended equipment. Second, they are the direct link from the suspension rope to the structure. Third, they transfer their load to the structure by pulling and pushing on the structure.

We will now examine the basic concepts and types of support systems.

2.0 Basic Concepts Of Support Systems

2.1 Rigging

There are two major rules of rigging:

Rule Number One. NEVER ASSUME anything when rigging. When in doubt, ask. After you are done, double check.

Rule Number Two. NEVER ASSUME that the loads from the suspended equipment to the support equipment are vertical. They're not. The loads also act in, out, and sideways, always trying to move the supports.

Most of the time much of the load is vertical. Remember though, we always have side loads on the rigging, which must be kept to a minimum.

2.2 Rated Load

Rated load is the load limit established for the support force and for the hoist force. The rated load of the hoist is shown on each hoist, and the rated load is shown on most support equipment. These rated loads are used to coordinate the strength of the hoist with the strength of the support equipment (Fig.8-3).

Fig. 8-3

3/4 HP
1 PHASE
60 Hz
110/220 VAC
14/9 AMP

MODEL

5/16 INCH DIA.
WIRE ROPE
MAX. RATED
LOAD 1000 LBS

In the chapter on hoists, we said that the **hoist-rated load** is the highest operating load permitted to be carried by one hoist, and that the maximum pulling force the hoist may ever deliver is limited by the manufacturer, based on the hoist-rated load shown on the nameplate.

The support-rated load also has built-in limits, but on some types of supports both the permitted pulling force and the length of the arm reach affect the rated load. The support equipment's rated load is the highest **operating load** that can be carried by the rigging at a given arm reach if the rigging is set up correctly. With many kinds of support equipment, the support rated load changes with arm-reach distance. The longer the arm reach, the lower the rated load. The **maximum pulling force** the rigging can withstand is determined by the manufacturer and the codes, based on the support-rated load, and sometimes based on arm reach.

The rated load of the support equipment specifies the largest hoist-rated load you can safely use with that rigging. In other words, to properly coordinate the two rated loads, **the support-equipment rated load must always be GREATER THAN OR EQUAL TO the hoist-rated load.**

For example, you can use a hoist rated at 1000 pounds (454 kg) with a properly set up 1000-pound (454 kg) rigging system. You can also use a 1000-pound (454 kg) rated hoist with a 1500-pound (680 kg) rated rigging system. However, a hoist with a rated load of 1250 (567 kg) or 1500 pounds (680 kg) must never be used with a less-than-1000-pound (454 kg) rated load support system. No matter how short the arm reach, keep the rated loads coordinated, and half the battle is won.

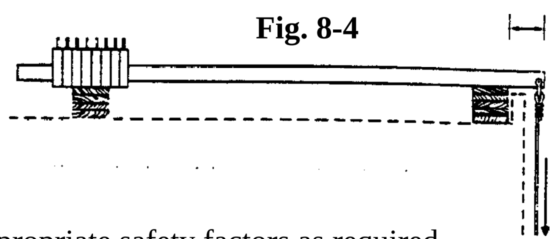
2.3 Arm Reach

Many rigging load ratings specify the reach you can use with a given load. This reach is what we call the **arm reach**. Arm reach is the distance from fulcrum to rope anchor. Arm reach affects the load holding capability of support equipment.

Even when suspended load and counterweight load remain the same, a change in arm reach can put more or less bend into your support equipment (Fig.8-4).

The larger force from a large-rated-load hoist can bend an arm reach more than the force from a small-rated-load hoist. You need a stronger arm for the same reach with a larger load.

Fig. 8-4



A rigging device such as a support beam or davit has a rated load assigned by the manufacturer which is the maximum load that can be placed on the device with appropriate safety factors as required by codes. This load may vary with arm reach.

Bending stress and shear stress are two factors that limit the rated load. The manufacturer evaluates both to determine the load that the support device can safely sustain.

As arm reach increases (the distance beyond the fulcrum to the load), the bending stress increases. The more the arm bends, the closer the arm comes to failing. An I-beam will twist and buckle downward as it fails. This means that there are limitations to arm reach to prevent failure by bending. For example, a beam rated for 1000 lbs. (454 kg) may be limited to an arm reach of two feet (.6m) maximum. The same beam might be rated for 600 lbs. (272 kg) at three feet (.9m), and so on. Generally, as arm reach increases, the rated load decreases to prevent failure by bending. Never exceed the rated load for a certain arm reach.

Remember the bending stress is one of two limitations. Arm reach and supported load determine the bending stress applied to the support device. The second limitation is shear stress.

You may think that by shortening arm reach, you can use a heavier rated-load hoist than the rigging rating; however, you cannot. The weight load limit on the rigging is the most load you can put on the rigging, no matter how short the arm reach. The reason is called **shear.**

Think of shear as a cutting action at the fulcrum. The load on the end of the arm reach pulls down on the fulcrum and the fulcrum pushes back. The arm will not be sheared if the load is kept within limits. The higher the load, the higher the shear.

The rated load of the support equipment allows for the shear limit. Do not exceed the rated load.

2.4 Spacings

Two support spacings are important:

- hoist-to-hoist, and
- wall-to-hoist

The wall-to-hoist **Spacing** (Fig.8-5) compares the distance from the wall to the support-rope-anchor-point with the distance from the wall to the hoist fairlead or hoist rope-entry point. If these distances are different, there are in and out side loads on the rigging.

These loads can be strong enough to shift the rigging outward and increase the length of the arm reach. Support strength can be reduced to a dangerous situation.

Spacings

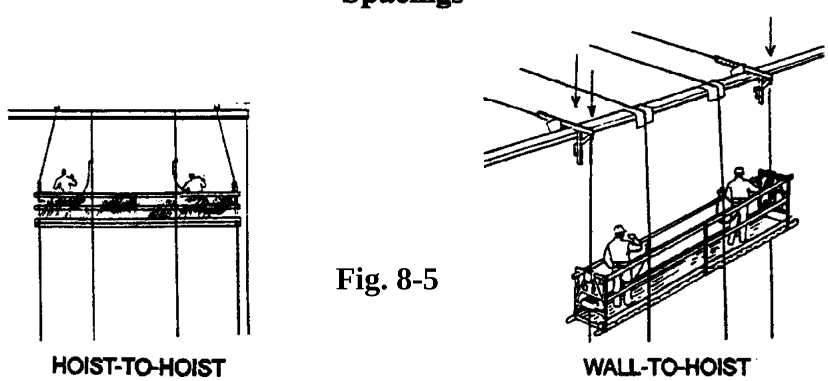


Fig. 8-5

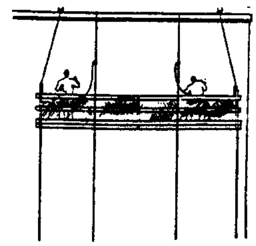
The distance between the rope connections on the supports needs to be the same as the distance between the ropes at the hoists. This proper spacing minimizes sideways loads on the rigging. If the distance between the supports is not correct, the force from the hoist will be felt on the arm reach, and that force will try to roll or slide the arm reach off the fulcrum.

The forces due to improper spacing are usually highest as the platform nears the support. Near the top, improper spacing changes the angle of the ropes, and the hoists pull more sideways and less vertically. This means sideloads on the rigging increase. The higher up you go, the greater the sideways force.

The sideways force near the top can damage the support system or even worse, it may overturn it.

Measure the spacing and keep the (Fig.8-6) platform level, especially near the top.

Fig. 8-6



Incorrect spacing of the support rope anchor with respect to the wall makes the hoist fairlead tilt in and pulls the arm reach out from the building. Remember the load capacity of the rigging depends on the arm reach. If you accidentally increase the arm reach, the support equipment load capacity drops, and so might you.

Side loads also are hard on equipment, causing wear and damage.

In one special kind of rigging the support equipment rope anchors are deliberately kept closer to the wall than the wall-to-hoist distance. This type of rigging is called **angulated roping** because the rope "angles" in to the wall. This type of rigging is used in some applications where the wall does not have platform stabilizing restraints.

Angulated roping can help provide a stable work surface. Rollers on the platform bear against the wall. When workers move, the pressure of the rollers on the wall keeps the platform from making sudden movements.

2.5 Angulation Force

Angulated roping is permitted because the problems of not bearing on the wall are greater than the slight additional loads created.

Again, the outward load is highest near the top (Fig.8-7). Angulated roping is permitted "somewhere below the top". How close you can safely approach the top is determined by degree of angulation and the force limits for your hoist and rigging.

There are three ways to approach the problem of too much angulation force at the top. Firstly, choose a wall-to-rope- anchor spacing that limits the angulation force at the top of travel and has less force lower down. The platform is still angulated, and by using fall protection connected to a hanging lifeline, the force is permitted to be as little as ten pounds (5 kg).

Secondly, set the angulation for 30 pounds (13.6 kg) pulling-out force at the top, and tie-in the ropes part way down to keep the required platform bearing force against the structure below the tie. When having reached the tie-in point part way up, release the rope ties and use the angulation from the top to finish the job.

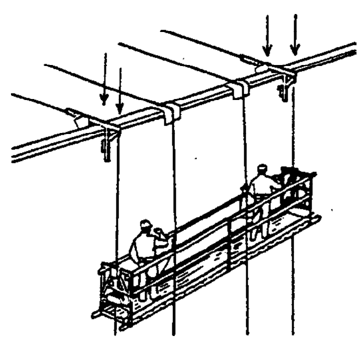


Fig. 8-7

Thirdly, work as high as is safe and practical and do the top with tool extensions.

Since each manufacturer's hoist and fairlead differ slightly, it is best to check with the hoist manufacturer for the hoist's angulation force limit. Most powered hoists comply with national standards, and one national standard requires 30 pounds (13.6 kg) of angulation force pulling the platform to the building when using angulated roping.

Always remember, though, that the force pushing the platform into the wall comes from the ropes trying to pull the rigging out.

2.6 Building Strength

Building strength is the next thing to check. The structure must be strong enough to do the job. Often this is not obvious. The load on the fulcrum can “punch through” a weak roof and a “rotten” parapet won’t hold the suspended equipment.

Some newer parapets are often made of plywood nailed onto a 2 x 4 (5x10 cm) stud fence, and are covered with stucco or fake brick. The parapet may look strong, but your equipment will tear the nails right out.

Many stink pipes are connected at the roof slab line with only rubber boots and clamps so the roof insulation and roof ballast can shift on the slab without breaking the pipe. Tie your line to that pipe, and you are tying to a piece of rubber hose.

Many old parapets aren’t much better. You must check the parapet support without the equipment connected, and then rig the equipment and test.

How do you know if your support strength is adequate? **First**, ask if it can take the load. **Second**, look at the structure and check it yourself. **Third**, use the kind of support equipment that is appropriate to the building. You wouldn’t use a hook on a glass parapet, so don’t use a hook on a questionable parapet, or a beam on a tin roof. Just in case, double-check the tieback.

Some jurisdictions require a licensed engineer to confirm the parapet or roof strength.

A final word on the vertical load into the structure. Overhead supports that are not cantilevered “bear” only the hoist force, while the support for a cantilevered load, that is, any load with an arm reach, “encounters” **more** than the hoist force at the fulcrum. For transportable equipment discussed in this course, the building under the fulcrum must be able to take four times the hoist-rated load.

2.7 Uplift

When a load is put on the end of the arm reach, the Support Equipment tries to rotate around the fulcrum, and lift up the support equipment behind the fulcrum. This force behind the fulcrum is called **uplift**. To stop the support equipment from rotating and going over the edge, we must hold down the uplift force.

We control uplift by using counterweights, anchors, or other means of restraint. We can use tie-down bolts, iron or concrete counterweights, or the horizontal reactions on the inside of a parapet clamp.

The amount of uplift you must resist depends on the rated load of the hoist, the length of arm reach, and the length of the support equipment behind the fulcrum. (Hooks and overhead connections do not normally have uplift.) The higher the load, the greater the uplift. The longer the overhang, the greater the uplift.

However, the longer the support equipment behind the fulcrum, the lower the uplift.

2.8 Counterweight Ratio

Regulations require that the ratio or safety factor to keep the Support Equipment on the roof is 4:1. This means that the moment from the uplift acting on the back of the support equipment has to be at least 4 times the moment of the rated load of the hoist acting on the arm reach. In other words the moment that keeps you up has to be at least 4 times the moment that is trying to take you down.

2.9 Counterweight Formula

The Counterweight Formula used to calculate the amount of weight necessary to keep the support system on the roof is:

$$W = \frac{(La)4}{b}$$

See (Fig.8-8)

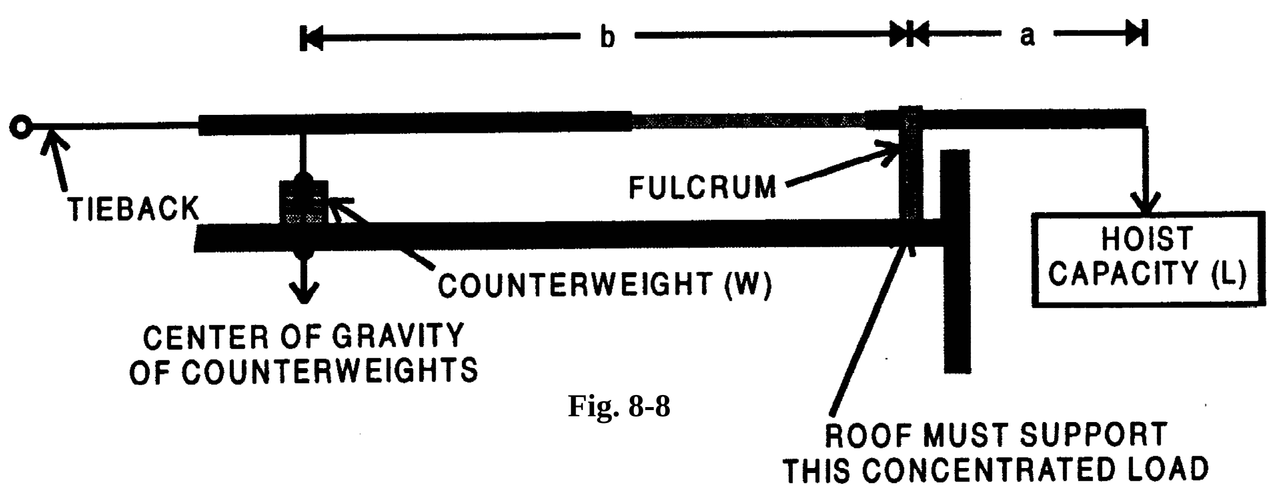


Fig. 8-8

where:

where:	W	=	Counterweight
	L	=	Load capacity of hoist
	a	=	Arm reach
	b	=	Backspan distance (the distance from the fulcrum to the center line of the counterweight mass).
	4	=	Ratio of 4:1 required by Regulations. (Safety factor)

All of the values are determined by the circumstances of the application, except how much counterweight is required to be safe. The load capacity of the hoist is known. The amount of Arm Reach is determined by the position of the Fulcrum and how far out to the center line of the platform.

The distance from the Fulcrum back to the center line of the Counterweight mass is known. The Ratio or Safety Factor is set at 4:1. The only unknown is how much Counterweight you need to secure the Beam.

Let us use two examples:

1. The Outreach is 2 feet (.6 m), and the beam is 16’ (.49 m) long.

The distance from the Fulcrum to where the center line of the Counterweight Mass will be is 14 feet (4.27 m).

Therefore: $W = \frac{(La)4}{b}$ or

$W =$ 1000 pound hoist x 2 foot arm reach x 4 safety factor, Divided by 14 foot backspan.

$= \frac{(1000 \text{ x}2) \text{ x } 4}{14}$ or

$W =$ 571 pounds.

2. The Outreach is 18 inches (dimensions must be expressed in portions of feet) or 1.5 feet.

The distance from the Fulcrum to where the centerline of the Counterweight Mass will be is 13 and 1/2 feet, or 13.5 feet.

Therefore: $W = \frac{(La)4}{b}$ or

$W =$ 750 pound hoist x 1.5 foot arm reach x 4 safety factor, Divided by 13.5 foot backspan.

$= \frac{(750 \text{ x}1.5) \text{ x } 4}{13.5}$ or

$W =$ 333 pounds.

2.10 Reaction

The building or structure holds the loads applied to the support equipment by the suspended equipment. The building or structure must be strong enough to hold the load. The support equipment transfers the forces from the rated load into the building. The support equipment must be strong enough to handle that reaction (Fig.8-9).

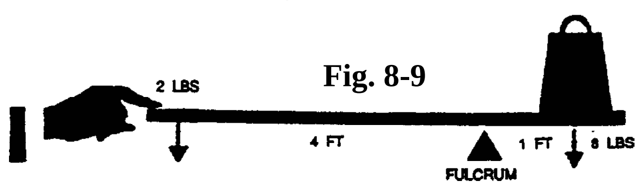


Fig. 8-9

The force into the building is the same value as the force from the equipment, but building strength deals with the building, and the reaction deals with the equipment (Fig.8-10).

The load at the fulcrum is larger than the load at the end of the arm reach. This is because of the cantilever reaction.

Cantilever reactions are always bigger than the cantilevered load. For example, if you have two feet of arm reach on a four-foot long beam, the load pushing down at the fulcrum is at least two times the load at the end. And, if you have a hoist on two feet of arm reach on a sixteen foot beam, the load pushing down under the fulcrum is one and one-seventh the load from the hoist .(Fig.8-11).

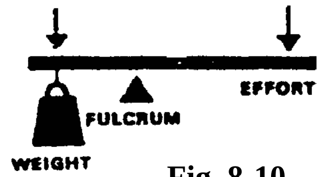


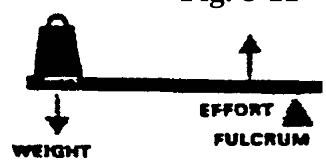
Fig. 8-10

If everything else stays the same, the longer the beam, the lower the load at the fulcrum. The longer the arm reach, the higher the load at stress under the fulcrum.

The higher the load at the fulcrum, the more the beam is being bent, and the more likely it will fail. You can avoid problems with reaction by using support equipment according to manufacturer's recommendations and procedures.

Another **reaction** is the sideways reaction from the pull on the ropes by wind or misalignment. The wind tries to pull the rope, and the rope anchor pulls back. The rope anchor reacts to the load from the wind, usually sideways. A side load on the rope anchor means a side load on the support, which may result in a sliding support or a tipping support. This is the second reaction to beware of: the side-load reaction.

Fig. 8-11



The fulcrum needs a wide base and a secure base to transfer the load properly.

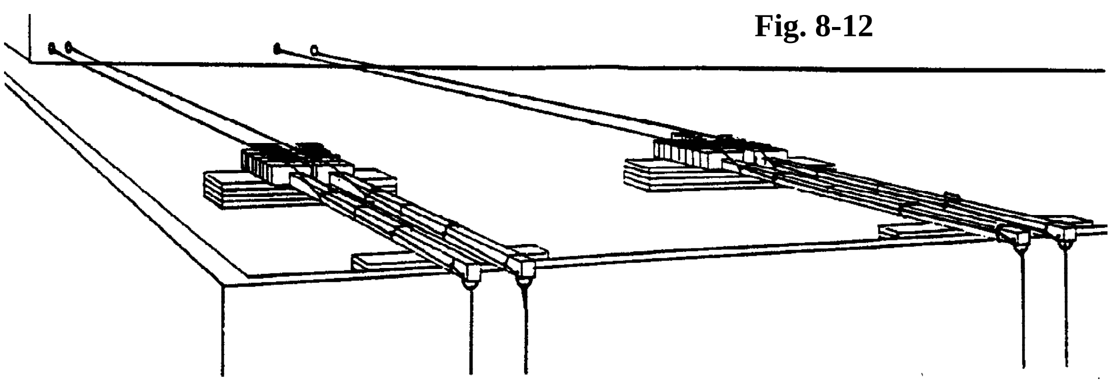
2.11 Your Tieback

Your tieback. It seems to be a strange way to name a piece of support equipment, but you will soon see why it was called this.

The **tieback** is a piece of safety equipment used with support equipment. Basically, it is a piece of rope the same size and strength as your suspension rope, tied straight back from the rear of the support equipment to a solid anchor. It keeps the rigging from coming down, which means it keeps the support equipment from dropping you and then dropping on you (Fig.8-12).

When you do rig, you must always hook up your tieback. Always, always, always. It is there for the unexpected. No one is perfect, and no one knows it all. The tieback holds the support equipment when you need it most.

Fig. 8-12



When will the tieback be used? It is used when the mechanical equipment on the roof kicks in and vibrates the outrigger until your arm reach is too long. Your tieback stops the outrigger before it slides over the edge.

Tiebacks will be used when the sun softens the roof and the fulcrum that was solid at 7:00 a.m. is soft at noon. It will be used when somebody missed the spacing, and set the hooks wrong, and the curve on the hook looks more like an apple peel curl than a question mark. It will be used when somebody, somewhere, missed something that will cause your support to come down on your head.

Anchor it securely to a 5000 pound (2268 kg) anchor point. This will keep the support in place when all goes wrong.

The tieback must be anchored straight back in line with the Support System. A single tieback can be anchored when it is out of line no more than 25 degrees on either side of the center line. When it is more than 25 degrees, you need two tiebacks, one in each direction. They cannot exceed another 25 degrees, or a total of 50 degrees in each direction. (Fig.8-13).

The tieback is your safety. It keeps the beam in place, so you are not as likely to lose the rigging and fall. It also keeps the rigging in place so it doesn't hit you in the head if it falls and you are left hanging on your lifeline.

The tieback is simply a piece of the rope, preferably wire rope, tied from the support equipment to structure. But it is a very important piece of rope. It must be at least as strong as the hoisting rope. Since the purpose of the tieback is to hold the equipment when something unusual happens, you must have the tieback tied somewhere directly behind the beam and it must be taut.

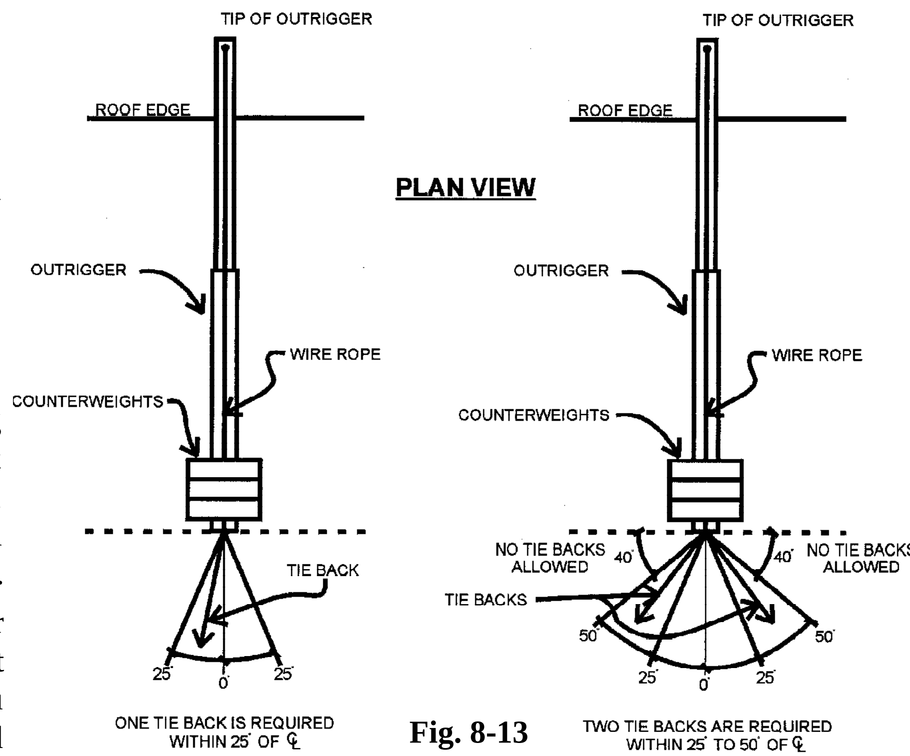


Fig. 8-13

Note: 1. Tie Back may also occur from tip of outrigger.
2. These Tie Back angles also apply to lifeline Tie Backs.

Locating tiebacks and their anchors can be very difficult and is alright as long as you have a reliable tieback and anchor. Some people tie a rope loosely around the penthouse, connect the tieback to the rope, and snug up the rope slack before connecting the tieback line to the beam.

If the Penthouse is the only available tieback point, 1/2" steel wire rope can be wrapped around the Penthouse. It should be joined together with wire rope clips and thimbles (and shackles if necessary). The wrap must not be tight or you will impose high impact loads if it becomes a loaded anchor.

Others have tied to a truck frame on the other side of the building. If you use a vehicle as an anchor, do not park across a travelled street, or leave the keys in the ignition or the vehicle in a towable condition.

A proper parapet clamp attached to the opposite parapet can also work as a tieback, provided the parapet is strong enough.

2.12 Rigging "RASBURRY"

Many professions and trades have catch words or special rhymes to help people remember important or complicated sequences. When each letter of the "catch" word stands for a particular thought or phrase, it is called an acrostic. The acrostic word that will help you remember important steps in rigging is **"RASBURRY."**

Just remember "RASBURRY" (used as a checklist).

"RASBURRY." **Ralph And Sarah Bought Up Rail Roads Yesterday.** Each letter is a reminder as to what to check in rigging:

Ralph	check	Rated loads of hoist and rigging
And	check	Arm Reach distance from the fulcrum
Sarah	check	Spacings of rigging
Bought	check	Building strength holding rigging
Up	check	Upforce and holddowns
Rail	check	Ratio for four-to-one
Roads	check	Reaction for overload
Yesterday	check	Your tieback

3.0 Support Equipment

3.1 Outriggers and Beams

One of the more common support systems used today is the outrigger or beam system. This system has four basic parts: the beam, the fulcrum, the hold-down or counterweight, and the tieback (Fig.8-14).

The **beam** provides a place to connect the suspended rope. It locates the suspended equipment with respect to the building and to the other ropes. It holds the load of the suspended equipment, and it transfers the load to the fulcrum and to the hold-down. The load on the beam tries to shear, bend, crush, and tip the beam off the fulcrum.

An outrigger beam has to be built to take the load, and the load has to be put on the beam correctly. Several shapes are used for outrigger beams.

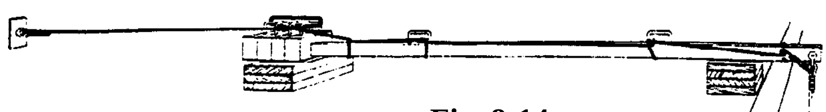


Fig. 8-14

H or I-Beams have a lot of material on top and bottom, called the flanges, and less in between along the web. H or I-beams are strong when the flat flanges carry the load, but are not very strong when the beams have to carry the load while lying on their edges, or when they try to carry a twisting or offset load from improper spacing. You need a much bigger beam to carry the same load when the beam is on edge. H or I-beams should **never** be used to carry a twisting load.

Round pipes are very good for carrying twisting loads, because the material is evenly spaced and can share the torque load. But round pipes are not as good as H or I-beams for carrying beam-bending loads because there isn't as much load-carrying material at the top or bottom of the beam, and there is less metal to resist crushing. You need to be sure of the reaction at the fulcrum before using round outrigger beams.

Square tube is not quite as good as an H or I-beam when carrying bending loads and not quite as good as round pipe when carrying twisting loads. However, it can carry loads in both directions, and it can carry a twisting load. It is a compromise general-purpose beam.

Each shape of beam can do the job if properly sized, properly reacted at the fulcrum, and properly maintained. Be sure that your beam has the correct load rating for the job.

Beams can be made of steel, aluminum, or wood. Each material can do the job if properly sized and properly maintained. Hazards to platforms also apply to beams, such as chemicals, acids and mechanical damage.

The design of an appropriate size beam for a given load and arm reach requires an engineer's knowledge of materials, forces, stresses, and calculations. Fortunately, standard outrigger beams are available from scaffold leasing and rental houses. The designs have been tested and approved up to certain loads and within certain arm reaches.

3.2 Installing Beams

Some people believe that beams must be installed perfectly level, and no other way. Beams can be installed level or at an angle, with the weights down and the rope end up. Surprisingly, they are both right, or both wrong, depending on your outlook.

When you set up your beam perfectly level, the rope end will shift down when it is loaded. How much depends on the beam, the load, and the structure. The beam and the support deflect (bend), and your beam is no longer level. If that beam vibrates or slides, it will slide in a direction that increases the arm reach. This is why a tieback is required.

When you set up your beam back end down, all the load into the structure is no longer vertical, and some of the reaction load starts pushing out. If you are resting on a parapet, it tries to push over the parapet at its weakest point.

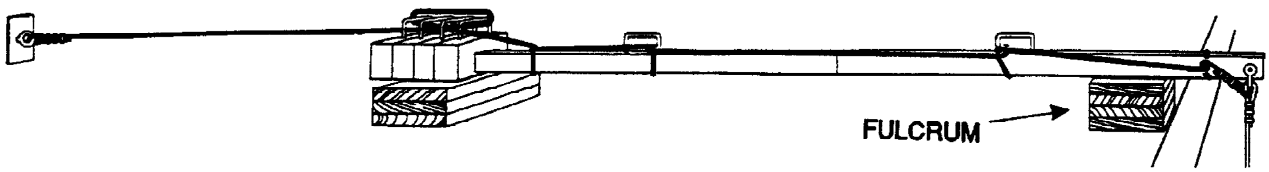
The best way to set a beam is to place the weight end **slightly** down, so the beam is almost level, but not quite. Slightly, usually means about six inches to a foot (12-25 cm) below level on a sixteen-foot beam. Many rolling outriggers (those with tires or wheels) are designed to rest at an angle, and when using those outriggers, follow the manufacturer's instructions.

3.3 The Fulcrum

The fulcrum is the place where the outboard side of the beam first rests on the building or structure (Fig.8-15). The fulcrum transfers the load into the structure, and keeps the beam stable. The fulcrum may use the parapet, the roof, a structural steel member, or a hanger from an overhead beam. No matter where the beam rests, the point where it pushes down is called the fulcrum.

The Fulcrum

Fig. 8-15



The fulcrum needs two things to do its job: building strength and reaction.

The structure holding the fulcrum needs to be sound and able to carry the large transfer loads from the beam. Remember, fulcrum needs a strong base because the load on the fulcrum is larger than the load of the suspended equipment.

Some outrigger beam systems use rolling fulcrum supports with rubber tires or castor wheels. These transfer loads into the roof or structure. Others have pads with jacks to set down so the wheels do not carry the load.

Soft tires put just as much reaction load into the roof as any other fulcrum. Tires do not lighten the load into the structure. Wheels only make the setup and relocation easier and help protect the roof surface.

However, if tires make it easier for you to move the beam, it is also easier for the beam to move by itself. Block the tires. Use the pads or jacks provided on some rolling outriggers to keep the beam from moving (Fig.8-16).

The fulcrum must transfer the load from the beam into the roof or structure safely (reaction). If you rest the beam on a rough, sharp, or irregular surface, the beam may be damaged. Some beams have smooth brackets at the fulcrum to spread the load, and other beams may need boards or pads to protect the beam.

How you protect the beam at the fulcrum depends on how you must rig the support. If you use a parapet because the roof is too weak, one method of load transfer and protection may be needed. If the load goes into the roof surface, another method may be used. A round beam will need a different reaction shape than an I-Beam.

The basic idea in reaction is to take the load from the hoist and rope and put it into the roof, without damaging the beam, its stand, or the roof.

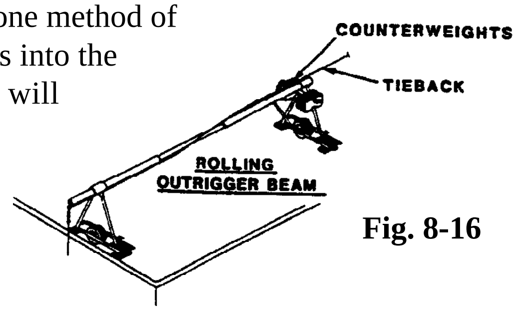


Fig. 8-16

3.4 Uplift

An outrigger beam is like the teeter totter with a four-to-one ratio included. The load over the side is **pulling** down, and the load at the fulcrum is pushed down. The uplift force at the other end of the beam therefore needs to be pulled down or pushed down by counterweights or tie-downs (Fig.8-17).

Tie-downs are pretty straightforward. You measure the arm reach distance, pick a beam that will handle the hoist-rated load and arm reach, and calculate uplift needed for the four-to-one ratio. You connect the beam end to the tie-down (usually part of the roof structure), and use the tie-down to react the uplift from the beam. For tension (pulling) connections, use a shackle or wire rope and clips to secure the beam to the holddown. For compression (pushing) connections, follow the same procedures as you would when reacting the fulcrum loads, and then tie the end down (or up).

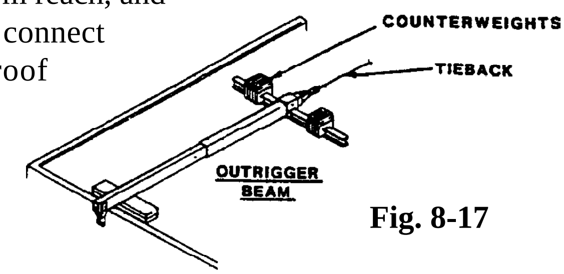


Fig. 8-17

Be careful when using a tie-down (Fig.8-18). Do not set it in such a way that the live end of the beam is not raised up off its support, because when a load is applied it will act with leverage and possibly pull the tie-down out. Don't overtighten.

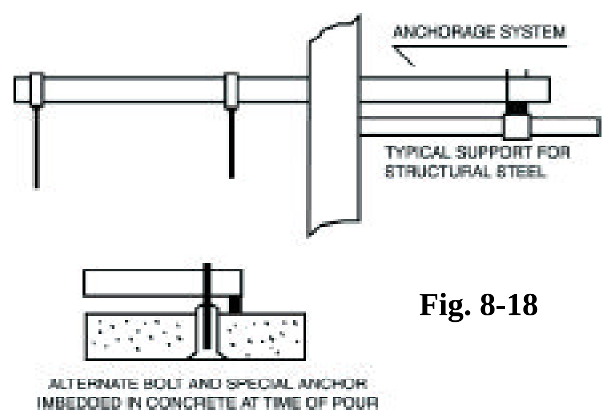


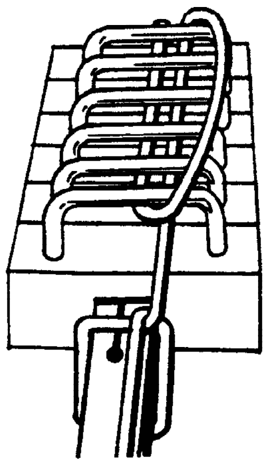
Fig. 8-18

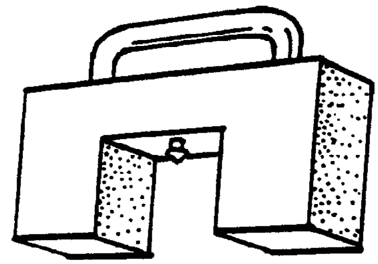
3.5 Counterweights

Counterweights are also pretty straightforward. You measure the arm reach distance, pick a beam that will handle the hoist and arm reach, and calculate the weights needed for the four-to-one ratio. You set up the beam, install the counterweight and the tieback, and measure the beam length behind the fulcrum. Then you use the hoist-rated load to figure the counterweight you need for a four-to-one ratio. Sometimes you can check the chart provided. Sometimes you have to do it yourself. Be careful with your calculations.

All weights are secured to the beam (Fig.8-19). All counterweights must be identified with their weight. Many beams have a cross bar at the uplift end, and the bar is often referred to as the "longhorn." You slide the weights on the longhorns and then pin the stops or connect the wire ropes holding the weights and beam together. Other beams have a hole at the uplift point. Wire rope is fed through the hole and the weights, pulled tightly, and then the ends are connected with wire rope clips, or slide-on weights that slide onto the beam itself.

It is important that you secure the weight to the beam. Weights which are not secured or can move are called **flowable**. Using flowable counterweights is strictly prohibited. It is not the container that counts, it is the weight. The material providing the weight must not flow. Weights must be physically fastened to the beam.





Bolt on Counterweight for Slot in Beam

Fig. 8-19

Never use water as a counterweight. In one instance, the bucket had a slow leak on a hot day, or workers took water from the barrel to mix mortar.

Packing sandbags on the end of the beam is another deadly idea. You can't bolt sand to the beam either. Three-fourths of the sandbags sit on the roof rather than the beam. If you can pile them on the beam, the beam rolls, the sand flows, or the bags split.

If you can't put a rope or a bar through it, it is not a counterweight.

3.6 Moving the Equipment

When it is time to move the equipment, the suspended load is always removed from the support system. The beam can hold the wire rope while the support is being changed from place to place. **NEVER** move the work platform using the beams! The platform is to be set down and moved separately from the beams.

If you can leave the tieback anchored while moving the beam, do so. This will prevent any movement forward by the beam. Relocate it once the weights are moved. It is almost always necessary to remove the weights unless the beam has wheels and is designed for loaded movement. Otherwise, you would need 4000 pounds (1814 kg) at the rope end to raise the weight end.

People have tried to move a light platform by removing some counterweight and lifting up on the beam to move the platform and rigging. This has resulted in back injuries. In a more serious instance, one worker was launched when the beam he was holding between his legs slipped and the beam dropped onto the parapet. The platform pulled down, the back end of the beam shot up, and the worker went over the roof edge.

Do it right and take the load off before moving the rigging.

3.7 Roof/Cornice Hooks

Roof hooks are another common support system. We will define all curved hooks used for support of suspended equipment as roof hooks. Cornice hooks and parapet hooks are types of roof hooks (Fig.8-20).

Roof hooks look like question marks. Each will show their load rating. The cornice hook is larger than a parapet hook because it is made to span the ornate stonework at the tops of older buildings. The inside-opening dimension or span can be over eight feet. Parapet hooks fit the simpler parapets of more modern buildings. The maximum throat opening of a parapet hook is about three feet (.9 m).

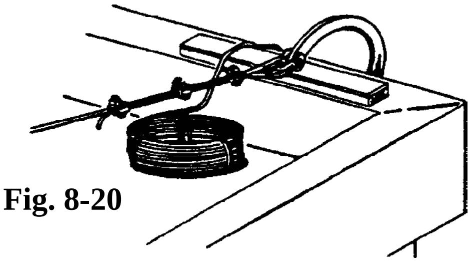


Fig. 8-20

Roof hooks come in various sizes and strengths. Each is load rated. The hook is almost always made from steel, usually flat plate.

Some roof hooks in use today were made before powered hoists became common. These hooks were made for the light loads of block and tackle rope falls, and are inadequate for powered hoists. New hook designs are engineered, tested, and rated for powered hoists.

The roof hook has an eye (Fig.8-21) where the suspension rope is connected, a main body, a second eye in the body for the tieback connection, and a point at the end of the curved section.

We will take the “RASBURRY” approach to roof hooks.

The **Rated Load** of the hook must be equal to or greater than the rated load of the hoist.

The hook carries the load along its curved section, which means the main body of the hook is being stressed very much like the arm reach part of an outrigger beam; that is, it is trying to bend. If you rest the hook on the tip, the moment, and therefore the bending, are at the highest. If you rest the hook on the main body, the moment and the bending are lower.

Fig. 8-21

If the hook carries the rated load on its tip, the hook must be kept vertical with no side loads of any kind. The side loads from even a small error in spacing may fold the hook. This is because the side load on the eye pulls one way, and the loaded tip doesn’t move. This pulling twists the flat plate of the hook out of line with the vertical load, and the vertical load folds the hook. Plates are notoriously weak at resisting twist.

If the hook carries the load on its body, that is, you are reacting the load on the main body of the hook, the hook rotates slightly at the point where the main body rests on the building. If you do get any twist, the hook doesn’t fold but instead tries to straighten the part between the eye and the rest point. Since it is already nearly straight, the hook does not fold, but holds.

The hook is weakest when on its tip, and can fail by twisting. The hook is strongest when the load is reacted by the main body. Never point-load the hook unless the manufacturer’s instructions state that the hook was tested for a point load.

Arm reach is adjustable. Arm reach can be increased by using a stand-off bracket.

Spacing is very important when using roof hooks. If the hooks are at one spacing and the hoists at another, the hooks will be pulled in (or out) as the platform travels up the building. Side loads will increase.

Sideways pull on the tip of the hook will make the top twist, and the vertical load will fold the hook. You will suddenly be hanging from your tieback.

Building strength is very important when using hooks. The load is generally transferred to the building at the top of the parapet and into the face of the building at the eye or standoff near the eye. Plywood boards are generally used to protect the building and to distribute the load on the roof or cornice. Some cornices and parapets are secured only by their own weight. Others may be false facades. Always investigate cornice, parapet, and roof strength thoroughly.

Uplift is not a concern with parapet hooks. The loads from the hooks are down when the hooks are properly installed.

Ratio is determined in the design of the hook and will be four- to-one if the hook is properly installed and the load limits are observed.

Reaction load is usually the same value as the rated load of the hoist. The reaction can be a concern along the sharp inside edges of the hook and under the tip. Proper protection to distribute the load is required. Wooden blocking under the hook will spread out the load and protect the building.

Your tieback is definitely needed with a roof hook. The tieback was first used on roof hooks and is still absolutely necessary today.

The rules for outrigger beam tiebacks must apply here. Always use rope equal in strength to the suspension rope.

Connect the tieback rope to the tieback eye before installing the roof hook. If you drop the hook, it won’t land on the sidewalk or pull you over.

Wear fall-arrest equipment when handling hooks. You will be near the edge installing or disconnecting an awkward piece of equipment.

3.8 Parapet Clamps

Parapet clamps grip the parapet. The parapet holds the total weight of suspended and support systems and therefore can only be used with a parapet strong enough to take the load and large enough to fit the clamp.

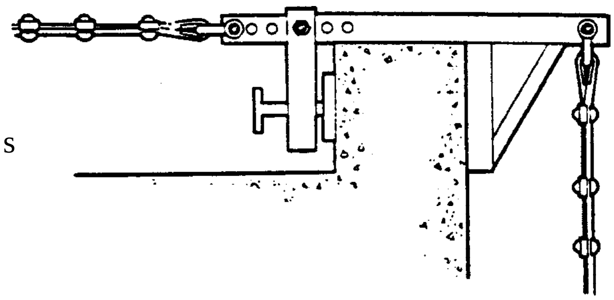
A parapet clamp looks very much like a large furniture clamp. Usually made of steel, it has a **foot,** a **screw,** an **arm,** and a **tieback point**. The suspension rope connection point is at the foot end, that is, the end opposite the screw (Fig.8-22).

The foot is usually fixed, and rests on the outboard side of the parapet. The screw rests on the inside of the parapet. The screw is attached to a movable mounting leg, which slides on the arm and adjusts the clamp for various parapet thickness. Different clamps are adjusted in different ways. Check the manufacturer’s instructions for the correct way to adjust and set your clamp. If pins are required, always use the right size and grade. Always use a tieback.

Parapet clamps are to be used only one way. The screw always goes to the inside of the parapet. The clamp will not have the proper ratio with the longer arm reach of the screw end outboard.

The parapet clamp grips the building parapet. Clamps come in different sizes, and the parapet must be high enough and thick enough to fit the clamp you are using. Do **NOT** block up the parapet to make it thicker or higher for the clamp. Never use more than one thin piece of wood to protect the top or inside of the parapet. Never put wood on the outside of the parapet unless it is secured against falling. Some clamp manufacturers prefer nothing between the clamp and the parapet. Always follow the manufacturer's instructions.

Fig. 8-22



3.9 Parapet Clamp "RASBURRY"

The rated load of a parapet clamp must be coordinated with the hoist-rated load. The rated load of the clamp must be greater than or equal to the rated load of the hoist.

The rated load applies only when the equipment is properly set up and well maintained.

Arm reach for a parapet clamp is set by the manufacturer. It is always the distance from the suspension rope point to the external support.

Spacing requires careful consideration as on any cantilevered system. Always set the hoists and rope connection points at the same spacing. Maintain correct distance from the wall to prevent any additional load on the clamp screw that might move the clamp off the wall.

Building strength is very important because the parapet carries the entire load. The parapet must be able to carry the rated load, the grip load, and the uplift at the screw.

The clamp grips the building parapet. The suspended load is cantilevered. When the arm pushes down at the outer edge of the parapet, the parapet cap must be able to take the reaction load. If the wire rope is not vertical, different loads are applied to the parapet. Check with the manufacturer or supplier for instructions.

When the arm pushes down on the outer edge of the parapet cap, the screw is pulled up. Because the screw is tight against the inside of the parapet, the parapet must be able to resist the uplift of the screw. Many parapet caps are just "set on," and can be lifted off quite easily. BE SURE the cap is anchored.

The screw squeezes the parapet. A hollow masonry parapet can collapse under this action. However, if the grip of the clamp is too light, the clamp will hold poorly. Be sure the parapet can carry the grip, the reaction, and the uplift. Do not hook the cap.

Uplift is taken by the end of the screw on the parapet, and is part of the design of the clamp.

Ratio is part of the equipment design, and if the rated loads are coordinated and the clamp properly set up, the ratio will be at least four-to-one.

Reaction is also part of the equipment design. Protecting the arm and the building by a flat wood block or one plywood piece under the arm and under the screw is often done.

Your tieback is always to be used with a parapet clamp. The tieback shall be equivalent in strength to the suspension rope.

3.10 Overhead Eyes and Beams

Overhead eyes are often used in soffits, and in areas where the potential arm reach is too great to permit a cantilevered member. The eye is usually welded or bolted to the overhead structure and certified by a professional engineer.

Overhead beams are commonly used as support equipment. They are suitable support as long as they are strong enough to hold the load, and the method of connecting the rope to the beam does not damage either of them.

Using an overhead eye or beam for support always requires that the suspension ropes be connected to the anchors and lowered to the ground where the platform is then attached. This method of rigging the platform on the ground is often referred to as “ground rigging.” Ground rigging may be used with almost any type of support equipment. It is introduced here because overhead equipment always requires ground rigging.

Rated load (working load) of the hook and the eye must be certified by test. The rated load of the sling must be at least as high as the rated load of the suspension rope. Keep the load side of the sling rope as straight as possible. Do not snug the sling eye up tight into the beam. The sling eye should be below the beam by at least four beam widths.

Arm reach does not apply to overhead connections.

Spacing is important as with all other setups. Improper spacing generates high side loads. Eyes are not as strong when pulled sideways as they are when pulled straight on. Nor can they carry full load when side loads are present. **Keep the hoists and eyes or slings the same distance apart.**

Building strength can be seriously compromised by eyes under side loads. Even though the eyes are reduced in capacity by side loads, their structural anchors are unable to carry even small side loads.

Beams can hold you only if the beam itself can carry the load. As we discussed in the section on outrigger beams, I-beams and tubes are good members for carrying loads if the span is adequate and free of twist. Angles and channels are poor choices because loads must be located precisely on and outside the member for reliable support.

Uplift does not apply to overhead connections.

Ratio does not apply to overhead connections.

Reaction applies to overhead connections when the platform does not have stirrups at the ends of the deck. The rope load from the part of the platform beyond the outboard stirrup iron is multiplied because of the cantilever effect, and the load into the eye or beam increases.

Refer problems with cantilevered support systems to a professional engineer.

Your tieback is not used with overhead connections.

Attaching the ropes to the anchor often requires ingenuity. Some applications allow the ropes to be connected while you stand on an adjacent surface. Other applications require “walking the steel” (with appropriate fall protection, of course). Still other applications allow connection of the ropes from an adjacent platform.

3.11 Attaching to the Beam

There will be applications requiring attaching to an overhead structure, such as a beam (Fig.8-23). The steel wire rope attachment must be protected from sharp edges. Soft blocking such as wood is required. Sharp turns of the rope must be eliminated. Finally, the termination must be tight.

Use at least a 1/2 (1.3 cm) inch diameter wire rope for rigging around a beam (Fig.8-24). The best kind of rope to use on a beam is sling rope, because it can better stand the stress. A regular sling used as a choker, or a loop choker, with the load angle at less than 45 degrees off center (135-degree choke), works best. Hook your suspension rope thimble to the sling eye using a shackle, and pin the bolt in the shackle. Protect the sling with padding at the edges of the beam.

There are padded slings made of stitched webbing with connectors that can be used instead of wire rope chokers. Check with your supplier. (Fig.8-25.)

NEVER rig a beam with fiber rope! Fiber ropes are too risky. They are easily damaged, deteriorate rapidly, and are difficult to evaluate for safety. Possible impact loads in the system are better handled with steel wire rope properly terminated.

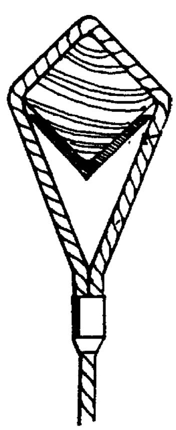


Fig. 8-23

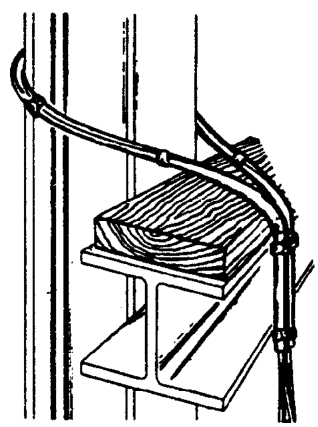


Fig. 8-24

Fig. 8-25

3.12 Hooks

Many overhead eyes and beams are rigged with hooks. Hooks are the weakest part of almost every setup. They need a lot of metal to carry a load. The hook may roll, or the load may not rest fully in the hook. Rigging a beam with a basket sling can pull the hook open. Also, the energy from any sudden load on the rope travels up the rope and whips the hook from side to side.

When using a hook on an overhead connection, consider two points. Firstly, use a hook sized by load, not by “size”. That is, use a hook that can hold the load and then connect it with parts that fit. Don't get a hook to fit the parts you have. Most hooks have a rated load based on a five-to-one ratio against failure. Always check ratio and rating.

Secondly, use a double-latching hook. There are different kinds of double latching hooks. Some are so safe they can't be conveniently put on or taken off. Never tape the safety back. Send the hook back to whoever "spec'ed it out." Then, get a proper double-latch hook. Use it correctly and safely.

Never carry the load on the latch of the safety hook. On some hooks the locked latch must be released to put on the load. Otherwise, the load is carried on the outside of the latch. Always be sure the eye, thimble or shackle rests in the hook.

3.13 Carriages and Trolleys

Carriages are wheeled cars that run on tracks or runways. They are commonly found in permanent platform installations (P.I.) and in large complex construction situations. These are discussed in greater detail in Chapter 6. Trolleys are carriages that run on overhead tracks.

Carriages support the platform on arms that reach over the edge, while trolleys usually support the platform by directly acting on the overhead structure. Carriages can have the arms connected or separately mounted. Some arms move on the cars. Most trolleys allow each support point to move independently.

Carriages and trolleys hold the suspended platform, move the suspended platform from position to position and transfer the load from the suspended equipment to the support structure. Some carriages have hoists mounted on the carriage.

Most carriages hold the platform at the end of arms connected to the carriage. The cantilevered load of the platform is transferred into the roof or structure at the front (parapet-side) wheels. The counterweight which prevents the car from overturning is part of the car structure and distributed over at least three, often four, wheels.

Some carriages use part of the building structure to help resist overturn. Usually behind the car, the anchors are called **tie-downs**. The carriage is lighter if the carried counterweight is less. The carriage can safely carry the dead load of the platform from station to station, but the ratio is inadequate for platform operation unless the tie-down is connected.

Most carriages have electrical connections, called **interlocks.** These ensure that proper mechanical connections are made before the carriage will move or the platform can be operated. Part of the daily check is to make sure that these interlocks are all working.

If you find an interlock bypassed or otherwise disabled, do not use the equipment. Manufacturers do not add parts without good reason. Always follow the manufacturer's instructions for testing, checking and operating the carriage.

It is the owner's responsibility to provide instructions for proper operation of the equipment. Reliable sources can provide replacement manuals. Do not put your life at risk to cover another person's mistake or carelessness.

The carriage can be heavy. Do not become trapped behind the carriage, do not try to push it on ice, and keep your feet out from under the wheels.

Finally, keep the electrical cord free of the carriage. Be sure you have enough cord before moving the carriage. Otherwise, it will pull the outlet off the wall, or tear the cord from the plug.

3.14 Trolleys

Use of a trolley system usually requires ground-rigging the platform. Follow the manufacturer's instructions for ground-rigging the platform and trolley. Do not use the equipment until you review the instructions.

Do not "whip" the trolley from one end of its track to the other. A trolley tag line pulled **along** the track axis will move most trolleys. If the trolley is hard to move in the track, it needs repair, you are moving it incorrectly, or it was designed incorrectly. Get some advice before you use it.

3.15 Carriage "RASBURRY"

Rated Load of a carriage support system is not usually marked on the carriage. Instead, a label on the platform states the allowable use load. The manufacturer has taken into account other loads on the system.

If you are to use the carriage or the trolley with another platform, you must check the manual for the rated load of the carriage or have the allowable load of the carriage determined by a professional engineer. Some manufacturers of permanent equipment design supports for lighter loads and special motors. The loads from your normal hoist motor may be too great for the support.

Arm reach of a carriage is built into the equipment by the manufacturer according to codes and regulations.

Spacing of a carriage is built into most carriages by the manufacturer. The need for proper spacing of the support points is the same as in other setups. Hoists and trolleys must be the same distance apart to keep side loads at a minimum.

Uplift protection for a carriage requires that the tie-down be properly connected. The rest of the protection is built into the equipment by the manufacturer according to codes and regulations.

Ratio of a carriage is built into the equipment by the manufacturer according to codes and regulations.

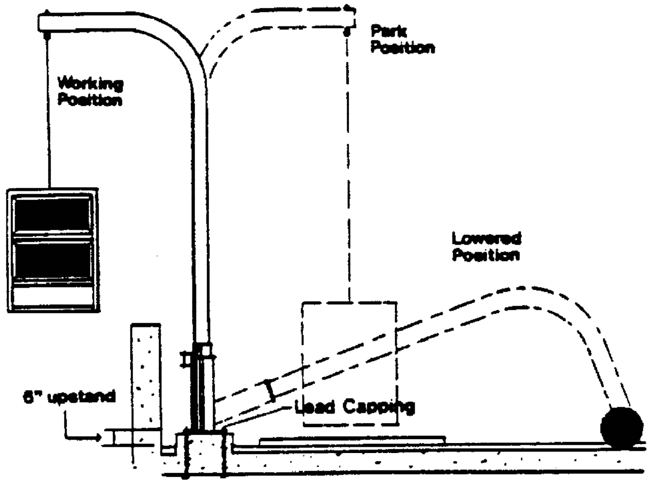
Reaction of a carriage is built into the equipment by the manufacturer according to codes and regulations.

Your tieback is not used on most carriages.

3.16 Sockets and Davits

A socket and davit support system uses a tube or weldment anchored to a building or structure, and a second tube or structure with an arm which rests in the anchored tube structure. We will talk about a commonly used socket and davit system with an aluminum tube as a davit and a welded tube as a socket (Fig.8-26).

The **socket** is the part affixed to the roof. The **davit** is the part that fits on the socket and has the arm. Some systems use an intermediate part called a socket-base adapter or socket tube, which permits lower profile sockets and lighter equipment to move.



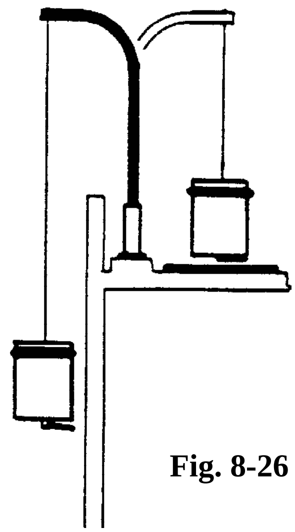


Fig. 8-26

Davits transfer the load from the suspension rope into a single building anchor, the socket. The socket transfers uplift and reaction at the same point. This is different from the outrigger beam, which transfers the load into two building points, the uplift point and the reaction point. The davits also determine the spacing of the overhead suspension points, and sometimes it allows for the platform to be docked on the roof level, if they are tall enough.

There are many kinds of davits. Some sit over the socket base, while others slide into position, pinned, and tilted upwards. Others may be lifted into position with a winch.

Some are fitted with brakes to lock the davit into position after rotation. Others use a pin or friction engineered into the design. Some davits weigh over 1000 pounds (450 kg) and are fixed in position, while others are mounted on carts. Still others are portable and weigh less than 50 pounds (250 kg). Always refer to the manufacturer’s instructions for the davits and sockets you are using.

There are two types of davits, the roof rig davit and the ground rig davit. The **roof rig davit** is taller so the platform may be swung inboard at the point of suspension. The **ground rig davit** is lower so the platform may not be swung in at the point of suspension.

Some davits have trolleys to allow the rope suspension point to move along the support arm. Loosening the trolley brake when moving the platform inboard greatly reduces the effort required.

There are several types of sockets. Some are low and use pins and an intermediate tube to allow rotation. Others are frame weldments. Still others are like pipes to hold special short davits.

3.17 Socket And Davit "RASBURRY"

Rated load of a davit is labeled on the davit. The rated load of the hoist must not be more than this rated load. The socket rated load is set by the manufacturer and coordinated with the davit. Old sockets or building attachments may have deteriorated with time. Confirm that they continue to be safe.

The **arm reach** of a davit is set by the manufacturer.

The spacing of the sockets is set when they are anchored into the roof. Many davits rotate in the sockets, allowing some spacing adjustment. The hoists should always be set so the davit anchor point provides the correct spacing between hoists and the correct spacing of the points away from the building wall.

Building strength is determined by the manufacturer and by the building structural engineer.

Uplift is built into the equipment by the manufacturer.

Ratio is built into the equipment by the manufacturer according to codes and regulations.

Reaction is built into the equipment by the manufacturer according to codes and regulations.

Your tieback may be necessary on certain davits. Some davits require that tiebacks be used. Follow the manufacturer's recommendations.

CHAPTER 9

SAFETY SYSTEM

Contents

Chapter 9: Safety System

1.0 Introduction

This Chapter covers the third major system used in suspended scaffold work, the Safety System. We will talk about the part called the Fall-Arrest Equipment.

It is called the fall-arrest system because of the way it works. It does not prevent a fall, but during a fall the system slows and stops your falling body. The equipment “arrests” your motion after a fall.

There are three points about fall-arrest:

One The farther you fall, the more likely you will be seriously injured. Drops of over six feet (2 m) are usually serious.

Two The more sudden the stop, the more serious the injury. Fall-arrest equipment is made to absorb the fall and slow you down gradually.

Three If the fall-arrest anchor doesn’t hold, you won’t stop. Being tied to a suspended scaffold is no protection if you and the platform fall together.

The Safety System must be out of the way while you work, but ready to act in an instant. Idle most of its life, it must handle a big load without warning. It has to hold a tumbling body that may have fallen in any direction and bring that body to a halt smoothly, spreading out the fall energy slowly. It has to stretch, hold, and be strong.

A Safety System is a simple system to use because it has only a few parts. However, the parts must act very quickly.

Each worker on a suspended scaffold must have their own **independent** fall-arrest equipment. Additionally, each worker must be hooked up before entering a platform and must not remove it until exiting.

2.0 Typical Systems

2.1 Fall Arrest Equipment

The most common fall arrest equipment has five major parts: (See Fig. 9-1).

- anchorage
- a vertical lifeline (some times called a dropline)
- a rope grab
- a lanyard with a shock absorber
- a full body harness

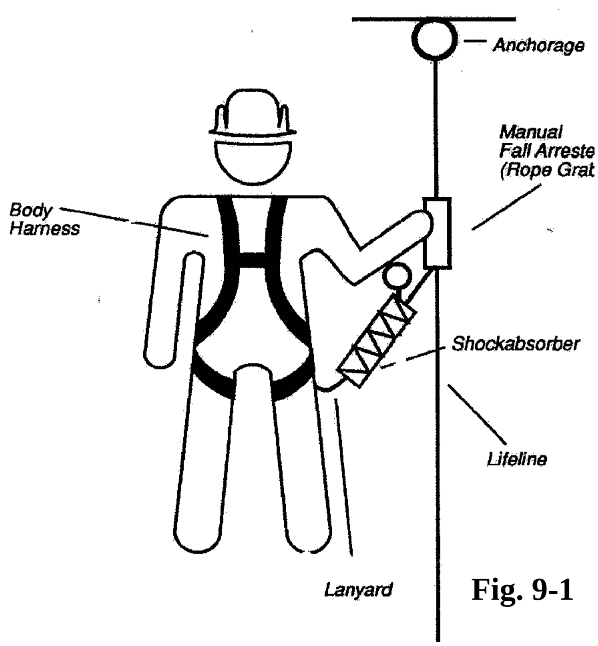


Fig. 9-1

These are usually attached with **connectors,** but can be integral (permanently attached together). (Fig. 9-2.)

The **anchorage** is the place on a structure which holds the fall-arrest equipment during the fall (Fig. 9-3). The **lifeline** extends the anchorage and its strength to the level of the worker.

At the work level, the **rope grab** and the **lanyard** connect the lifeline to the worker's full body harness. The lanyard allows the worker to move along the platform without having to continually lift and pull the lifeline sideways. The **rope grab** lets the lanyard move up and down on the lifeline. It is designed to grab and hold falling worker to the lifeline. The shock absorber in the lanyard cushions the fall as it pulls out. The **full body harness** spreads the energy of the fall into the stronger parts of the human body.

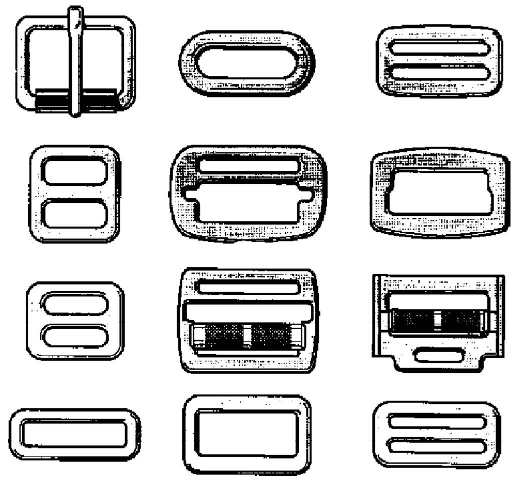


Fig. 9-2

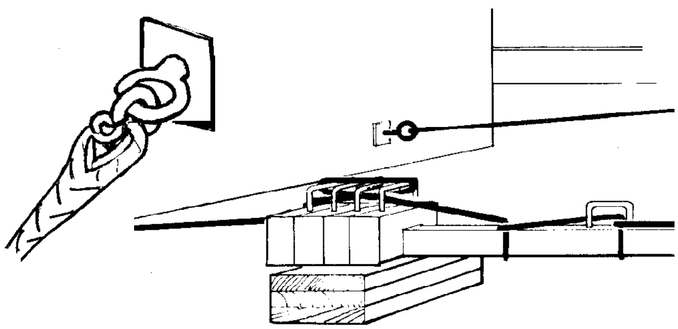


Fig. 9-3

2.2 Secondary Support System

Another common Safety System is the **secondary support** and it has seven major parts:

- anchorage
- secondary wire rope
- auxiliary brake
- trolleyline (dogline/horizontal lifeline)
- rope grab
- lanyard
- full body harness

There are other special-purpose suspended scaffold fall-arrest methods that use retractable reels or nets. Some four-rope suspension permanent platforms permit operation of the platform without fall-arrest protection, but it is always better to "tie-off" to those platforms, just in case. (Fig. 9-4.)

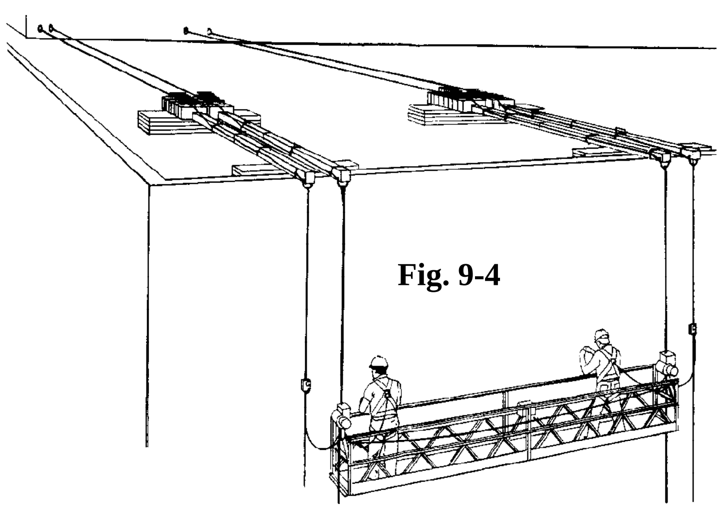


Fig. 9-4

The fall-arrest equipment needs to move the energy to the strong points of our body, limit the load due to the energy, and give the body time to spread out the energy.

3.0 The Parts Of The System

3.1 The Anchorage

The anchorage holds the fall-arrest system during your fall. It is the part of the system upon which all others rely.

An anchorage must be able to hold at least 5000 pounds (2268 kg), it must not cut or weaken the lifeline, it must not be in a place which will expose the lifeline to damage, and it must be reliable. The anchor should be positioned overhead, to minimize your swinging in a fall.

The strength of the eyebolt is greatly reduced if the pull is at an angle. (See Fig. 9-3.)

The anchor may be an shoulder type eyebolt, about 2” (5 cm) across the open part of the eye, or it may be a large diameter steel pipe. It may be a piece of 1/2” (12 mm) wire rope clipped around a beam, or it could be a concrete column.

When “tying off” the lifeline to the anchor, keep the lifeline connection strength above 5000 pounds (2268 kg). Use a spliced eye with a thimble and a shackle, or use another means such as the rope anchor shown in (See Fig. 9-5). Knots such as the bowline can be used for the termination if they are tied correctly and protected at their termination for wear. Knots can lose 50% of their strength in their termination. (Ref ANSI Z359)

If the only lifeline anchor available has a sharp edge, like an I-beam or C channel, use 1/2” (12 mm) wire rope around the beam, or a softener and shackle the lifeline thimble to the wire rope. A 1” (2.5 cm) web sling or a lifeline of at least 5/8” (16 mm) diameter filament nylon around the beam is often satisfactory also. See Fig. 9-5. Remember, sharp edges weaken, so use protection.

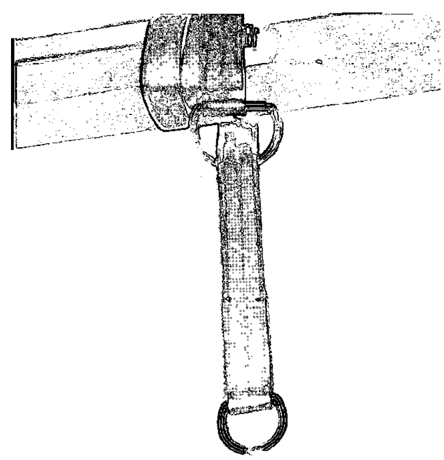


Fig. 9-5

3.2 The Lifeline

The lifeline is usually the vertical line that the worker hooks to, to prevent a fall to a lower level. The lifeline must be flexible, have stretch, and be capable of handling limited abrasion. There are many kinds of rope that are used for Lifelines, but they are usually synthetic, to provide the necessary protection for the worker. The size will be 5/8” (16 mm) or 3/4” ” (19 mm) with a minimum breaking strength of 5000 pounds (2268 kg). The Rope Grab used must suit the size and type of Lifeline.

Today, most synthetic Lifelines are three strand (Fig. 9-6) with breaking strengths approaching 10,000 pounds (4536 kg). The manufacturers or suppliers will advise you on the best Lifeline

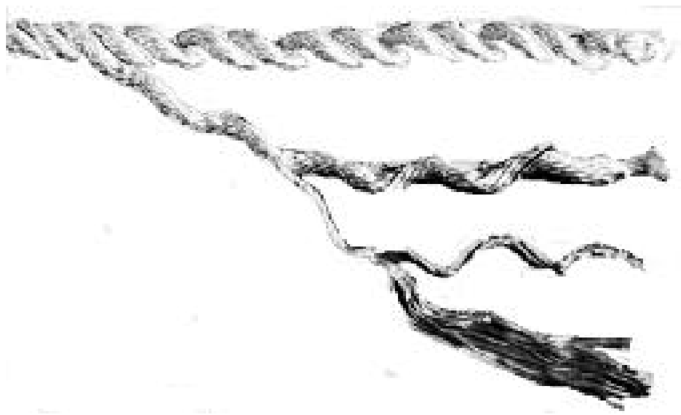


Fig. 9-6

to use. The sun's rays (U.V.) can do considerable damage to synthetics if the wrong type is used. The Rope Grab supplier will also advise on the type of rope to use with the equipment.

Some Lifelines may be steel wire rope as a secondary line to save the equipment from falling. The minimum size will be 5/16" (8 mm).

3.3 Stretch

The type of material used in a Lifeline will dictate the amount of stretch you will have .You need stretch to absorb the impact of the fall; however, the type used must not allow you to impact with the ground (bottom out). The longer the Lifeline (the height of the building), the more the extension length of the fall. As an example, some polypropylenes will stretch about 9%, whereas nylon can stretch 20%. See Fig. 9-7.

On a 200 foot (61 m) high building, if you were to close to the ground level and fell, the length would be 219 feet (67 m); but with nylon it would be 240 feet (73 m). It follows that you would be advised to use polypropylene and not nylon as a lifeline.

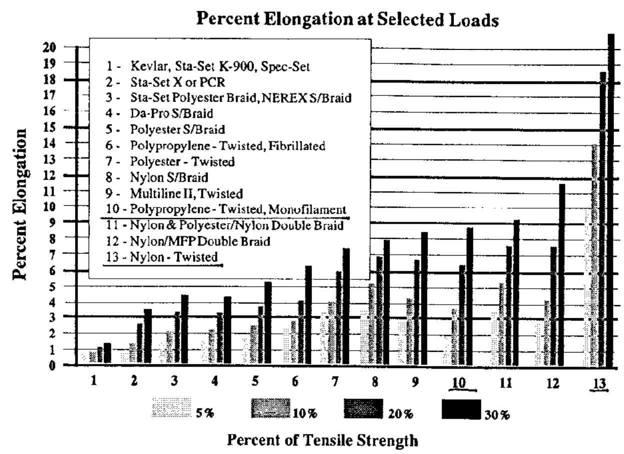


Fig. 9-7

3.4 Rope Grab

The rope grab is that part of the system which allows the lanyard to move up and down on the lifeline. It transfers the load from the lanyard to the lifeline length, and it allows for vertical adjustment of the work level without adjusting lifeline length or seriously compromising fall-arrest protection.

3.5 Mechanical Grabs

Mechanical rope grabs are of three basic types:

- the sleeve
- the cam
- the sliding roller (Fig. 9-8).

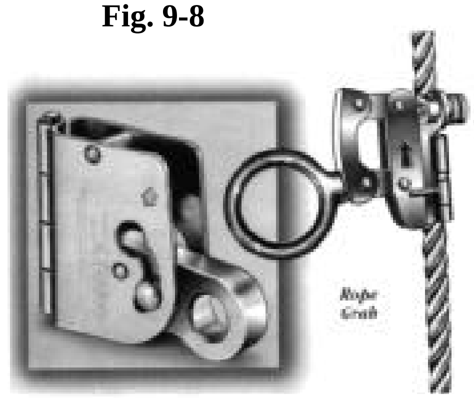
The sleeve type uses drag of the rope on a special cylinder to stop and hold the rope. Without the load on the lanyard, the lifeline slides around the cylinder freely.

The sliding roller type uses a floating roller in a guide between two fixed rollers. As the lifeline gathers speed through the grab, increasing drag on the rollers holds and stops it.

The cam type uses the load acting on the lanyard connection to arrest the load in a fall.

The cam type grab may have two steel plates that slide on the lifeline, or it may have a sleeve to guide the lifeline past the metal pivoting foot. The cam type usually requires that the operator disengage the cam action when lowering the grab, which reduces the fall protection at a time it is most necessary while moving.

Fig. 9-8



The main advantage of the cam type is that the grab can be set onto the lifeline above the working level, keeping the lanyard connection high on the lifeline for a shorter fall. Its disadvantage is that the manual release of the grab during vertical travel requires constant operator action, and may be deliberately defeated by an inexperienced or less than knowledgeable operator.

The automatic sliding roller grab relies on the friction of the lifeline passing through the sleeve to trip an inertial clutch, or to move a wedge or roller up and lock the grab on the lifeline. This type of grab slides on the lifeline and only acts when a fall is sensed.

Its advantage is that it can adjust to work level without operator action. However, it can be fouled by dirt and move so easily as to be below the operator at the time of the fall, increasing the fall-arrest distance. These should be used with a 2’ (.6 m) lanyard.

The mechanical rope grab is sensitive to rope size, the swelling of rope on humid or wet days, the fraying or “fluffing” of ropes, some kinds of contamination, and being put on backwards. Changes in size can affect the movement of rope through the sleeves. Rope grabs are designed and identified to be used in an upright position. Ensure that the arrow is up when installing.

Always use lifelines from reputable suppliers and keep them in good condition.

Newer grabs are combination cam-inertial, have “self-rescue” capability, or slide easily down the lifeline with a little drag, and then lock-up in a fall. Each grab should be used with its recommended rope type and size.

No one grab is the best. Some jurisdictions permit only the cam-type. Others permit only the friction grab. Work environment may dictate one grab rather than another. Your safety supplier or consultant can advise you. Most grab manufacturers will indicate whether their grab works around sandblasting, concrete, slag, etc. Some chemicals make synthetics extremely slick and defeat certain grabs.

Remember, to minimize fall energy, use a shock absorber and weight the bottom end of the lifeline.

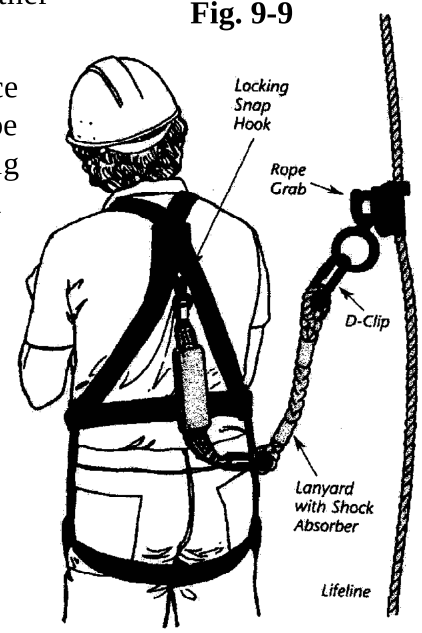
In addition to the Mechanical Grabs, are Triple Sliding Hitches. Although, if these are tied and used correctly, they will be safe. Experience has taught us that there is a high risk of incorrect use. We therefore recommend that they not be used.

Correct use of the Safety System requires that the Rope Grab must be kept at shoulder height or higher. Allowing it to be lower increases the fall distance.

3.6 Lanyards

The S.I.A. advises workers to use Shock Absorbers with their Safety System. In addition to the Lifeline having stretch, the Shock Absorber further cushions the impact to the body. (Fig. 9-9.)

Fig. 9-9



There are many types on the market, but they are designed to reduce the impact load in a fall. The lanyard with the Shock Absorber can be purchased in many lengths, depending on the type of work being performed. If they were hooked up to a horizontal Lifeline they would be shorter than if hooked to a vertical Lifeline used on a long platform.

The material in a Shock Absorber is folded back on itself, and stitched

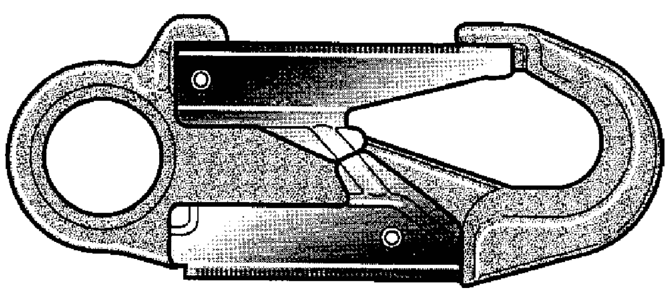


Fig. 9-10

or woven in a controlled manner, to tear apart when load is applied during a fall. A Shock Absorbing Lanyard can be directly hooked or attached to the D-Ring of the Full Body Harness, and the Rope Grab. Directly attached, means you purchase the Full Body Harness Shock Absorber, and Rope Grab, as one unit. If snap hooks are used for connecting components they must be double locking (Fig. 9-10). If the gate of the hook is not double locking, you can experience RollOut (Fig. 9-11). Double Locking Hooks are required by the S.I.A., OSHA and CSA.

Another advantage of the Shock Absorber is that if you have had a fall, it will be pulled out,

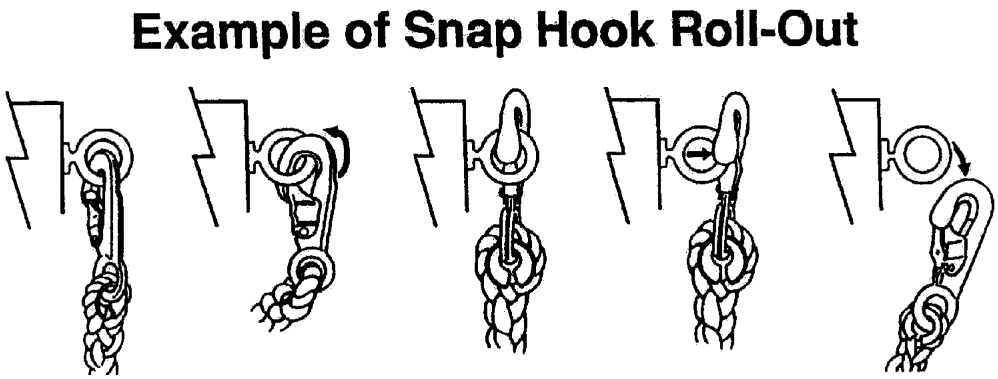


Fig. 9-11

which tells you that the complete Safety System must be replaced.

Some special lanyard/lifelines are made from wire rope and are coiled in spring-loaded reels. The reel pays out line on demand, but locks very much like a seat belt when the line tries to leave rapidly. See Fig. 9-12. These are known as Self Retracting Lifelines.

Fig. 9-12

In suspended scaffold work, the amount of rope paid out by the retracting reel lanyards is limited because all horizontal movement away from the lifeline will become vertical distance in a fall. That is, if you walk five feet from the lifeline and then fall, you will fall at least five feet down. You will also swing.

Always use compatible equipment from the same manufacturer. Manufacturers test their own lanyards with their own equipment to verify compliance with standards.

3.7 Body Support Devices

The S.I.A. and OSHA require that Suspended Scaffold workers use a Full Body Harness (Fig. 9-13).Practice, experience, and improved devices have led us to this conclusion.

It should be stated up front that belts continue to be used by many workers in other industries as restraint devices (Fig. 9-14) or devices to prevent too much horizontal movement. However, this is not the case for Suspended Scaffold workers who are at risk from vertical falls.

Full Body Harnesses come in many different designs. They are all produced in accordance with ANSI Z359.1, A10.14 and CSA Z259.10. Body Support Devices are divided into many different types in accordance with how they are to be used. Only Full Body Harnesses for fall arrest must be used.

The Full Body Harness is made up of straps that go over the shoulders, across the chest, and around the thighs. The harness has a D-Ring high in the center of the back between the shoulder blades. If workers were to work inside tanks, there may be a requirement for rescue retrieval, which would require additional rings on the shoulders for lifting. However, for Fall Arrest, only the D-Ring in the center of the back is used.

The Full Body Harness provides better body support because it spreads fall energy over a greater part of the body, presses less into the body in a fall, and has the D-Ring high on the back to prevent tumbling during a fall.

Harnesses are usually made of webbing, and many times are color coded with vertical and horizontal straps of different colors, to assist workers in knowing how to put them on correctly.

The connections are of many different designs (Fig. 9-2). They are all safe to use, when

Fig. 9-13

Fig. 9-14

used correctly. The connections and straps are adjustable to suit each worker. Workers must adjust for wearing on the outside of their clothing either in summer or winter conditions for proper fit. The harness should be snug and the chest strap positioned properly to prevent you from coming out of the harness in a head first fall.

The harness will be labeled showing manufacturer, type of harness, and the standard to which it was made (either ANSI or CSA). Each will have a date and serial number for control purposes.

Remember that your Full Body Harness is personal and is not to be shared with others without adjustment and inspection. You must take care of it by inspecting and storing it correctly.

Remember that when rigging, or using Suspended Scaffold, you must be hooked up at all times.

4.0 Care Of Equipment

4.1 Inspection and Care

Manufacturers have particular requirements for proper inspection of their equipment. Follow their instructions. Below are some inspection guidelines. Never use damaged or questionable equipment.

1) Check all labels for ANSI/CSA approval. Look for clean patches where the label may have been removed. Replace as necessary.
2) Ropes and Webbing: Begin at one end of the web and bend about 6” (15 cm) in your

hand to open the web and reveal cut, frayed, burned, or torn strands.

3) Check for any chemical damage.
4) Inspect both sides and the connections. Burned strands usually show as a darkened color change.
   a) Metal parts, including D-rings, buckles, grabs, etc.: Check for dents, cracks, burrs, sharp edges, distortion, etc.
   b) Be sure screw hold-downs are not worn, and that mating parts align without forcing.
   c) Buckle parts should move freely. Friction buckle parts should be straight. Sliding bars on sliding bar buckles should move freely, with complete ridges. The ridges should not be smooth.
   d) Grommets are to be tightly clamped.
   e) Connectors should close completely. “Double locking” connectors should lock closed, and the block not open without releasing the safety.
5) The grab: The grab should slide easily on the rope in the up direction, and lock in the down direction when the lanyard is given a sharp pull.

4.2 Cleaning

Clean most synthetic material by wiping with a damp sponge and then hand washing with a mild soap made for synthetics. Rinse completely. **NO BLEACH!** Air dry out of the sun and away from fluorescent lights.

Metal parts should be wiped clean. Use no harsh cleaners or abrasives, which may remove the plating.

4.3 Storage

Hang up harnesses, lanyards, and lifeline, or place loosely in a container at the end of each day. Store away from heat, water, chemicals and their fumes, as well as sunlight.

All fall-arrest equipment has a shelf life. Even when not used, it will deteriorate. The old style leather belts, for example, would age and even crumble in storage (leather belts are no longer used). Fluorescent lights and sunlight are harmful to many synthetic fibers.

If you have a piece of fall-arrest equipment more than seven years old, replace it, even if it appears to be in good condition.

5.0 Equipment That Has Been In A Fall

Fall-arrest equipment involved in a fall must be replaced. The equipment has been subjected to shock and impact loads, which severely reduce its strength and capacity. Discard or destroy the equipment so that it will not be inadvertently used by anyone else.

6.0 The Last Word

The Safety System is used because none of us is perfect. The fall-arrest system is used and worn because we owe it to ourselves, to our fellow workers, and to our families to ensure our safety. Always follow the manufacturer’s instructions!

This is the last chance.

CHAPTER 10

HAZARDS of the WORKPLACE

Contents

Chapter 10: Hazards Of The Workplace

1.0 Introduction

One of the main purposes of this course is to train people to use suspended work platforms safely. You need to know not only what the equipment looks like and how to operate it correctly, but also what problems to watch for in the workplace.

The problems that can injure and kill you are **hazards**.

Actions that may not be serious on the ground can be fatal on a suspended scaffold.

People who study accidents and injuries divide the hazards into similar groups of hazards. We will begin by looking at some of those groups of hazards commonly found around suspended scaffolds.

The most obvious hazard is **falling.**

Another is **slipping**.

Another hazard is the **falling object** from above.

Each of these hazards involves **gravity**. Gravity is not friendly toward suspended-platform operators. Remember, a suspended platform fights and overcomes gravity. if you let down your guard, gravity is quick to take advantage of your mistake.

Another hazard is **crushing.** Gravity takes advantage of your carelessness, trapping you under or behind a weight, causing injury or even killing you.

Similar to crushing is **pinching,** where your fingers or legs are caught between one or more moving parts. If the parts are heavy enough (gravity again), and the opening narrow enough, the hazard becomes a **shear** hazard, where the moving equipment can cut off your body parts.

Still another hazard is **shock.** Using your body as a path to get back to ground, electricity can injure or kill you.

There are other hazards, such as **cold**, which slows you down, or takes away your judgment.

Heat from welding and other repair processes can create **burn** hazards that can injure you and/or damage equipment.

Chemicals introduce hazards which can burn you, change your blood, rob you of air, or make you think you are on the ground when you are not. Chemicals can cut your rope from above and your deck from below. You need to know how to be careful around these hazards.

If you just said to yourself, “I’ll be careful. I’ll read labels and instructions,” you would be prepared. That information will help you to protect yourself if you interpret it correctly. However, labels can never tell you everything, and labels cannot train you.

2.0 Multiplying Effect of Hazards

One of the most important things to remember about suspended-platform work is that one hazard can create another. When you slip on the ground you may only move your foot slightly and then regain your balance. In the air, however, that same slip can shift the suspended work platform, drive the guardrail you just grabbed into the wall and smash your fingers. Alternatively, your slip may roll the deck so your feet go out from under you, sliding you off the deck past the toeboard that was supposed to be there and isn't. A slip becomes a fall.

If you get an electrical shock on the ground, you may get thrown down. In the air, the same shock can launch you off the platform. **The shock can create a serious fall.**

2.1 Alcohol, Caffeine, Nicotine, and Other Drugs

The effect of one hazard on another brings us to a very important subject. **Drugs and other substances which alter your body chemistry will increase the effect of hazards.**

We all know that alcohol slows reaction time. It can make you feel more in control when you are really less in control. Slow reactions and missed connections can turn a simple procedure into a fatal fall.

Alcohol also lets more blood flow to the skin. In cold or wet weather on a suspended-work platform, the extra heat loss caused by alcohol may lead to a condition known as "hypothermia". Hypothermia is the lowering of body temperature due to an excess loss of body heat. It often results in loss of judgment.

"Soft" drugs, "hard" drugs, and "mind-altering" drugs can change your perceptions. On a platform, you need to know what is actually happening.

The same caution applies when using cold remedies and prescription drugs. The drowsiness or agitation often caused by approved medicines can create an environment that turns a routine operation into an accident.

When in doubt, ask your doctor or pharmacist whether you can operate a suspended-work platform while using a particular drug. No one wants to be in the air with a freaked-out partner. Take only work-approved prescriptions. If you are taking prescribed drugs that may affect your performance, advise your foreman.

Since nicotine and caffeine can constrict blood vessels, take care to avoid excessive use in cold weather. Give yourself the edge against frostbite.

2.2 Fall Hazards

In suspended platform work, a serious fall hazard exists whenever workers are ten feet (3 m) or more above the **safe surface** below (some people prefer a six-foot limit). The safe surface is a place where you may land the work platform and safely exit. A fall hazard exists near the edge of the roof on the elevated-work platform, in a well shaft, and any place else you can fall. We'll go through a typical two-point work platform setup on a building to show some of the hazards you may encounter and the safe practices you should follow.

2.3 Setting Up

Rigging the equipment means putting the ropes, beams, cables, and other support equipment into place onsite. During rigging, you will go near the open edges of a roof or slab to lower the ropes and cables or to move equipment into position.

Before we go any further, here is a practical suggestion. Wear your fall-arrest equipment on the site. It makes for easy carrying, is always with you, and no one will “borrow” it. Now, let’s see about protecting you from the fall hazards.

There are a few things you will have already done before you get this far, i.e. checking to be sure the equipment will operate properly and reliably. You have checked the rated-load tag on the hoist and compared it to the rated load of the support equipment to be sure the support equipment is strong enough. You have checked the equipment manuals and inspected the equipment according to the manufacturer’s instructions. Now, it is time to do the rigging.

The first thing you do when you go on to the roof is to check the weather. If it is too windy, shut down. Never go onto an icy construction slab or unprotected icy roof in the wind! Even when lying flat out, there are times you won’t be able to stop your slide!

The second thing you do is check overhead to see if a crane is working above, if electrical wires are present, if a helipad is present, etc. In other words, check above to see what is going to knock you off the roof. **Look up**.

Then, check the roof surface to see what hazards are there. See if there are any open holes in the roof, pools of water, ice and/or snow, grease near the edge, etc. Look for construction activity to see if anything on the roof might soon change.

The next thing to do is have the hazards corrected or correct them yourself. Report the problems. Make those other guys do their jobs right also. Do not handle ropes while standing on a grease slick — **clean and sand the slick. Cover or block the holes.**

Once you have checked for potential hazards; above, around and underfoot, you are ready for the next step — locating the place where you are to rig and lower your platform. This spot is commonly (and strangely), called **the drop.**

The next thing you do is locate the anchor for your lifeline. Lay the line to the side of the work area, and tie the upper end of the lifeline to the anchor.

Next, you want to check out the strength of your supports. Is the roof or parapet strong enough to hold you and your equipment? Can the roof hold the counterweights?

Lay out the tieback lines and secure them to adequate anchors. Once that is done, it’s time to go near the edge.

Now, tie off. Tie off means attaching the grab on the lanyard of the full body harness you are wearing, to the lifeline. Tie off to the lifeline short of where you could fall over the edge, and put the slack end of the lifeline to the side.

Next, move your equipment onto the surface behind the drop. Stay back as much as you can from **unprotected edges.** These are roof or slab edges that have less than a three foot-six inch high parapet or guard.

Any rigging procedures provided by the equipment suppliers should be followed to reduce the hazards. This Course also provides knowledge on the proper way to rig.

To reduce the risks, rigging should be done at ground level or on the roof rather than making terminations hanging over the roof edge.

It is important to remember that riggers who keep their lines clear and neat, and follow a method, are faster and definitely safer than the shaky rigger who messes his lines and works it out “as he goes along.”

Always be sure the equipment and the ropes are neatly tied back before handling rope or equipment near the edge so they don’t pull you over if the equipment becomes loose. Always “hook-up” before you start the rigging.

Protect others from falling objects by **roping off** the area below to keep pedestrians and other workers away. Put up signs and barriers to warn pedestrians of overhead work.

2.4 Fall Hazards And The Platform Itself

Before you continue with the rigging, you need to check the deck for fall protection. To prevent falls from the platform deck, the work platform must have a clear deck and have its rails and toeboards in place. The toeboard and guardrails can also keep a slip from becoming a fall. The deck must be clean, free of trash and other trip hazards. Of course, it must be able to carry the load and it must be in good condition.

You are required to protect all sides of the deck. However, you may have seen work platforms without guardrails on the workface side, called the **platform front.** In some uses of the work platform, regulations require protection only of the “open” sides. The generally accepted OSHA definition of “open” is a space greater than 12 inches (30 cm) between the deck and wall when the work platform is forced from the wall. Suspended-work platforms which use the building or structure as a side must be attached to the structure, at least at the work station (more on that later), and the attachments must be such that they will permit no more than a 12 inch (30 cm) space between the deck and the wall when you push the deck from the wall. At this writing, if the space is greater than 12 inches (30 cm), you must put a guardrail on the front. The hoists on the end of these kinds of work platforms sometimes serve as protection if they permit less than a 12 inch (30 cm) square opening. Using a suspended scaffold without a front guardrail and without being tied in to the building is dangerous.

If you move the suspended work platform into position on the roof to connect the ropes, it is called **roof-rigging. You must be tied-off before you do this work!**

When you have to move the work platform into position at the bottom of the drop to connect the ropes, it is called **ground-rigging.**

Since the ground-rigged work platform is on the ground below, you may have to raise or lower ropes and electrical cords. Lower the ropes by rolling out the free end first. Don’t drop the ropes over the side. If the ropes weigh over 30-40 pounds (15-20 kg), use a come-along or other tied-off lifting device to raise them so you won’t be pulled over the edge or hurt your back. Wear gloves because the lubricated rope is slippery, messy, and it can cut.

If you lower the ropes to your hoist from above or bring the rope to the roof not in the hoist, you will have to **reeve** the rope onto the hoist, that is, wind the rope onto the sheaves or drum and through the rest of the hoist. If the rope passes through the hoist, be sure it goes straight down and out of the bottom of the deck, or it goes into the wire winder, and it is put in **every** keeper provided. If you have a drum hoist, be sure there are at least four or more **wraps** (turns of rope around the drum) left on the drum (more, if the manufacturer requires more). You need the ropes to be securely attached to the hoist in order to keep the suspended equipment from falling.

After all the ropes and cables are connected, terminations checked, safeties in place (and the ropes and cables are lowered), you can lower the hanging end of your lifeline over the edge. Watch the edge so it cannot damage the lifeline. Double check the terminations, the tiebacks, and the spacing of the outreach (the distance between the two). Then, check your partner's side while he checks your side.

One last piece of fall-hazard protection equipment has yet to be checked — the secondary brake. Test the secondary brake trip mechanism on the stirrup or hoist per the manufacturer's instructions and be sure it is working properly. If your hoists have secondary brakes which are shop tested, check the tag to be sure you aren't beyond the recheck date. (Some hoist instructions require you check the brake before reeving.)

If the ropes and cables are connected, the support system properly set up and checked, the tiebacks connected and checked, the lifeline anchored on the roof, the reeving checked, and the work-platform guards in place, you can test your setup.

2.5 Testing The Rigging

If you are ground-rigged, have someone check the rigging on the roof while you load test it, in case you blew it and you try to pull the rigging over the side onto your head. It shouldn't move at all. **Please** don't let just anybody check your rigging!

To test, put your tools and material into the work platform. Tie off to the lifeline. Raise both ends of the work platform about two feet (.6 m) off the ground or roof. **Field-check** the equipment by having **BOTH YOU AND YOUR PARTNER STAND ON ONE** end and raise the work platform a foot, then **LOWER AND STOP IT** while in the air. Recheck the reeving. Do the same thing to your partner's side. There are people who fell because they only checked in the Up direction. Check both directions.

If you are roof-rigged, you do the same test we just described, but over the roof. **Please**, not over the side! If it all checks out, tie off your lifelines. You may now operate the work platform. You have minimized your risk of falling.

If your work platform is roof-rigged, get on the work platform before "pushing out." Then, move the work platform outboard.

2.6 Slip Hazards

Slip hazards are common on walking surfaces that are slick, wet or oily. The deck can become worn, or contaminated with paint, ice, paper, garbage, soapy water, etc., making the surface slippery. The roof or slab can also become slippery for similar reasons. The best way to minimize a slip hazard is to keep the work area clean. This also minimizes other hazards.

The guardrails on the deck help you regain your balance when you slip. This minimizes the injury from slip hazards.

2.7 Falling Objects

When working in areas where falling objects may present a hazard to you, protect yourself — wearing a **hardhat is a must**. Ideally no one should work above you. Overhead protection on the platform needs to be considered if it is necessary. It must be designed to suit the platform and the extent of falling objects or debris that may fall. Making the overhead protection adequate to protect the workers will result in a rigid structure that will trap workers when they use Fall Protection. See Chapter 3 for precautions necessary when this happens.

Ducking to avoid a falling object can cause you to grip onto the lightning conductors and other building parts near the edge of the roof or slab. If you wear your fall protection near the edge and you trip trying to get out of the way of a falling object, that trip won't become a fatal fall.

2.8 Crushing, Pinching and Shearing Hazards

Some unloaded suspended-work platforms can weigh more than 1500 pounds (680 kg). There are roofcars approaching 100,000 pounds (4536 kg). Some work-platform hoists can pull on the rope with more than 6,000 pounds (2722 kg) when stalling. When the suspended scaffold machines are moving and you are trapped between them and the wall or overhead structure, they can crush you. The best defense against these crush hazards is to be sure the roofcar curbs and stops are in good condition, and to respect the power of the equipment when it is moving. Check that your hoist upper-limit stops are working.

A pinch hazard exists wherever your fingers can get caught between operating parts. A common pinch hazard occurs where the front guardrail comes close to the wall when the work platform rocks, and when the work platform comes up under the parapet cap lip at the top of the building. Tilting socket bases also can pose a pinch hazard, where your fingers get caught between the base and the tube as the tube is tilted up. Worn wire rope guides and fairleads can also pinch. The best way to minimize injuries from pinch hazards is to keep your hands clear of the moving surfaces, and to keep the guides and guards in good working order. Use care when setting down beams, plates, and weights.

2.9 Electrical Shock Hazards

Electrical shock is a very serious hazard on suspended equipment.

First, a shock often stops the heart, and you are a long way from the medical help needed to start it again. Someone had better be trained in CPR.

Second, muscles contract when hit by even small amounts of electrical charge, causing arms and legs to move violently. A small shock to the leg muscles can easily throw you off the work platform. Use GFCI's where necessary.

Third, many platform rollers and roofs do not conduct electricity. If the cable electrical ground is damaged, the work platform can become **"hot,"** that is, charged with electricity; just waiting for you to touch the building and complete the circuit.

Fourth, the cables are so long and the hoist so far from the **circuit breaker** or electrical protection, that the breaker may not detect a problem at the hoist when you are frozen to the building by the electricity.

Fifth, the equipment is movable, increasing the chance for cable and connection damage during handling.

Sixth, the wire-rope suspension system conducts electricity fairly well, enough to be damaged when there is a "short".

Electrical shock hazard can be minimized by:

- using cables with good grounds
- using conducting rollers or ties when you are attached to the building
- using ground fault circuit interrupters at the tool outlet on the work platform
- using care when handling cable
- keeping a safe distance from electrical lines

You should use cables with built-in strength members on tall drops. The cable connections should have woven wire grips or special loop-type cable grips, known as **strain relief devices**, which put the pull on the cable and anchors, and thereby protect the plug and receptacle. **Do not** use damaged cable. **Do not** use knots. (see Electrical)

2.10 Chemical Hazards

At some time, you may use strong chemicals in your work. The use of acids, solvents, caustics, and other corrosive and toxic chemicals requires special care on your part.

(See Fig . 10-1.)

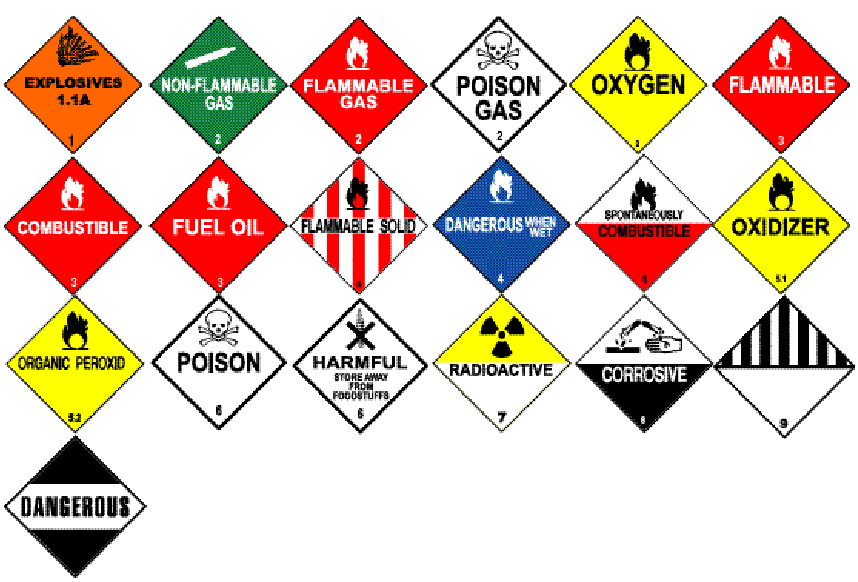


Fig.10-1

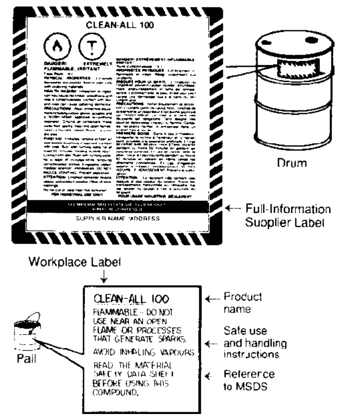


Fig. 10-2

The obvious risks to you when using chemicals, are the burns and the toxic effects. **Read the labels and follow the instructions carefully.** If an antidote is given on the label, take some with you on the work platform. It may keep you from a very nasty burn and/or from blindness. **The Material Safety Data Sheet (M.S.D.S.), for any chemical you use, must be available for reference at your worksite (Fig . 10-2).**

Some acid and caustic fumes react with water and they only need a little moisture to become fiercely active. They burn moist surfaces, e.g. the inside of your lungs and the cornea of your eye. Your skin often won't feel their damage. Some acid and caustic burns can take hours to show themselves. The results are irreversible blindness or slow suffocation. **Wear the recommended protection.**

Remember, water dumped into some acids turns to steam so quickly that the hot acid is blown out of the container. Also remember, some chemicals are explosive in their burning.

Some acids and their fumes make flexible wire rope as brittle as glass, and when the **embrittled** "rope" passes through the hoist, it shatters. There are special wire ropes made from non-reactive metals so these chemicals can be safely used on a suspended-work platform. Before using the chemical, check with the wire rope and the hoist manufacturers or suppliers for their recommendations.

Chemicals can attack your lifeline, harness, and lanyard and weaken them severely. Under certain conditions caustics can attack Fall-Arrest Equipment, weakening it severely. Fortunately, lanyards and lifelines of different kinds of materials are available to protect against that weakening. Chemicals which attack one material sometimes do not attack the other(s). Before using strong acids, caustics, and chemicals, ask the lifeline manufacturer or supplier what type of line should be used with the chemical substance(s) present.

The metals used in the deck, guardrails, and other parts of the work platform and rigging can be weakened by chemical attack. Always contact the deck manufacturers for their recommendation when using chemicals, and ask them what is the procedure and frequency for cleaning and neutralizing the deck.

Yes, you will have to contact several people when you use strong chemicals. You need to be sure you do not weaken your equipment. However, the concerned people want you to ask rather than fall, and they will give you all the help they can.

One final reminder when using chemicals. If you rent a deck and you plan to use chemicals, tell the rental company. They often have decks that are already protected, making life easier all the way around. **Always** tell the owner of the deck what chemical you used. Most chemicals take time to do their damage and the next worker on the equipment needs a reliable deck.

2.11 Suspended Scaffold Welding Hazards

Arc or stick welding from a suspended-work platform can be one of the more dangerous work activities you will do (refer to Chapter 11 for background). Welding requires the melting of metal. In order to melt metal, large amounts of electrical current are pumped across a resistance to cause heat. If that current gets loose, it can melt the metal in the wire ropes.

It would be nice if the welding current went completely through the welding arc as it is supposed to, but it does not always do what is supposed to. The welding current takes different paths back to the welder, and the paths share the current according to how much resistance the current meets with in each path. One very low resistance path back to the welder is through the bearings of the hoist (pitting them), up the wire rope (which it sometimes severs at the drum or sheave contact), and across the wire-rope termination resistance (which also can melt). It finally gets to the welder through the steel of the building or through the welder-ground rod.

2.12 Wind, Cold And Heat Hazards

The suspended platform on a building or structure is in a harsh environment. Wind whips onto the work platform, channeled between adjacent buildings. If the windspeed exceeds 25 mph (40 kph) you should not be using the platform. The sun can heat the face of a dark building to over 160 F (71 C) degrees. Mirrored building surfaces can cause sunburn faster than any lake on a summer day. High parapets and black surfaces can raise temperatures on a roof to well over 100 F (38 C) degrees, while the air is thick and sticky from the moisture of cooling towers.

The cold on a platform can be fierce. The steady “thermal” winds of winter that climb the outside of the buildings rob the body of heat. The aluminum deck and rails suck heat from feet and hands. Damp weather reduces most of your insulation to nothing. This makes work in some coastal areas as cold as work on the Northern Plains in winter.

2.13 Heat

During the heat of summer, platform work should be done early, before the sun can raise the temperature to scorching.

Protect yourself from the sun and heat. Sun blocks on the lips and bridge of the nose will reduce burning. Sunscreens will reduce burning and will add moisture to your skin. Drink plenty of liquids — but no alcohol. Drink more water than you need to quench your thirst. Modern thinking is that you need more water than your thirst demands for top personal efficiency.

Do not wear tightly-fitting clothes in hot weather but rather, wear light fabrics that “breathe.” However, avoid very loose clothing since it could catch on equipment. In the pounding heat next to a structure, bare skin can often be hotter then wearing a light shirt.

The equipment is not as affected by hot weather as is the operator. Sometimes, the power company drops the voltage and causes problems with hoist motors – discussed in Chapter 2.

Follow the manufacturer’s instructions regarding lubricants for hot-weather operation, as well as other special precautions. Watch that you do not burn yourself on the sun-heated metal, e.g. the parapet clamp. On very hot days, with loaded platforms and many starts, the hoist motors may overheat and shut down. Do not pour water on to cool them — **it’s a quick way to the grave, and a good way to crack the insulation in the motor core.**

Extra care is needed when rigging and moving the equipment. Excessive exertion can cause you or your partner to overheat. You have to watch each other for the symptoms of heat problems. Your handbook has a chart describing the symptoms. Review it regularly.

Your perspiration can make the holding of ropes and moving of equipment difficult. A good pair of leather gloves will minimize the effect of being slippery from perspiration, and a headband can aid in keeping perspiration from your eyes.

Good sunglasses can help prevent headaches. They reduce heat coming into your eyes. The best protection, of course, is wearing tinted glasses. These protect your eyes from the heat and glare and as well, protect the eyes from the swirling particles in the updrafts and falling particles from work above. **Safety glasses are a must in many work conditions, and are always a good idea on a suspended platform.**

Last but not least, wearing a **hard hat** serves two purposes:

- It protects the head from injury, and,
- From the effects of the sun.

2.14 Cold And People

Cold weather also requires that you use special protection for your safety. As the temperature drops, the body must provide more energy to maintain its temperature. Blood carries more heat to all parts of the body, preventing freezing and keeping the muscles working.

When the body loses more heat than it generates, it keeps the available heat at its center, sacrificing the extremities to preserve the whole. Sometimes, even when the rest of the body has plenty of heat, the loss of heat at an extremity is greater than the heat the blood can supply. Both of these are dangerous conditions you can prevent.

Your worst enemies in the cold are **wind, moisture and metal.**

WIND CHILL CHART

Wind (MPH)

Temperature F°	0	5	10	15	20	25	30	35	40
35	35	33	21	16	12	7	5	3	1
30	30	27	16	11	3	0	-2	-4	-4
25	25	21	9	1	-4	-7	-11	-13	-15
20	20	16	2	-6	-9	-15	-18	-20	-22
15	15	12	-2	-11	-17	-22	-26	-27	-29
10	10	7	-9	-18	-24	-29	-33	-35	-36
5	5	1	-15	-25	-32	-37	-41	-43	-45
0	0	-6	-22	-33	-40	-45	-49	-52	-54
-10	-10	-15	-31	-45	-52	-58	-63	-67	-69
-20	-20	-26	-45	-60	-68	-75	-78	-83	-87
-30	-30	-35	-58	-70	-81	-89	-94	-98	-101
-40	-40	-47	-70	-85	-96	-104	-109	-113	-116

FIG. 10-3

Wind takes heat from your body by rubbing air across exposed skin thereby taking the heat out faster than your body can replace it. Moisture moves into your insulation and conducts heat away. Metal steals heat from you so quickly that you cannot even feel it happening.

The effect of wind on the body is called **wind chill factor.** For example, if the wind is 20 mph, and the actual air temperature is 30 degrees, the **wind chill factor** is 3 degrees See Fig. 10-3. Look it over to see the combinations where exposed flesh can freeze in one minute or less. Stay out of the wind or, if that is not possible, protect your skin with proper clothing.

Moisture is another heat robber. Your clothes give you protection from cold by trapping air and slowing heat loss. Your perspiration makes the cloth damp, and the moisture connects your skin to the outside cold air, rapidly transferring heat. Some fabrics such as wool, will **wick**, or slowly drain off moisture from your skin and keep you warmer. Newer fabrics made for cold weather will keep you dry if changed often and are allowed to breathe. A good trick is to not lace your boots tightly. The moisture in the wool escapes out the top of the sock. Another trick is to change to dry socks at noon and not to wear the same boots two days in a row. The object is to keep moisture near the skin to a minimum.

Wet or very dry skin is more prone to frostbite than oily skin. A common trick used in colder climates is to rub a small amount of baby oil into the skin on your face in order to keep your skin from drying. A beard is really good protection. If you wet your hands, **GET THEM UNDER COVER IMMEDIATELY.** The evaporating moisture can cause frostbite.

Cold metal can pull heat from your finger(s) and give you frostbite **before you can take your hand away.** The prevention for this is really simple. **DO NOT TOUCH COLD METAL WITH BARE SKIN.** Cold metal and concrete can draw the heat from your feet and legs as you stand so that your legs feel like wood when you try to move. Wear thick socks, and do not lean on the metal rails. Your legs can quickly fatigue while standing on a frozen metal deck or cold concrete roof slab.

If you have to rig in very cold weather, your gloves will get cold. Keep a second pair under your coat and switch back and forth as needed. Handwarmers are also useful.

Your body will burn a lot of energy in cold weather. Limit caffeine and nicotine intake since they affect the body’s ability to deliver heat to the extremities.

2.15 Hypothermia

The most deadly of the cold-weather problems is a condition called **hypothermia.** It is the lowering of core-body temperature to below normal. Various symptoms are described in your handbook, but the most important symptom here is the loss of judgment. A person who suffers from hypothermia will soon believe he is somewhere else, e.g. on the ground. If your partner appears to be confused, **GET YOURSELVES DOWN IMMEDIATELY** and go to a warm place.

2.16 Cold And Equipment

The equipment may operate more slowly than normal in cold weather since the grease and oil will be thicker. Remember, do not operate the hoist below its lower temperature limit.

When the weather is colder than the limit, **do not use the hoist.** Remember, it is colder "on top" than on the ground. As a rule of thumb, the air temperature drops one degree for every 100 feet (30 m) you go up.

The lubricants in the hoist may have to be changed more often and changed to a lighter grade in cold weather. Consult the Hoist Manual.

Ice and snow have the uncanny ability to collect in every nook and cranny. Check your equipment carefully even though it has been covered. Be sure there is no ice in your grab and that the secondary brake works. Pull the grab and the wire rope to trigger the brake. If they are slow, do not use them and **DO NOT BLOW ON THEM.** The moisture in your breath can ice them up. Check the manufacturer's instructions regarding use of de-icing additives.

Taking it inside and outside constantly, is harder on the equipment than is leaving it out. The moisture in the air collects on the cold metal. It dilutes the oil, refreezes in seals, bearings, joints, damages components and can cause stoppages.

3.0 First Aid

Recognizing that there are risks because of Hazards In the Workplace, workers should be aware of action necessary if an accident takes place. Knowing First Aid will assist you and your partner if you are faced with an emergency situation. Lack of prompt action for heart, breathing and severe bleeding problems, can cause death or serious injury if not dealt with immediately. Knowing what you should do for First Aid and CPR (Cardio-Pulmonary Resuscitation) will be very important.

4.0 Weather

Even within the seasons, the weather conditions can vary considerably. Operators of Suspended Scaffold equipment must pay attention to weather reports and constantly watch during the day for any change in conditions requiring them to shut down operations. It takes time to get to a docking level. Thunderstorms can travel fast.

With oncoming bad weather conditions and at the end of each day, the equipment must be stored/tied-in, in such a manner that no harm can come to it or to other parts of the structure.

CHAPTER 11

SPECIAL WORK
&
SPECIAL PLACES

Contents

Chapter 11: Special Work And Special Places

1.0 Introduction

To do your job, you may need to use special equipment or enter special areas. Some of these procedures and places can be hazardous.

Several kinds of work may present hazards to you on a suspended platform. Not every situation you may encounter is listed here.

Your employer must advise you of hazardous chemicals, and the general contractor is supposed to keep a master list of known chemical hazards. In most chemical plants, petroleum plants, nuclear plants, and **other places where the potential risk** is high, there is a safety officer whose duty is to advise and ensure that safe practices are followed. Check with the safety officer when operating in large facilities (Reference O.S.H.A., W.H.M.I.S., Hazcom).

Special hazards can affect you or your equipment. Direct effects involve the air you breathe, your skin, lungs and eyes, to name a few.

Hazards include heat, chemicals, explosive atmospheres and, as well rigging where hazardous conditions may be present.

2.0 Hazard Warnings

Employers have the obligation to warn workers of any hazardous conditions. Workers have the right to know what these conditions may mean to them. Posting of warning signs is required by law.

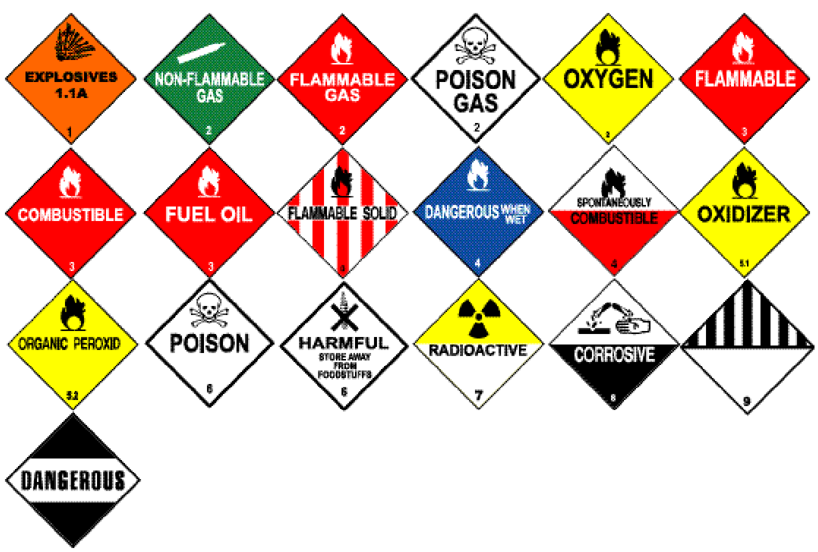


Fig. 11-1

Placards (Fig 11-1) are posted on sites and mobile vehicles (transport trucks) to indicate that some form of hazard could exist. You will see these posted as temporary or permanent indications of a level of risk.

Suspended scaffold workers need not be able to specifically identify what the risk is, but rather that there is one. Workers should ask their employer to identify what the risk is for the location that they will work in. Employers will have the answer or will get it. Any Personal Protection Equipment (P.P.E.) necessary will be provided.

3.0 Suffocation

The air you breathe must have adequate oxygen. Oxygen is a gas that makes up part of our atmosphere. Without adequate oxygen in the air, you could faint and possibly die.

A common use of a suspended platform requires the operator to enter a pit or tank to clean or resurface the walls. Many of these tanks are open only at the top.

If the tank were to be used to store something using oxygen or displaced oxygen, no oxygen may be left in the tank. You may feel fine for a few minutes, then suddenly pass out. Your brain begins to die from lack of oxygen.

Wear a special harness and tie off outside when going into tanks (Fig 11-2). If you have to be pulled out, it can be done quickly without the rescuer having to enter the tank. Carry air, or have a blower that moves fresh air into the tank (not a gas or other fueled blower unless the air intake is well away from the blower exhaust). Otherwise, rely on:

- Respirator with supplied air from tank or compressor outside the tank.
- Self-contained breathing apparatus (SCBA).
- Fans or blowers free of exhaust fumes.

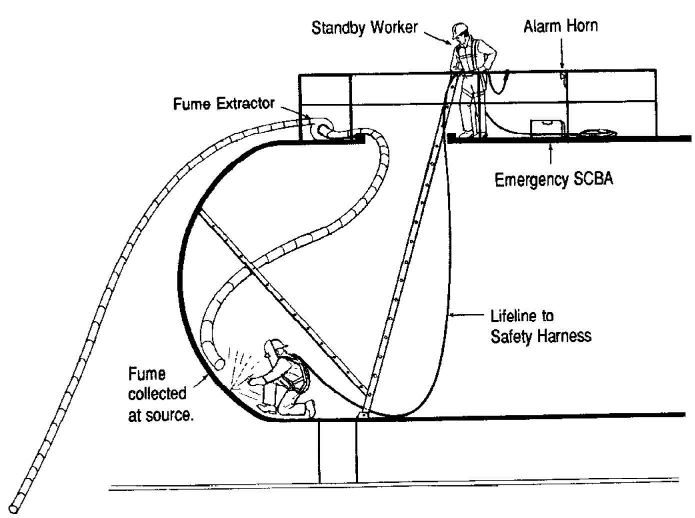


Fig. 11-2

Suspended scaffold operators need to be aware that people drown not only in water but also in grain, sand, and other like material.

The surface of the grain looks sound, but grain can be like quicksand. If you should fall into grain without a safety line, often your only chance is to swim. Sometimes it works, and sometimes it doesn't. Usually entering areas such as this requires "confined space" training.

4.0 Toxic Gas And Chemicals

Your body needs oxygen to function. Without oxygen, the cells die. There are chemicals that stop your body from using oxygen and will interfere with the body's ability to function. These chemicals are called **toxic gases.**

Carbon monoxide is odorless and tasteless. Worst of all, your blood takes in carbon monoxide before it takes in oxygen. Working in a tank with carbon monoxide is often fatal. **Be sure of your air. (**Fig 11-3.)

Other chemicals poison your blood, and block nerve action so you can't breathe, and you suffocate from paralyzed muscles. The list is seemingly endless and for our purposes here, we will list just a few examples:

- Carbon tetrachloride (a cleaner), is five times above the toxic limit when you just smell it.
- Methyl chloride (a paint remover) affects the heart.
- Prussic acid blocks nerves, suffocating the helpless and paralyzed victim.

Be sure of your air, or you may die.

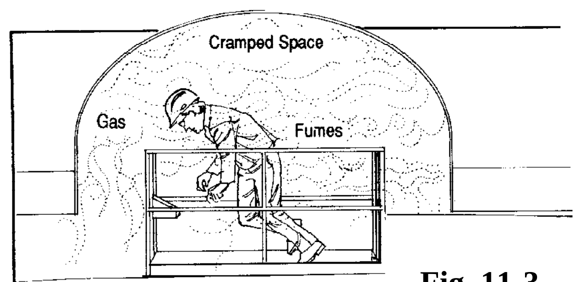


Fig. 11-3

5.0 Explosive Air

You may be required to repair or clean walls in a petroleum tank or a grain bin. The air mix with petroleum or grain can often burn so rapidly that it explodes. Whenever you work in or near a closed area where dust, petroleum, or chemicals have been stored, you must take special precautions.

Remember, you are in there because something is wrong with the tank. Fuel or gas that has seeped out may seep back in. One toxic atmosphere may be replaced by another. In industrial and plant settings, ask the safety officer to test the atmosphere.

You will almost always use an air motor hoist where an explosive environment exists, so electricity can't "ignite" any dust or gas. Chapter 2 discussed the type of power units you must use because of risk of explosion. You will probably take off all the steel you are wearing, including your regular boots (nails in the heels). You may have to use a trowel or scraper of non-sparking metal. Precautions depend on the situation.

If you are not trained in this work, don't "fake it." This is your life. Ask questions about the environment and don't become a fatality.

Equipment designed for use in dangerous environments must meet special requirements. Tools and hoists are non-sparking. Hoist belts are non-static, so no charge can build up on the belt. The air system is designed to run cool, so no hot spots can set off the dust or gas. Any parts replaced on a hoist, deck, etc., must be original equipment replacements! The wrong part can blow a tank sky high.

Some equipment requires a ground tie from one part to another, all the way back to the main ground stake. If used, all ground ties must be firmly intact.

Before entering the work area, empty your pockets of metal objects, matches and, especially, lighters and cigarettes.

6.0 Nuclear

Suspended platform work near nuclear facilities requires special training and the permission of the safety officer. Nuclear contamination is unseen and easily spread. It is usual practice for suspended scaffold equipment to be specially made for the facility and to be washed down after use in a special de-contamination area.

Use only the tools and equipment provided by the facility. Do not take anything in or bring anything out. Report any contact between the platform and piping, vessels or other equipment, **no matter how slight.**

Follow the instructions of the safety officer and the equipment manufacturer. One knows the area; the other knows the equipment.

7.0 Grit And Dirt

Someone has to clean and repair ovens and smokestacks. They can be hot, dirty places, with fired-on soot and other material. Removing baked-on sludge in a hot stack wearing a respirator can be backbreaking labor.

Remember, you are on a suspended platform. A twenty-pound hammer used to knock loose the sheets of grit can swing the deck.

The hoists need to be covered to protect the insides from the grit. Keep the load light so the hoist motors, which are covered and already hot from the heat in the walls, don't "trip out."

Your lifeline will be covered with grit and dust. It is very important that the rope grab you use is designed to operate under such conditions beforehand. Check with the manufacturer. Make sure the temperature of surfaces is within the range of the lifeline.

Debris from the walls can strike the tail line rope and fill it with grit. A wire winder protects the tail line from falling debris and contamination.

Wipe the rope above the hoist as you ascend. It will remove some of the grit on the rope and lengthen the hoist life.

After each job, send the hoist in for cleaning and inspection. There is not a good way to keep a hoist clean in a hostile environment. The next best thing is to have it cleaned and checked out frequently. The dirtier the environment, the more frequently hoists need to be serviced.

8.0 Welding

Welding is often done from a suspended scaffold, but should only be done by qualified welders. Workers who use platforms for other reasons, should be aware of the risks and what is required for protection.

Workers who use suspended scaffolds need protections from falling, which could happen if the primary hoist line is damaged. They also need protection from electrocution caused by large current buildup in welding operations.

The suspended scaffold also needs protection from electrical current buildup. Damage from flame cuts or excess heat is another hazard. If current goes through the ropes and terminations, they can become hot enough to melt. To prevent damage from stray currents, you need a good ground lead current path.See Fig. 11-4.

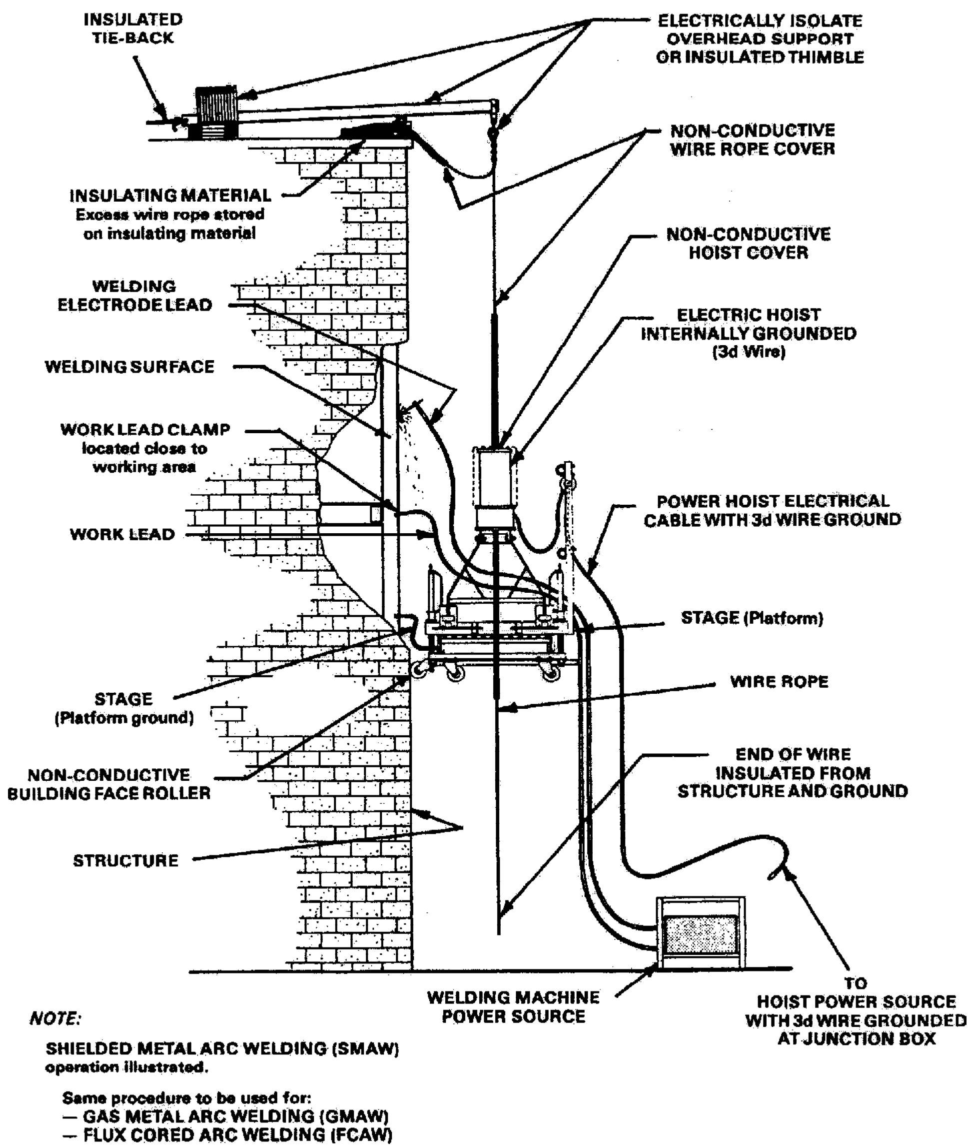


Fig. 11-4

The three different types of welding procedures are:

1. Arc Welding – high currents (85-250 amps) creates high heat melting metal in the weld zone.
2. Gas Welding – high temperature flame melts metals in weld zone.
3. Heliarc Welding – combines electrical current to the weld zone and flame to melt the rods.

Heat protection is a priority. You must protect the platform by grounding the platform and preventing stray current. You must insulate the wire ropes. This includes the hoist line and its terminations, and the tail line. The tieback must be insulated. There should be no uninsulated contact with the structure. (Fig. 11-4.)

Protection should be provided to avoid direct contact of welding leads or flame. The components need protection. Shielding is necessary for the primary hoist line, the motor, and the lifeline.

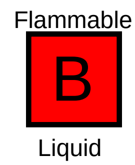
An ABC fire extinguisher should be available on the platform. (Fig. 11-5.)

Welding from a suspended scaffold should only be done by workers that are qualified and fully understand the risks when suspended. When the welding is done, the workers who use the suspended scaffold must fully inspect the equipment.

Class "A" Extinguishers

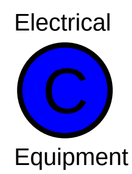
For fires in ordinary combustible materials such as wood, paper and textiles where a quenching, cooling effect is required.

Class "B" Extinguishers



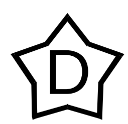
For flammable liquid and gas fires, such as oil, gasoline, paint and grease where oxygen exclusion or flame interruption is essential.

Class "C" Extinguishers



For fires involving electrical wiring and equipment where the non-conductivity of the extinguishing agent is crucial.
This type of extinguisher should be present wherever functional testing and system energizing take place.

Class "D" Extinguishers



For fires in combustible metals such as sodium, magnesium, and postassium.

How to Use the Extinguisher

Aim the extinguisher at the base of the fire to extinguish the flames at their source.

Fig. 11-5

9.0 Water Contact

If you operate a suspended scaffold over water, take special care to keep the platform, ropes and cable out of the water. Most scaffold equipment can withstand short periods of rain, but not immersion. You may have to use wire winders discussed in Chapter 5.

Electrical wiring on the platform and the wires in the power cable may short out in water.

Water going into the hoist can cause deterioration to the hoist and ropes.

10.0 Corrosives

Take precautions when using corrosives such as acids and caustics and neutralizers.

Remember that, by changing the metal in the deck and rope, acids weaken the system. Acids become more active when exposed to a little water, and the moist surfaces of your eyes and lungs can be irreparably damaged. Always wear proper protection.

Most hoists and ropes are sensitive to corrosives. Check your support and lifeline ropes and avoid dangerous combinations of rope and chemicals.

Advise your supplier about any acid or caustic you plan to use before you rent equipment. The supplier will give you a protected deck and know the equipment should be neutralized and tested before being rented out again.

Take carbonated water, clean water, and baking soda with you on the scaffold. Carbonated water is a mild acid that will neutralize alkaline caustics. The combination of baking soda and water neutralizes acid. Water can be used to flush away acids, caustics, as well as lime and Portland cements that are dangerous to your eyes.

Use caution when neutralizing acid in containers. Dumping neutralizer into the container can cause the acid to blow out of the container.

If you get any chemical in your eye(s), flush immediately, continuously, and thoroughly with water. Get to emergency care **ASAP!**

11.0 Rescue Plan

Many of the authorities across the country require the employers of users of suspended scaffolds, to have a **Rescue Plan** in place. This does not mean that in your written plan you simply state, “Call 911.” Action taken in a “Rescue Situation” must be controlled. Cool heads, no panic, is what is needed if and when this situation happens.

In preparing a **Rescue Plan**, there are a number of considerations.

- Will you be rescuing workers, or equipment?
- What rescue equipment would be needed?
- Expected response time of other emergency services.
- What will be the height restrictions of emergency services?
- What crane service is available?
- Where will in-house rescue equipment be kept?
- Who will be on the Rescue Team?
- What practice/training is needed?

12.0 Bridges, Steps, And Terraces

Much suspended scaffold work is done under bridges, over terraces, and on hills with steep slopes and terraces. These special places require special considerations for rigging.

Basic rules still hold. You need a support system, a suspended system, and a safety system. Since the rigging may need to be different, the safety system is doubly important.

The support system may use a boom on a truck holding the basket or a beam over a hole in the roadway. The rules of rigging are still the same — “RASBURRY.”

Sometimes the support system may be the steel beams under the bridge. It may be necessary to change the connection of the wire rope as the basket is moved along the beam, or around another beam. Moving the support point to a new support point while suspended is called **mid-air transfer.**

Using a horizontal wire rope as a support can be extremely dangerous. The downward pull on a horizontal rope and the pull on the end connections can easily exceed the breaking strength of the rope. The tighter the horizontal rope, the more dangerous it is.

The suspension system for equipment used under a structure is often a **single line.** Single-line equipment is easier to handle and can reach awkward places. The usual rules apply.

The fall-arrest system can be difficult to install properly, because of the need for an overhead anchor. One method is to use two anchors and move them, one at a time, with the scaffold transfer.

Some riggers use secondary lines on the suspended scaffold so the worker can tie off to the scaffold. This method can also be used in mid-air transfers, with the secondary ropes connected to a different point than the primary support ropes.

When the suspended scaffold must be rigged on a sloped, terraced, or stepped surface, the rules about lifelines, tiebacks, and “RASBURRY” still apply.

The scaffold can be prepared and still moved into position with a forklift, if space permits. A frame scaffold can be used to hold the low end while the rest of the platform is assembled. Follow the rules for using the frame scaffolding and be sure footings are secure.

Many terraces and steps are under large overhangs. Connect the terminations and the lifeline anchors to the eyes before assembling the rest of the system. Most of the anchors can be reached with a ladder, although some require the use of a scaffold. If you need to use a hook, use the type with a safety latch. Tape a rope or cord to the latch so you can pull the latch open when you need to remove the hook. **NEVER TAPE THE LATCH OPEN!**

13.0 Mid-Air Transfers

The mid-air transfer is dangerous. It involves moving the support points for the suspension to a new support point, while suspended in the air. Mid-air transfers are normally done only with single- point baskets.

The procedure is described in manuals on the equipment designed for the application. The equipment must have two suspension points: one on the wire rope, and one on the basket. A short length of wire rope is used to connect the basket suspension point to the overhead suspension point and suspend the basket while the support rope suspension point is moved. Once the suspension point is moved and secured, the short rope is removed.

The intermediate point may be chosen to be half way between the old and new suspension points. Each time the basket suspension is changed from support to next support, the basket swings down and over.

It is important that the connections and terminations are tight and able to take the swing. That is why the transfer must only be done with equipment designed for the procedure, in strict accordance with the manufacturer's instructions, and only while the operator is tied off to the lifeline.

The lifeline must also be moved. Many times a second lanyard can be used to tie off the worker while the transfer is made. It is connected to the worker's body harness and then wrapped around the overhead beam and secured. The lifeline is loosened and moved, and after the lifeline has been re-secured and checked, the second lanyard is removed from the overhead.

A mid-air transfer must be carefully planned from the ground before any attempt is made in the air. Every step must be checked and rechecked before moving to the next.

It is strongly recommended that only pins with clips or cotter keys be used in this process. The use of ropes and cables on shackles can cause the shackle pin to back out.

CHAPTER 12

STANDARDS
CODES - LAWS
& REGULATIONS

Contents

Chapter 12: Standards, Codes, Laws and Regulations

1.0 General

It will be helpful for the student to be aware of the different guidelines/regulations that are written to provide direction for those who make, supply or use suspended scaffold. The laws, regulations and codes can be federal, state/provincial, municipal, local, or site-prepared ordinances. The student must be aware of all of those that affect the safe use of the equipment to be operated. The laws, regulations, standards and codes are made up by people with different backgrounds. The mixture of people and the wide circulation of draft copies prepared for feedback, result in sensible guidelines/regulations for all to follow.

2.0 Standards Development

"Standards" are developed by a wide range of industry experts, in order to provide guidance to those who make equipment, as well as to those who use it. The intent is to provide safe equipment that can be depended upon.

"Standards" are not laws and, in most cases, must be quoted by the different governing forces to make the "standards" mandatory. There are a number of different "standards" writing bodies who are nationally and internationally recognized, i.e. U.L., U.L.C., C.S.A., Factory Mutual, A.N.S.I., etc. These are the prime groups or associations involved with the writing of standards for suspended scaffold.

2.1 Underwriter's Laboratory (U.L.)

This is a "standards" writing organization as well as being a testing laboratory with offices located throughout the world. It is also a non-profit organization, which certifies equipment and components presented to it by the manufacturers. Its requirement for high standards ensures any "U.L. Listed" products can be depended upon to be safe.

2.2 Underwriter's Laboratory of Canada (U.L.C.)

Although equipment and components are tested in the United States, U.L. maintains an office in Canada for ease of certification.

2.3 Canadian Standards Association (C.S.A.)

This Organization in Canada, operates in the same way as U.L. does in the United States.

2.4 Factory Mutual

This is another testing laboratory and "standards" writing organization. Factory Mutual is recognized for its reliability in certifying products for safety in the Suspended Scaffold business.

2.5 American National Standards Institute (A.N.S.I.)

There are two main differences with this organization from the others. First, the public forms a large component of the committees writing the standards. The standards are widely accepted as being those which detail the manufacturing methods and the conditions for use of equipment and components. Secondly, A.N.S.I. does not test and certify products.

3.0 Laws and Regulations

In the same way as there are organizations to set standards for equipment design, there are policing organizations for enforcement of the laws and regulations for the safe use of Suspended Scaffold.

3.1 Occupational Safety and Health Administration (O.S.H.A.)

Congress granted O.S.H.A. its mandate to be the writer for the Laws and Regulations, as well as to be the Police Officers to enforce compliance. Regulations are written and the public is given the opportunity for input. Upon completion, they become law throughout the United States. Each State will accept the Federal OSHA Regulations and have them enforced by Federal OSHA officers or, enact their own regulations as equal to or better, and enforce their own regulations.

3.2 Other Policing Authorities and Agencies

There are many jurisdictions throughout North America (including Federal, State, Provincial and Local), who enforce the Laws and Regulations that are written. Some of these agencies may have a self-interest to ensure that their particular skill, or the environment is protected in a safe manner. Policing of safety regulations is not just the job for federal or local state officers. Each worker must be their own safety officer on the job to follow the common sense rules.

4.0 Industry Associations

There are many associations setting standards to which they expect their members to abide by. Only those who affect our industry directly will be discussed:

4.1 Scaffold Industry Association (S.I.A.)

The S.I.A. is a non-profit trade organization representing the access industry manufacturers, dealers, insurance companies, consultants, and other companies in promoting product standards and procedures throughout North America. The Association publishes a "Code of Safe Practices" for Suspended Powered Scaffolds and other products, and promotes safety with its members and their customers.

The members of the S.I.A. spend considerable time in dealing with the safety concerns of all products the industry markets. In addition, the S.I.A. and their members are extremely active in their representation on many "standard" writing committees, in order to offer their expertise to responsible safety standards.

The S.I.A. is known for the total coverage of many training programs for the upgrading of knowledge for all users of products the members market.

4.2 Scaffold Shoring and Forming Institute (S.S.F.I.)

The S.S.F.I. is a non-profit trade organization, composed of equipment manufacturers who promote safe practices in construction and related industries. It publishes safety requirements for suspended powered scaffolds and other products. These are to provide advice in the operation, construction, maintenance, and use of suspended scaffolds and other products.

5.0 Safety Organizations

There are many "Safety Associations" throughout North America. They are highly effective in the promotion of safety standards throughout our entire industry. They can be either Federal or State/Provincial organizations. Users of Suspended Scaffolds should take the opportunity to join with these associations to further their knowledge.

6.0 Regulation References

The following References are abbreviated for simplicity. Each student should consult the actual text for full wording. It must be remembered that each State must have Regulations that are equal or better than Federal OSHA Regulations.

6.1 O.S.H.A. Part 1910 Subpart F: Powered Platforms, Manlifts and Vehicle-Mounted Work Platforms

(f) "Powered platform installations" - "Equipment."

(1) "General requirements." The following requirements apply to equipment, which are part of a powered platform installation, such as platforms, stabilizing components, carriages, outriggers, davits, hoisting machines, wire ropes and electrical components.

(i) Equipment installations shall be designed by or under the direction of a registered professional engineer experienced in such design;

(ii) The design shall provide for a minimum live load of 250 pounds (113.6 kg) for each occupant of a suspended or supported platform;

(iii) Equipment that is exposed to wind when not in service shall be designed to withstand forces generated by winds of at least 100 miles per hour (44.7 m/s) at 30 feet (9.2 m) above grade; and

(iv) Equipment that is exposed to wind when in service shall be designed to withstand forces generated by winds of at least 50 miles per hour (22.4 m/s) for all elevations.

(2) "Construction requirements." Bolted connections shall be self-locking or shall otherwise be secured to prevent loss of the connections by vibration.

(3) "Suspension methods." Elevated building maintenance equipment shall be suspended by a carriage, outriggers, davits or an equivalent method.

(i) "Carriages." Carriages used for suspension of elevated building maintenance equipment shall comply with the following:
(A) The horizontal movement of a carriage shall be controlled so as to ensure its safe movement and allow accurate positioning of the platform for vertical travel or storage

(B) Powered carriages shall not exceed a traversing speed of 50 feet per minute (0.3 m/s);

(C) The initiation of a traversing movement for a manually propelled carriage on a smooth level surface shall not require a person to exert a horizontal force greater than 40 pounds (444.8 n);

(D) Structural stops and curbs shall be provided to prevent the traversing of the carriage beyond its designed limits of travel;

(E) Traversing controls for a powered carriage shall be of a continuous pressure weatherproof type. Multiple controls when provided shall be arranged to permit operation from only one control station at a time. An emergency stop device shall be provided on each end of a powered carriage for interrupting power to the carriage drive motors;

(F) The operating control(s) shall be so connected that in the case of suspended equipment traversing of a carriage is not possible until the suspended portion of the equipment is located at its uppermost designed position for traversing; and is free of contact with the face of the building or building guides. In addition, all protective devices and interlocks are to be in the proper position to allow traversing of the carriage;

(G) Stability for underfoot supported carriages shall be obtained by gravity, by an attachment to a structural support, or by a combination of gravity and a structural support. The use of flowing counterweights to achieve stability is prohibited. {1} The stability factor against overturning shall not be less than two for horizontal traversing of the carriage, including the effects of impact and wind. {2} The carriages and their anchorages shall be capable of resisting accidental over-tensioning of the wire ropes suspending the working platform, and this calculated value shall include the effect of one and one-half times the stall capacity of the hoist motor. All parts of the installation shall be capable of withstanding without damage to any part of the installation the forces resulting from the stall load of the hoist and one half the wind load. {3} Roof carriages which rely on having tie-down devices secured to the building to develop the required stability against overturning shall be provided with an interlock which will prevent vertical platform movement unless the tiedown is engaged;

(H) An automatically applied braking or locking system, or equivalent, shall be provided that will prevent unintentional traversing of power traversed or power assisted carriages;

(I) A manual or automatic braking or locking system or equivalent, shall be provided that will prevent unintentional traversing of manually propelled carriages;

(J) A means to lock out the power supply for the carriage shall be provided;

(K) Safe access to and egress from the carriage shall be provided from a safe surface. If the carriage traverses an elevated area, any operating area on the carriage shall be protected by a guardrail system in compliance with the provisions of paragraph (f)(5)(i)(F) of this section. Any access gate shall be self-closing and self-latching, or provided with an interlock;

(L) Each carriage work station position shall be identified by location markings and/or position indicators; and

(M) The motors shall stall if the load on the hoist motors is at any time in excess of three times that necessary for lifting the working platform with its rated load.

(ii) “Transportable outriggers.”

(A) Transportable outriggers may be used as a method of suspension for ground-rigged working platforms where the point of suspension does not exceed 300 feet (91.5 m) above a safe surface. Tie-in guide system(s) shall be provided which meet the requirements of paragraph (e)(2) of this section.

(B) Transportable outriggers shall be used only with selfpowered, ground-rigged working platforms.

(C) Each transportable outrigger shall be secured with a tie-down to a verified anchorage on the building during the entire period of its use. The anchorage shall be designed to have a stability factor of not less than four against overturning or upsetting of the outrigger

(D) Access to and egress from the working platform shall be from and to a safe surface below the point of suspension.

(E) Each transportable outrigger shall be designed for lateral stability to prevent roll-over in the event an accidental lateral load is applied to the outrigger The accidental lateral load to be considered in this design shall be not less than 70 percent of the rated load of the hoist.

(F) Each transportable outrigger shall be designed to support an ultimate load of not less than four times the rated load of the hoist.

(G) Each transportable outrigger shall be so located that the suspension wire ropes for two point suspended working platforms are hung parallel.

(H) A transportable outrigger shall be tied-back to a verified anchorage on the building with a rope equivalent in strength to the suspension rope.

(1) The tie-back rope shall be installed parallel to the centerline of the outrigger.

(iii) Davits.

(A) Every davit installation, fixed or transportable, rotatable or non-rotatable shall be designed and installed to insure that it has a stability factor against overturning of not less than four

(B) The following requirements apply to roof rigged davit systems:

{1} Access to and egress from the working platform shall be from a safe surface. Access or egress shall not require persons to climb over a building's parapet or guardrailing; and

{2} The working platform shall be provided with wheels, casters or a carriage for traversing horizontally.

(C) The following requirements apply to ground-rigged davit systems:

{1} The point of suspension shall not exceed 300 feet (91.5 m) above a safe surface. Guide system(s) shall be provided which meet the requirements of paragraph (e)(2) of this section;

{2} Access and egress to and from the working platform shall only be from a safe surface below the point of suspension.

(D) A rotating davit shall not require a horizontal force in excess of 40 pounds (177.9 n) per person to initiate a rotating movement.

(E) The following requirements shall apply to transportable davits:

{1} A davit or part of a davit weighing more than 80 pounds (36 kg) shall be provided with a means for its transport, which shall keep the center of gravity of the davit at or below 36 inches (914 mm) above the safe surface during transport:

{2} A davit shall be provided with a pivoting socket or with a base that will allow the insertion or removal of a davit at a position of not more than 35 degrees above the horizontal, with the complete davit inboard of the building face being serviced; and

{3} Means shall be provided to lock the davit to its socket or base before it is used to suspend the platform.

(4) "Hoisting machines."

(i) Raising and lowering of suspended or supported equipment shall be performed only by a hoisting machine.

(ii) Each hoisting machine shall be capable of arresting any overspeed descent of the load.

(iii) Each hoisting machine shall be powered only by air, electric or hydraulic sources.

(iv) Flammable liquids shall not be carried on the working platform.

(v) Each hoisting machine shall be capable of raising or lowering 125 percent of the rated load of the hoist.

(vi) Moving parts of a hoisting machine shall be enclosed or guarded in compliance with paragraphs (a)(l) and (2) of 1910.212 of this part.

(vii) Winding drums, traction drums and sheaves and directional sheaves used in conjunction with hoisting machines shall be compatible with, and sized for, the wire rope used.

(viii) Each winding drum shall be provided with a positive means of attaching the wire rope to the drum. The attachment shall be capable of developing at least four times the rated load of the hoist.

(ix) Each hoisting machine shall be provided with a primary brake and at least one independent secondary brake, each capable of stopping and holding not less than 125 percent of the lifting capacity of the hoist.

(A) The primary brake shall be directly connected to the drive train of the hoisting machine, and shall not be connected through belts, chains, clutches, or set screw type devices. The brake shall automatically set when power to the prime mover is interrupted.

(B)

{1} The secondary brake shall be an automatic emergency type of brake that, if actuated during each stopping cycle, shall not engage before the hoist is stopped by the primary brake.

{2} When a secondary brake is actuated, it shall stop and hold the platform within a vertical distance of 24 inches (609.6 mm).

(x) Any component of a hoisting machine which requires lubrication for its protection and proper functioning shall be provided with a means for that lubrication to be applied.

(5) "Suspended equipment."

(i) "General requirements."

(A) Each suspended unit component, except suspension ropes and guardrail systems, shall be capable of supporting, without failure, at least four times the maximum intended live load applied or transmitted to that component.

(B) Each suspended unit component shall be constructed of materials that will withstand anticipated weather conditions.

(C) Each suspended unit shall be provided with a load rating plate, conspicuously located, stating the unit weight and rated load of the suspended unit.

(D) When the suspension points on a suspended unit are not at the unit ends, the unit shall be capable of remaining continuously stable under all conditions of use and position of the live load, and shall maintain at least a l to 1 stability factor against unit upset.

(E) Guide rollers, guide shoes or building face rollers shall be provided, and shall compensate for variations in building dimensions and for minor horizontal out-of-level variations of each suspended unit.

(F) Each working platform of a suspended unit shall be secured to the building facade by one or more of the following methods, or by an equivalent method:

{1} Continuous engagement to building anchors as provided in paragraph (e)(2)(i) of this section;

{2} Intermittent engagement to building anchors as provided in paragraph (e)(2)(iii)(A) of this section;

{3} Button-guide engagement as provided in paragraph (e)(2)(iii)(B) of this sections, or

{4} Angulated roping and building face rollers as provided in paragraph (e)(2)(iii)(C) of this section.

(G) Each working platform of a suspended unit shall be provided with a guardrail system on all sides, which shall meet the following requirements:

{1} The system shall consist of a top guardrail, midrail, and a toeboard;

{2} The top guardrail shall not be less than 36 inches (914 mm) high and shall be able to withstand at least a 100-pound (444 n) force in any downward or outward direction;

{3} The midrail shall be able to withstand at least a 75-pound (333 n) force in any downward or outward direction; and

{4} The areas between the guardrail and toeboard on the ends and outboard side, and the area between the midrail and toeboard on the inboard side, shall be closed with a material that is capable of withstanding a load of 100 pounds (45.4 kg) applied horizontally over any area of one square foot (0.09 m2). The material shall have all openings small enough to reject passage of lifelines and potential falling objects which may be hazardous to persons below.

{5} Toeboards shall be capable of withstanding, without failure, a force of at least 50 pounds (222 n) applied in any downward or horizontal direction at any point along the toeboard.

{6} Toeboards shall be 3 inches (9 cm) minimum in length from their edge to the level of the platform floor.

{7} Toeboards shall be securely fastened in place at the outermost edge of the platform and have no more than one-half inch (1.3 cm) clearance above the platform floor.

{8} Toeboards shall be solid or with an opening not over one inch (2.5 cm) in the greatest dimension.

(ii) “Two and four-point suspended working platforms.”

(A) The working platform shall be not less than 24 inches (610 mm) wide and shall be provided with a minimum of a 12 inch (305 mm) wide passage at or past any obstruction on the platform.

1926.451 GENERAL REQUIREMENTS.

This section does not apply to aerial lifts, the criteria for which are set out exclusively in Sec. 1926.453.

(a) Capacity

(1) Except as provided in paragraphs (a)(2), (a)(3), (a)(4), (a)(S) and (g) of this section, each scaffold and scaffold component shall be capable of supporting, without failure, its own weight and at least 4 times the maximum intended load applied or transmitted to it.

(2) Direct connections to roofs and floors, and counterweights used to balance adjustable suspension scaffolds, shall be capable of resisting at least 4 times the tipping moment imposed by the scaffold operating at the rated load of the hoist, or l.5 (minimum) times the tipping moment imposed by the scaffold operating at the stall load of the hoist, whichever is greater.

(3) Each suspension rope, including connecting hardware, used on non-adjustable suspension scaffolds shall be capable of supporting, without failure, at least 6 times the maximum intended load applied or transmitted to that rope.

(4) Each suspension rope, including connecting hardware, used on adjustable suspension scaffolds shall be capable of supporting, without failure, at least 6 times the maximum intended load applied or transmitted to that rope with the scaffold operating at either the rated load of the hoist, or 2 (minimum) times the stall load of the hoist, whichever is greater.

(5) The stall load of any scaffold hoist shall not exceed 3 times its rated load.

(6) Scaffolds shall be designed by a qualified person and shall be constructed and loaded in accordance with that design. Non-mandatory Appendix A to this subpart contains examples of criteria that will enable an employer to comply with paragraph (a) of this section.

. . .

(d) Criteria for suspension scaffolds.

(1) All suspension scaffold support devices, such as outrigger beams, cornice hooks, parapet clamps, and similar devices, shall rest on surfaces capable of supporting at least 4 times the load imposed on them by the scaffold operating at the rated load of the hoist (or at least 1.5 times the load imposed on them by the scaffold at the stall capacity of the hoist, whichever is greater).

(2) Suspension scaffold outrigger beams,

when used, shall be made of structural metal or equivalent strength material, and shall be restrained to prevent movement.

(3) The inboard ends of suspension scaffold outrigger beams shall be stabilized by bolts or other direct connections to the floor or roof deck, or they shall have their inboard ends stabilized by counterweights, except masons' multi-point adjustable suspension scaffold outrigger beams shall not be stabilized by counterweights.

(i) Before the scaffold is used, direct connections shall be evaluated by a competent person who shall confirm, based on the evaluation, that the supporting surfaces are capable of supporting the loads to be imposed. In addition, masons' multi-point adjustable suspension scaffold connections shall be designed by an engineer experienced in such scaffold design.

(ii) Counterweights shall be made of non-flowable material. Sand, gravel and similar materials that can be easily dislocated shall not be used as counterweights.

(iii) Only those items specifically designed as counterweights shall be used to counterweight scaffold systems. Construction materials such as, but not limited to, masonry units and rolls of roofing felt, shall not be used as counterweights.

(iv) Counterweights shall be secured by mechanical means to the outrigger beams to prevent accidental displacement.

(v) Counterweights shall not be removed from an outrigger beam until the scaffold is disassembled.

(vi) Outrigger beams which are not stabilized by bolts or other direct connections to the floor or roof deck shall be secured by tiebacks.

(vii) Tiebacks shall be equivalent in strength to the suspension ropes.

(viii)Outrigger beams shall be placed perpendicular to its bearing support (usually the face of the building or structure). However, where the employer can demonstrate that it is not possible to place an outrigger beam perpendicular to the face of the building or structure because of obstructions that cannot be moved, the outrigger beam may be placed at some other angle, provided opposing angle tiebacks are used.

(ix) Tiebacks shall be secured to a structurally sound anchorage on the building or structure. Sound anchorages include structural members, but do not include standpipes, vents, other piping systems, or electrical conduit.

(x) Tiebacks shall be installed perpendicular to the face of the building or structure, or opposing angle tiebacks shall be installed. Single tiebacks installed at an angle are prohibited.

(4) Suspension scaffold outrigger beams shall be:

(i) Provided with stop bolts or shackles at both ends;

(ii) Securely fastened together with the flanges turned out when channel iron beams are used in place of l-beams;

(iii) Installed with all bearing supports perpendicular to the beam center line;

(iv) Set and maintained with the web in a vertical position; and

(v) When an outrigger beam is used, the shackle or clevis with which the rope is attached to the outrigger beam shall be placed directly over the centerline of the stirrup.

(5) Suspension scaffold support devices such as cornice hooks, roof hooks, roof irons, parapet clamps, or similar devices shall be:

(i) Made of steel, wrought iron, or materials of equivalent strength;

(ii) Supported by bearing blocks; and

(iii) Secured against movement by tiebacks installed at right angles to the face of the building or structure, or opposing angle tiebacks shall be installed and secured to a structurally sound point of anchorage on the building or structure. Sound points of anchorage include structural members, but do not include standpipes, vents, other piping systems, or electrical conduit.

(iv) Tiebacks shall be equivalent in strength to the hoisting rope.

(6) When winding drum hoists are used on a suspension sheaf fold, they shall contain not less than four wraps of the suspension rope at the lowest point of scaffold travel. When other types of hoists are used, the suspension ropes shall be long enough to allow the scaffold to be lowered to the level below without the rope end passing through the hoist, or the rope end shall be configured or provided with means to prevent the end from passing through the hoist.

(7) The use of repaired wire rope as suspension rope is prohibited.

(8) Wire suspension ropes shall not be joined together except through the use of eye splice thimbles connected with shackles or coverplates and bolts.

(9) The load end of wire suspension ropes shall be equipped with proper size thimbles and secured by eyesplicing or equivalent means.

10) Ropes shall be inspected for defects by a competent person prior to each workshift and after every occurrence which could affect a rope's integrity. Ropes shall be replaced if any of the following conditions exist:

(i) Any physical damage which impairs the function and strength of the rope.

(ii) Kinks that might impair the tracking or wrapping of rope around the drum(s) or sheave(s).

(iii) Six randomly distributed broken wires in one rope lay or three broken wires in one strand in one rope lay.

(iv) Abrasion, corrosion, scrubbing, flattening or peening causing loss of more than one-third of the original diameter of the outside wires.

(v) Heat damage caused by a torch or any damage caused by contact with electrical wires.

(vi) Evidence that the secondary brake has been activated during an overspeed condition and has engaged the suspension rope.

(11) Swaged attachments or spliced eyes on wire suspension ropes shall not be used unless they are made by the wire rope manufacturer or a qualified person.

(12) When wire rope clips are used on suspension scaffolds:

(i) There shall be a minimum of 3 wire rope clips installed, with the clips a minimum of 6 rope diameters apart;

(ii) Clips shall be installed according to the manufacturer's recommendations;

(iii) Clips shall be retightened to the manufacturer's recommendations after the initial loading;

(iv) Clips shall be inspected and retightened to the manufacturer's recommendations at the start of each workshift thereafter;

(v) U-bolt clips shall not be used at the point of suspension for any scaffold hoist;

(vi) When U-bolt clips are used, the U-bolt shall be placed over the dead end of the rope, and the saddle shall be placed over the live end of the rope.

(13) Suspension scaffold power-operated hoists and manual hoists shall be tested by a qualified testing laboratory.

(14) Gasoline-powered equipment and hoists shall not be used on suspension scaffolds.

(15) Gears and brakes of power-operated hoists used on suspension scaffolds shall be enclosed.

(16) In addition to the normal operating brake, suspension scaffold power-operated hoists and manually operated hoists shall have a braking device or locking pawl which engages automatically when a hoist makes either of the following uncontrolled movements: an instantaneous change in momentum or an accelerated overspeed.

(17) Manually operated hoists shall require a positive crank force to descend.

(18) Two-point and multi-point suspension scaffolds shall be tied or otherwise secured to prevent them from swaying, as determined to be necessary based on an evaluation by a competent person. Window cleaners' anchors shall not be used for this purpose.

(19) Devices whose sole function is to provide emergency escape and rescue shall not be used as working platforms. This provision does not preclude the use of systems which are designed emergency systems.

. . .

(g) Fall protection.

(1) Each employee on a scaffold more than 10 feet (3.1 m) above a lower level shall be protected from falling to that lower level. Paragraphs (g)(I) (i) through (vii) of this section establish the types of fall protection to be provided to the employees on each type of scaffold. Paragraph (g)(2) of this section addresses fall protection for scaffold erectors and dismantlers. Note to paragraph (g)(1): The fall protection requirements for employees installing suspension scaffold support systems on floors, roofs, and other elevated surfaces are set forth in subpart M of this part.

(i) Each employee on a boatswains' chair, catenary scaffold, float scaffold, needle beam scaffold, or ladder jack scaffold shall be protected by a personal fall arrest system;

(ii) Each employee on a single-point or two-point adjustable suspension scaffold shall be protected by both a personal fall arrest system and guardrail system;

(iii) Each employee on a crawling board (chicken ladder) shall be protected by a personal fall arrest system, a guardrail system (with minimum 200 pound toprail capacity), or by a three-fourth inch (1.9 cm) diameter grabline or equivalent handhold securely fastened beside each crawling board;

(iv) Each employee on a self-contained adjustable scaffold shall be protected by a guardrail system (with minimum 200 pound toprail capacity) when the platform is supported by the frame structure, and by both a personal fall arrest system and a guardrail system (with minimum 200 pound toprail capacity) when the platform is supported by ropes;

(v) Each employee on a walkway located within a scaffold shall be protected by a guardrail system (with minimum 200 pound toprail capacity) installed within 9-1/2 inches (24.1 cm) of and along at least one side of the walkway.

(vi) Each employee performing overhand bricklaying operations from a supported scaffold shall be protected from falling from all open sides and ends of the scaffold (except at the side next to the wall being laid) by the use of a personal fall arrest system or guardrail system (with minimum 200 pound toprail capacity).

(vii) For all scaffolds not otherwise specified in paragraphs (g)(I)(i) through (g)(I)(vi) of this section, each employee shall be protected by the use of personal fall arrest systems or guardrail systems meeting the requirements of paragraph (g)(4) of this section.

(2) Effective September 2, 1997, the employer shall have a competent person determine the

feasibility and safety of providing fall protection for employees erecting or dismantling supported scaffolds. Employers are required to provide fall protection for employees erecting or dismantling supported scaffolds where the installation and use of such protection is feasible and does not create a greater hazard.

(3) In addition to meeting the requirements of Sec. I 926.502(d), personal fall arrest systems used on scaffolds shall be attached by lanyard to a vertical lifeline, horizontal lifeline, or scaffold structural member Vertical lifelines shall not be used when overhead components, such as overhead protection or additional platform levels, are part of a singlepoint or two-point adjustable suspension scaffold.

(i) When vertical lifelines are used, they shall be fastened to a fixed safe point of anchorage, shall be independent of the scaffold, and shall be protected from sharp edges and abrasion. Safe points of anchorage include structural members of buildings, but do not include standpipes, vents, other piping systems, electrical conduit, outrigger beams, or counterweights.

(ii) When horizontal lifelines are used, they shall be secured to two or more structural members of the scaffold, or they may be looped around both suspension and independent suspension lines (on scaffolds so equipped) above the hoist and brake attached to the end of the scaffold. Horizontal lifelines shall not be attached only to the suspension ropes.

(iii) When lanyards are connected to horizontal lifelines or structural members on a single-point or two-point adjustable suspension scaffold, the scaffold shall be equipped with additional independent support lines and automatic locking devices capable of stopping the fall of the scaffold in the event one or both of the suspension ropes fail. The independent support lines shall be equal in number and strength to the suspension ropes.

(iv) Vertical lifelines, independent support lines, and suspension ropes shall not be attached to each other, nor shall they be attached to or use the same point of anchorage, nor shall they be attached to the same point on the scaffold or personal fall arrest system.

(4) Guardrail systems installed to meet the requirements of this section shall comply with the following provisions (guardrail systems built in accordance with Appendix A to this subpart will be deemed to meet the requirements of paragraphs (g)(4) (vii), (viii), and (ix) of this section):

(i) Guardrail systems shall be installed along all open sides and ends of platforms. Guardrail systems shall be installed before the scaffold is released for use by employees other than erection/dismantling crews.

(ii) The top edge height of toprails or equivalent member on supported scaffolds manufactured or placed in service after January I, 2000 shall be installed between 38 inches (0.97 m) and 45 inches (1.2 m) above the platform surface. The top edge height on supported scaffolds manufactured and placed in service before January 1, 2000, and on all suspended scaffolds where both a guardrail and a personal fall arrest system are required shall be between 36 inches (0.9 m) and 45 inches (1.2 m). When conditions warrant, the height of the top edge may exceed the 45-inch height, provided the guardrail system meets all other criteria of paragraph (g)(4).

(iii) When midrails, screens, mesh, intermediate vertical members, solid panels, or equivalent structural members are used, they shall be installed between the top edge of the guardrail system and the scaffold platform.

(iv) When midrails are used, they shall be installed at a height approximately midway between the top edge of the guardrail system and the platform surface.

(v) When screens and mesh are used, they shall extend from the top edge of the guardrail system to the scaffold platform, and along the entire opening between the supports.

(vi) When intermediate members (such as balusters or additional rails) are used, they shall not be more than 19 inches (48 cm) apart.

(vii) Each toprail or equivalent member of a guardrail system shall be capable of withstanding, without failure, a force applied in any downward or horizontal direction at any point along its top edge of at least 100 pounds (445 n) for guardrail systems installed on single-point adjustable suspension scaffolds or two-point adjustable suspension scaffolds, and at least 200 pounds (890 n) for guardrail systems installed on all other scaffolds.

(viii)When the loads specified in paragraph (g)(4)(vii) of this section are applied in a downward direction, the top edge shall not drop below the height above the platform surface that is prescribed in paragraph (g)(4)(ii) of this section.

(ix) Midrails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members of a guardrail system shall be capable of withstanding, without failure, a force applied in any downward or horizontal direction at any point along the midrail or other member of at least 75 pounds (333 n) for guardrail systems with a minimum 100 pound toprail capacity, and at least 150 pounds (666 n) for guardrail systems with a minimum 200 pound toprail capacity.

(x) Suspension scaffold hoists and non-walk-through stirrups may be used as end guardrails, if the space between the hoist or stirrup and the side guardrail or structure does not allow passage of an employee to the end of the scaffold.

(xi) Guardrails shall be surfaced to prevent injury to an employee from punctures or lacerations, and to prevent snagging of clothing.

(xii) The ends of all rails shall not overhang the terminal posts except when such overhang does not constitute a projection hazard to employees.

(xiii) Steel or plastic banding shall not be used as a toprail or midrail.

(xiv) Manila or plastic (or other synthetic) rope being used for toprails or midrails shall be inspected by a competent person as frequently as necessary to ensure that it continues to meet the strength requirements of paragraph (g) of this section.

(xv) Crossbracing is acceptable in place of a midrail when the crossing point of two braces is between 20 inches (0.5 m) and 30 inches (0.8 m) above the work platform or as a toprail when the crossing point of two braces is between 38 inches (0.97 m) and 48 inches (1.3 m) above the work platform. The end points at each upright shall be no more than 48 inches (1.3 m) apart.

1926.452 ADDITIONAL REQUIREMENTS APPLICABLE TO SPECIFIC TYPES OF SCAFFOLDS.

(o) Single-point adjustable suspension scaffolds.

(1) When two single-point adjustable suspension scaffolds are combined to form a two-point adjustable suspension scaffold, the resulting two-point scaffold shall comply with the requirements for two-point adjustable suspension scaffolds in paragraph (p) of this section.

(2) The supporting rope between the scaffold and the suspension device shall be kept vertical unless all of the following conditions are met:

(i) The rigging has been designed by a qualified person, and

(ii) The scaffold is accessible to rescuers, and

(iii) The supporting rope is protected to ensure that it will not chafe at any point where a change in direction occurs, and

(iv) The scaffold is positioned so that swinging cannot bring
the scaffold into contact with another surface.

(3) Boatswains' chair tackle shall consist of correct size ball bearings or bushed blocks containing safety hooks and properly "eye-spliced" minimum five-eighth (5/8) inch (1.6 cm) diameter first-grade manila rope, or other rope which will satisfy the criteria (e.g., strength and durability) of manila rope.

(4) Boatswains' chair seat slings shall be reeved through four corner holes in the seat; shall cross each other on the underside of the seat; and shall be rigged so as to prevent slippage, which could cause an out-of-level condition.

(5) Boatswains' chair seat slings shall be a minimum of five-eight (5/8) inch (1.6 cm) diameter fiber, synthetic, or other rope which will satisfy the criteria (e.g., strength, slip resistance, durability, etc.) of first grade manila rope.

(6) When a heat-producing process such as gas or arc welding is being conducted, boatswains' chair seat slings shall be a minimum of three-eight (3/8) inch (1.0 cm) wire rope.

(7) Non-cross-laminated wood boatswains chairs shall be reinforced on their underside by cleats securely fastened to prevent the board from splitting.

(p) Two-point adjustable suspension scaffolds (swing stages).

The following requirements do not apply to two-point adjustable suspension scaffolds used as masons' or stonesetters' scaffolds.

Such scaffolds are covered by paragraph (q) of this section.

(1) Platforms shall not be more than 36 inches (0.9 m) wide unless designed by a qualified person to prevent unstable conditions.

(2) The platform shall be securely fastened to hangers (stirrups) by U-bolts or by other means, which satisfy the requirements of Sec. 1926.451 (a).

(3) The blocks for fiber or synthetic ropes shall consist of at least one double and one single block. The sheaves of all blocks shall fit the size of the rope used.

(4) Platforms shall be of the ladder-type, plank-type, beam-type, or light-metal type. Light metal-type platforms having a rated capacity of 750 pounds or less and platforms 40 feet (12.2 m) or less in length shall be tested and listed by a nationally recognized testing laboratory.

(5) Two-point scaffolds shall not be bridged or otherwise connected one to another during raising and lowering operations unless the bridge connections are articulated (attached), and the hoists properly sized.

(6) Passage may be made from one platform to another only when the platforms are at the same height, are abutting, and walk-through stirrups specifically designed for this purpose are used.

(q) Multi-point adjustable suspension scaffolds, stonesetters' multi-point adjustable suspension scaffolds, and masons' multi-point adjustable suspension scaffolds.

(1) When two or more scaffolds are used they shall not be bridged one to another unless they are designed to be bridged, the bridge connections are articulated, and the hoists are properly sized.

(2) If bridges are not used, passage may be made from one platform to another only when the platforms are at the same height and are abutting.

(3) Scaffolds shall be suspended from metal outriggers, brackets, wire rope slings, hooks,

or means that meet equivalent criteria (e.g., strength, durability).

6.2 Canadian Regulations

Regulations that are enforced for Suspended Scaffolds in Canada, are done so through each Province (State). Each of the Provinces are required to have in place Regulations that each will enforce as their requirement for safe use of Suspended Scaffolds.

Basically they are the same as OSHA requirements, with some variances:

The guardrail height is consistent at 42 inches.

The top rail of guardrail must withstand 200 pounds.

The safety factor for the primary hoist line is 10:1.

U-bolt clamps can be used for any terminations.

Power unit certification, if obtained through CSA, only requires the motor to be CSA certified, not the complete unit.

7.0 Standard References

The following references and their content are fully considered when the Regulatory Authorities put forth their Regulations

7.1 United States

American National Standards Institute (ANSI)

A10.8-1988 Scaffolding – Safety Requirements, American National Standards Institute (ANSI)

Z 359.1-1992 Safety Requirements for Personal Fall Arrest Systems, Sub-systems and components, American Society of Mechanical Engineers (ASME)

A120.1-1996 Safety Requirements for Powered Platforms for Building Maintenance.

7.2 Canada

Canadian Standards Association

CAN/CSA – Z259.1-1995
Safety Belts and Lanyards

CAN/CSA – Z259.2.2-1998
Self-retracting Devices for Personal Fall-arrest Systems

CAN/CSA – Z259.3M-1978
Lineman's Body Belt and Lineman's Safety Strap

CAN/CSA – Z259.10-1990
Full Body Harness

CAN/CSA – Z259.11-1992
Shock Absorbers for Personal Fall-Arrest Systems

CAN/CSA – Z259.12
Connecting Hardware (draft)

CAN/CSA – Z259.??? –1999
Flexible Horizontal Lifeline Systems Standard

8.0 Codes of Safe Practice/Safety Rules for Suspended Powered Scaffold

(draft)

CAN/CSA – Z259.2.1-???
Fall Arresters, Vertical Lifelines, and Rails

CAN/CSA – Z91-M90
Safety Code for Window Cleaning Operations

CAN/CSA – Z271-M97
Safety Code for Suspended Elevating Platforms

It shall be the responsibility of all users to read and comply with the following common sense guidelines which are designed to promote safety in the erecting, dismantling and use of Suspended Powered Scaffolds. These guidelines do not purport to be all-inclusive nor to supplant or replace other additional safety and precautionary measures to cover usual or unusual conditions. If these guidelines in any way conflict with any state, local, provincial, federal or other government statute or regulation, said statute or regulation shall supersede these guidelines and it shall be the responsibility of each user to comply therewith.

1. GENERAL GUIDELINES

A. POST THESE SAFETY GUIDELINES in a conspicuous place and be sure that all persons who erect, use, locate, or dismantle suspended scaffold systems are fully aware of them and also use them in tool box safety meetings

B. FOLLOW ALL EQUIPMENT MANUFACTURERS' RECOMMENDATIONS as well as all state, local and federal codes, ordinances and regulations relating to suspended powered scaffolding.

C. SURVEY THE JOBSITE. A survey shall be made of the jobsite by a competent person for hazards such as exposed electrical wires, obstructions that could overload or tip the suspended powered scaffold when it is raised or lowered, unguarded roof edges or openings, inadequate or missing tiebacks. Those conditions should be corrected before installing or using suspended powered scaffold systems.

D. INSPECT ALL EQUIPMENT BEFORE EACH USE. Never use any equipment that is damaged or defective in any way. Mark it or tag it as damaged or defective equipment and remove it from the jobsite.

E. ERECT AND DISMANTLE SUSPENDED POWERED SCAFFOLD EQUIPMENT in accordance with design and/or manufacturer's recommendations.

F. DO NOT ERECT, DISMANTLE, OR ALTER SUSPENDED POWERED SCAFFOLD SYSTEMS unless under the supervision of a competent person.

G. DO NOT ABUSE OR MISUSE SUSPENDED POWERED SCAFFOLD EQUIPMENT. Never overload platforms or hoists.

H. ERECTED SUSPENDED POWERED SCAFFOLDS SHOULD BE CONTINUOUSLY INSPECTED by the user to ensure that they are maintained in a safe condition. Report any unsafe condition to your supervisor.

1. NEVER TAKE CHANCES! IF IN DOUBT REGARDING THE SAFETY OR USE OF SUSPENDED SCAFFOLDS, CONSULT YOUR SCAFFOLD SUPPLIER.

J. NEVER USE SUSPENDED SCAFFOLD EQUIPMENT FOR PURPOSES OR IN WAYS FOR WHICH IT WAS NOT INTENDED.

K. CARE SHOULD BE TAKEN WHEN OPERATING AND STORING EQUIPMENT DURING WINDY CONDITIONS.

L. SUSPENDED POWERED SCAFFOLD SYSTEMS should be installed and used in accordance with the manufacturer's recommended procedures. Do not alter components in the field.

M. SUSPENDED POWERED PLATFORMS MUST NEVER BE OPERATED NEAR LIVE POWER LINES unless proper precautions are taken. Consult the power service company for advice.

N. ALWAYS ATTACH FALL ARREST EQUIPMENT when working on suspended powered scaffolds.

O. DO NOT WORK ON OR INSTALL SUSPENDED POWERED SCAFFOLDS if your physical condition is such that you feel dizzy or unsteady in any way.

R. DO NOT WORK ON SUSPENDED POWERED SCAFFOLDS when under the influence of alcohol or illegal drugs.

11. GUIDELINES FOR ERECTION AND USE OF SUSPENDED SCAFFOLD SYSTEMS

A. RIGGING:

1. WEAR FALL PREVENTION EQUIPMENT when rigging on exposed roofs or floors.

2. ROOF HOOKS, PARAPET CLAMPS, OUTRIGGER BEAMS, OR OTHER SUPPORTING DEVICES must be capable of supporting the hoist machine rated load with a factor of safety of 4.

3. VERIFY THAT THE BUILDING OR STRUCTURE WILL SUPPORT the suspended loads with a factor of safety of 4.

4. ALL OVERHEAD RIGGING must be secured from movement in any direction.

5. COUNTERWEIGHTS USED WITH OUTRIGGER BEAMS must be of a non-flowable material and must be secured to the beam to prevent accidental displacement.

6. OUTRIGGER BEAMS THAT DO NOT USE COUNTERWEIGHTS must be installed and secured on the roof structure with devices specifically designed for that purpose. Direct connections shall be evaluated by a competent person.

7. TIE BACK ALL TRANSPORTABLE RIGGING DEVICES. Tiebacks shall be equivalent in strength to suspension ropes.

8. INSTALL TIEBACKS AT RIGHT ANGLES TO THE FACE OF THE BUILDING and secure, without slack, to a structurally sound portion of the structure, capable of supporting the hoisting machine rated load with a safety factor of 4.

IN THE EVENT TIEBACKS CANNOT BE INSTALLED AT RIGHT ANGLES, two tiebacks at opposing angles must be used to prevent movement.

9. RIG AND USE HOISTING MACHINES DIRECTLY UNDER THEIR SUSPENSION POINTS.

B. WIRE ROPE AND HARDWARE:

1. USE ONLY WIRE ROPE AND ATTACHMENTS as specified by the hoisting machine manufacturer.

2. ASSURE THAT WIRE ROPE IS LONG ENOUGH to reach to the lowest possible landing.

3. CLEAN AND LUBRICATE WIRE ROPE in accordance with the wire rope manufacturer's instructions.

4. HANDLE WIRE ROPE WITH CARE.

5. COIL AND UNCOIL WIRE ROPE in accordance with the wire rope manufacturer's instructions in order to avoid kinks or damage.

6. TIGHTEN WIRE ROPE CLAMPS in accordance with the clamp manufacturer's instructions.

7. DO NOT USE WIRE ROPE THAT IS KINKED, BIRDCAGED, CORRODED, UNDERSIZED, OR DAMAGED IN ANY WAY. Do not expose wire rope to fire, undue heat, corrosive atmosphere, electricity, chemicals, or damage by tool handling.

8. USE THIMBLES AND SHACKLES AT ALL WIRE ROPE SUSPENSION TERMINATIONS.

9. USE J-TYPE CLAMPS OR SWEDGE FITTINGS. Do not use U-bolts. Retighten J Clamps under load and retighten daily.

10.WIRE ROPES USED WITH TRACTION HOISTS MUST HAVE PREPARED ENDS. Follow manufacturer's recommendations.

C. POWER SUPPLY:

1. GROUND ALL ELECTRICAL POWER SOURCES AND POWER CORD CONNECTIONS and protect them with circuit breakers.

2. USE POWER CORDS OF THE PROPER WIRE SIZE THAT ARE LONG ENOUGH for the job.

3. POWER CORD CONNECTIONS MUST BE RESTRAINED to prevent their separation.

4. USE STRAIN RELIEF DEVICES TO ATTACH POWER CORDS TO THE SUSPENDED SCAFFOLD to prevent them from falling.

5. PROTECT POWER CORDS AT SHARP EDGES.

6. USE GFI WITH POWER TOOLS.

D. FALL ARREST EQUIPMENT:

1. EACH PERSON ON A SUSPENDED POWERED SCAFFOLD must be attached to a separate fall arrest system unless the installation was specifically designed not to require one.

2. EACH LIFELINE MUST BE FASTENED to a separate anchorage capable of holding a minimum of 5000 pounds.

3. DO NOT WRAP LIFELINES AROUND STRUCTURAL MEMBERS unless lifelines are protected and a suitable anchorage connection is used.

4. PROTECT LIFELINES AT SHARP CORNERS to prevent chafing.

5. RIG FALL ARREST SYSTEMS to prevent free fall in excess of six feet.

6. SUSPEND LIFELINES FREELY without contact with structural members or building facade.

7. USE LIFELINES OF SIZE AND CONSTRUCTION that are compatible with the rope grab used.

8. ASSURE A PROPERLY ATTACHED ROPE GRAB IS INSTALLED ON EACH LIFELINE. Install in accordance with the manufacturer's recommendations.

9. KEEP FALL ARREST DEVICE POSITIONED ABOVE YOUR HEAD LEVEL.

10. USE ONLY FULL BODY HARNESSES of the proper size and that are tightly fastened.

11. ASSURE FULL BODY HARNESS HAS LANYARD attachment with D-ring at the center of your back.

12. CONSULT FALL PROTECTION SUPPLIER FOR INSPECTION PROCEDURE. INSPECT FALL PROTECTION ANCHORAGE/EQUIPMENT BEFORE EACH USE.

13. WHEN A SECONDARY WIRE ROPE SYSTEM IS USED, a horizontal lifeline secured to two or more structural members of the scaffold may be used in lieu of vertical lifelines.

E. DURING USE:

1. USE ALL EQUIPMENT AND ALL DEVICES in accordance with the manufacturer's instructions.

2. DO NOT OVERLOAD, MODIFY, OR SUBSTITUTE EQUIPMENT.

3. BEFORE COMMENCING WORK OPERATIONS preload wire rope and equipment with the maximum working load, then retighten wire rope rigging clamps and recheck rigging to manufacturer's recommendations.

4. INSPECT ALL RIGGING EQUIPMENT AND SUSPENDED POWER SCAFFOLD SYSTEMS DAILY.

5. INSPECT WIRE ROPE DURING EACH ASCENT OR DESCENT FOR DAMAGE.

6. USE CARE TO PREVENT DAMAGE TO EQUIPMENT by corrosive or other damaging substances.

7. CLEAN AND SERVICE EQUIPMENT REGULARLY.

8. ALWAYS MAINTAIN AT LEAST (4) FOUR WRAPS OF WIRE ROPE ON DRUM TYPE HOISTS.

9. DO NOT JOIN PLATFORMS unless the installation was designed for that purpose.

10. 0NLY MOVE SUSPENDED SCAFFOLDS HORIZONTALLY WHEN NOT OCCUPIED.

11.WHEN RIGGING FOR ANOTHER DROP assure sufficient wire rope is available before moving the suspended scaffold system horizontally.

12. WHEN WELDING FROM SUSPENDED POWERED SCAFFOLDS:

a. Assure platform is grounded to structure.

b. Insulate wire rope above and below the platform.

c. Insulate wire rope at suspension point and assure wire rope does not contact structure along its entire length.

d. Prevent the bitter end from touching the ground.

CHAPTER 13

PUTTING
IT
ALL TOGETHER

Contents

Chapter 13: Putting It All Together

1.0 Chapter Reviews

In this Chapter of the Suspended Scaffold Training Program, it will be helpful for us to review the content of each Chapter in order to bring it all together. By now, you will have seen that there are many details to be aware of in operating the equipment safely and productively.

The intent of this Course is to ensure that workers will not fall, so each of the Chapters could start with "Hook Up Before You Get On To The Equipment." This must be the number one safety message for this program.

Before we summarize this program, let us do a review of the message we received from each of the foregoing Chapters.

Chapter 1 - Basic Systems

This Chapter spells out the Basic Systems necessary for a complete Suspended Scaffold or Swing Stage. These include the Support System, Suspended System and finally, the Safety System. Each of these Systems must be all-inclusive to ensure that all the components are correctly selected to suit the job to be done.

The Support System at the upper level must be complete and safely rigged with all the correct components to be sure that everything suspended from it can operate with the full confidence of safe support. Most of the components at the upper level are static, don't move, and are safely locked together and terminated.

The Suspended System is all that hangs from the Support System. The total of these components when correctly used will provide the platform necessary to support the workers to conduct their work in a productive and safe manner.

The Safety System, or could be called the Personal Protective System, includes all the components used by the individual worker, to provide a back-up safety system. Each worker must be independently outfitted and tied back at the upper level. It is mandatory that each worker hook up before entering the working platform, either at the ground or the upper level, and that it is not removed until the worker exits from the platform.

There are many different systems available in the marketplace to cope with the different work situations and the users have the opportunity to select the most capable for themselves.

Chapter 2 - Motors And Rotating Mechanical Concepts

This Chapter deals with the concepts of manual and mechanical power. A Suspended Scaffold operator should have a basic understanding of the theory as to why certain things happen when force is used to accomplish work. You have had an opportunity to consider the manual, mechanical, electrical and fluid power. Additionally, you considered the labeling of the equipment and how important it is in the identification of the critical information necessary to use the equipment correctly and safely.

Chapter 3 - Work Platforms

In order for workers to perform their work in a convenient, productive and safe manner, the platform from which to work is presented. The platform components and the reason for them were explained in enough detail to allow operators to make the correct selection for their use.

It can be said for most Chapters in this program, that for any of the mechanical components to afford the proper safety, they must be in good condition. It is up to the users of the equipment to ensure that care and proper maintenance is performed.

Chapter 4 - Cages, Chairs, Baskets and Similar Equipment

The use of cages, chairs, and similar equipment presented in Chapter 4, is different to the extent that the user of the equipment is usually working alone. This puts the responsibility with one person to select, install and determine that all necessary components are correctly used and that the complete system is safe. There may be no other person doing a check on you to confirm that everything has been done correctly.

Chapter 5 - Hoists and Accessories

The hoisting device and its proper operation will make the difference as to whether or not your company makes money on each job. The correct operation of the type of hoist you will use and the necessary maintenance of all of the parts is in the hands of the operator. All hoists are designed differently by reputable manufacturers and the responsibility for knowing their safe operation is up to you. The manufacturer’s instructions for the equipment the employer owns must be read and followed by the workers.

Each of the hoists has many accessory components, which will increase the productivity and safe operation. Their limitations and required maintenance are also up to the trained operator.

Chapter 6 - Permanent Installations

There will be buildings where equipment is required on a continuing basis for maintenance on the outside of the structure. Some buildings will have equipment designed and dedicated for that building only.

The equipment is so wide, varied and complex, that it will require additional training for graduates of this course to safely use and design.

This chapter is presented as an overview of the Permanent Installations (P.I.’s).

Chapter 7 - Suspension Rope

The link between the upper level and the working platform is the rope that is used. The rope supporting the platform is steel wire rope. The safety rope supporting the operator is synthetic. Knowing the construction of each type of rope you will use is extremely important in order to ensure it is capable of supporting either you or the equipment, in a safe manner. This link in the overall operation is directly related to your health. Close attention must be paid to this important area of concern.

Chapter 8 - Support Systems

The support method at the upper level will vary in accordance with the design of the building or structure. There are many considerations you must assess to be sure that the support system at the roof level, or wherever you may terminate, is dependable to safely support all that hangs below, including you. The support system, as with all the other systems and their components, must be constantly checked to confirm they remain dependable day after day. Continued maintenance and inspection by you is mandatory for ongoing safety.

Chapter 9 - Safety System

Mistakes made in using Suspended Scaffold are unforgiving. Many other types of working platforms at ground level may forgive you if you make an error, or leave out a critical part - but this is not so with Suspended Scaffold. With this in mind, it is mandatory by law that **each person** on a Suspended Scaffold is **independently hooked up** before entering the platform. This means that each person must have his/her own Personal Protective Equipment tied to a separate anchor point at the upper level. The safe termination at the anchor point, the lifeline, the rope grab, and the correctly designed body harness include all the components discussed in this Chapter. The continued safe use of this personal protection depends on you to ensure that it is cared for properly.

Chapter 10 - Hazards of the Workplace

The potential hazards of the Suspended Scaffold workplace are only limited by your imagination. Many are identified in this Chapter. They are all important to varying degrees. You cannot afford to have any potential hazard affect your safe operation. As has been stated before, using this type of equipment is very unforgiving. Trained operators will consider in advance about what can affect them and cause a risk to their well being.

Chapter 11 - Special Work and Special Places

There are many jobsite locations that can cause conditions over which we may have little control. They are there. However, this does not stop us from taking the proper safety precautions to eliminate the risk to ourselves. If there is a risk, you must take action to remove the hazard or provide the protection necessary to ensure that it cannot harm you. It is your life and you must protect it.

Chapter 12 - Standards, Codes, Laws and Regulations

The guidelines and their legal enforcement, are in the hands of many agencies. All of these are discussed. Users of Suspended Scaffold equipment can feel comfortable that there are organizations in existence who control the provision of safe products and their correct use. There are standards to give guidance to manufacturers in making equipment, and laws to ensure the equipment is used correctly. The user (you) still has the final responsibility for ensuring you follow the rules.

The first twelve Chapters have identified the basics for knowing the capabilities of the equipment and how to use it. From this point on, we will discuss how we are "Putting It All Together," to ensure we do use it in a responsible and safe way. These considerations will fall into the categories of "Beforehand," "During," and "Afterwards." It is important to you, as a user of Suspended Scaffold, that all of the following points are fully considered. The result of an accident can be considerable to you, your family, and your employer.

2.0 Action Considerations

2.1 Action Beforehand

Contract Received

- Be sure you know exactly what it is that you are expected to do.

Site Inspection

To provide the right equipment and do the job in a productive and safe manner, you must not assume anything about the jobsite conditions. You must visit the jobsite yourself.

- What should be noted about the building structure that will affect the way I do this job?
- What hazards or obstructions will I have to overcome?
- How will I get access to the set-up area?
- What is the carrying distance and how will I get the equipment there?
- Are all the anchors in place and are they safe? Must others be installed?
- Where is the power supply coming from? What voltage is available? What distance?
- How many drops will I have to do?
- What length stages do I need?
- Do I need any engineering assistance?
- Will there be any other tradesmen on the building at the same time and can they interfere with my work?

- Will there be any traffic problems in the area?
- Will I need any form of radio communication?
- Are there any building permits required?
- Are there any special governing regulations with which I must comply?

Selection of Equipment

- What is the nature of the work and what type of equipment will do the job best?
- What type and length of platform will I need?
- What total loads will I have to put on the platform? They must not exceed the platform capacity.
- What type of hoist do I need? Are there any environmental problems that may affect the hoist selection?
- Should I buy or rent the equipment? If I own some equipment, will it do the job safely?
- Do I know all the Manufacturer's Instructions regarding the use of the equipment I select?
- If I own the equipment, has it been inspected in order to be sure it will do the job safely?
- What type of Personal Protective Equipment do I need?

Installation

- Who will install the equipment? Will the setup be done by me or should I contract it out? Is it a responsible company?

Codes of Safe Practices

- Am I fully aware of the content of the Codes of Safe Practices for Suspended Scaffold published by the Scaffold Industry Association? (Note: A copy is included in this manual.)

Pre-operation Check-off List

- At the conclusion of this Chapter, there is a Suspended Scaffold Pre-operation Check-off List. It is designed for a very specific purpose.
- It is to be used only by persons who are training in Suspended Scaffold use.
- After the installation is complete, it is to be used to check that everything has been done before the equipment is put to work.
- The Check-off List should be used after any move to a new location and the beginning of each day.

Glossary of Terms

- There are many terms or words describing or identifying the different components or conditions to assist you throughout this program. A final summary of these is listed at the end of this manual.

2.2 Action During

For a user of Suspended Scaffold, the equipment becomes a “tool of the trade.” The user’s main function is to get the work assigned by the Contract completed as quickly as possible in a safe manner. It could become very easy to assume that the “tool” will continue to operate to everyone’s satisfaction with very little attention paid to it - not so. You may be many hundreds of feet in the air and the platform you are working on becomes extremely important.

- At the normal breaks during the day (coffee, lunch, end of the day), you should continue to check the equipment. You should not assume at any time that conditions have not changed.
- Any unusual noises should be investigated to determine their cause. Correct the fault before continuing.
- You should keep the platform level and work together with your partner as a team.
- Keep free from all obstructions when you are going up or down.
- Keep all lines free of each other.
- On long platform lengths, do not jam or bypass any controls on the equipment.
- Keep your Fall Arrest Equipment on at all times and keep the rope grab shoulder height or better in order to reduce fall distance should a fall happen.
- Keep the working platform close to the building face. Tie in where possible.
- Keep an eye on weather conditions that may get worse during your day.
- At the end of each workday, the total work platform must be stored in such a manner as to keep it safe from harm. This could be on the roof, ground, or somewhere on the building. This important consideration would be to keep any of the components from moving around. Any moving components can do damage to themselves or to the building structure.
- At the start of each day, the Pre-operation Check-off List must be used to confirm the total systems are in proper order. Weather conditions, other trades, vandals, and numerous situations may have changed your safe conditions.

2.3 Action Afterwards

Much of what you do after you have finished using the equipment on the job, will depend on whether you own it or rent it. If it is rented, you must return all systems to the supplier in an undamaged, safe, uncontaminated condition and capable of being rented again. You may be the next renter. Any equipment that is not in proper order, should be identified to the supplier.

On the other hand, if your company owns the equipment, you or someone must protect the investment and the continued safe use of the equipment. Safe storage must be a number one consideration. There must be no deterioration of the equipment while it is in storage for the next job. Everything must be stored off the ground and in a protected area. However, before storing the equipment, there are a number of things to be done:

- Mechanical equipment requires continued maintenance. Someone in your organization must have the responsibility for ensuring it is done. If your company employs a qualified mechanic who can follow the Manufacturer's Instructions, then any maintenance should be done **before** the equipment goes into storage. If no qualified mechanic is employed, the supplier can perform the maintenance for you. Your equipment should be ready for the next job before going into storage.
- All of the Support Equipment must be thoroughly checked and cleaned before storage.
- All Suspension Equipment must be inspected. All steel wire rope and synthetic rope requires close examination before it is coiled and stored. Any deteriorated components must be disposed of.
- Personal Protective Equipment is just that - personal. You must be assured that any part of this equipment is examined closely and stored in a such a manner that whenever you use it, you will feel confident that if you fall, it will save **your** life.

3.0 Conclusions

Congratulations on having completed the Suspended Scaffold Training Program. If you pass the final examination, you can feel proud of your achievement. You must not drop your guard at any time. As a worker, you have rights of protection. If there are conditions you feel are unsafe, these should be brought to the attention of your management to have corrected before you proceed.

Using Suspended Scaffold that is not safe provides "no forgiveness." It must be right.

Lastly, always **hook up** before you enter a platform at any level. You now have the knowledge - let's use it.

4.0 PRE-OPERATIONAL CHECK-OFF LIST

The use of this Check List requires proper training. Make sure that you read, understand and follow these checks. Also follow the Manufacturer's Instructions, Scaffold Industry Association's Safety Guidelines, and any ordinances that apply.

CHECK SUPPORT SYSTEMS

___________ The structure is able to support the loads.

___________ The tie-back rope is properly tied-off.

___________ The outrigger is of proper design and correctly assembled.

___________ The number of counterweights are correct for the overhang load.

___________ All beams, clamps and hooks are correctly tied back.

___________ Sockets and davits are correctly secured.

SUSPENSION UNIT

___________ All parts (rails, rungs, deck, bumper rollers, welds, connections, toe-boards/ guardrails, stanchions) of the stage/cage/chair have been checked to make sure that they are safe and will not break or come loose.

___________ The stirrups or connections and their parts have been checked and are safe.

___________ The capacity plate showing the maximum load will not be exceeded.

___________ The stage stirrups are in line with the roof supports.

HOIST COMPONENTS

___________ The manufacturer's operating instructions have been read and understood.

___________ Hoists are in proper operating condition.

___________ The wire rope has been inspected, reeved and is attached properly.

___________ The length of steel wire rope is long enough to reach the ground and is attached correctly to the roof support.

___________ After load is applied, all fittings have been checked for tightness.

___________ The electrical cable or air hose connections have been inspected and are safe. Strain relief has been provided.

___________ The power supplied is enough to operate the hoist properly.

___________ The hoist is correctly attached to the stirrup.

FALL ARREST SYSTEM

Note: No person shall enter a stage/cage/ chair unless each person has "hooked-up" in a safe manner.

___________ Each person to use the stage/cage/chair has own independent Fall Arrest System.

___________ Each life line has been totally checked for safe use and is correctly attached at an independent safe anchor point at roof level. Roof edge protection has been provided for the lifeline.

___________ Each rope grab has been checked for correct operation and installation.

___________ Each full body harness or belt has been thoroughly checked to make sure that all components are safe.

___________ Each lanyard has been thoroughly checked for safe condition. All parts are sound and correctly attached to the rope grab. The D-ring is in the center of the back.

___________ The body harness is the proper size and fits correctly and is snug to the body.

ADDITIONAL CHECKS

___________ The equipment must be kept clear of exposed electrical lines and equipment.

___________ The equipment must not be used in bad weather conditions.

___________ The total rigging must be checked each time you use or move it.

___________ Never overload the equipment.

___________ Immediately report any improper operation to your supervisor.

REMEMBER: IF IN DOUBT, ASK

ALWAYS HOOK-UP YOUR SAFETY EQUIPMENT BEFORE YOU GET ON THE PLATFORM!

Suspended Platforms Job Survey Sheet

Date:______________By: ____________

Basic Information

Customer Name:____ Tel: ________________

Address: ____

Job Name:____ Job Contract: ___________

Job Address: ____ Tel: __________________

Is User Training Required? Yes ☐ No ☐

Job Site Inspection Needed? Yes ☐ No ☐ Duration of jobl:____________________

Delivery Required (Date & Time Requirements):____

Description of Work to be Performed: ____

Number of Fall Arrest Equipment: ______________________Lifeline Length:___________________

Building Height:_____________________________________Wire Rope Length: __________________

Power Cord Length: __________________________________Power Cord Adapter: ________________

Total Weight of Platform (Live & Dead Loads): ____

Type of Suspended Equipment

	Number	Size		Number	Size
Fixed Length Platform			Modular Platform		
Work Cage			Bosun Chair		
Work Cage w/extension			Hoist (describe)		
Other					

Type of Roof Support Equipment

Outrigger Beam ____ Parapet Clamp _________________
(Overall Length & Overhang Requirements) (Size)

Outrigger Support ______________________________________ Cornice Hook __________________
(Describe) (Size)

Counterweights (50lbs ea.) ______________________________ Davits ________________________
(Number required) (Size)

Rolling Roof Dolly ___________ Is Truss Required? ______________ Moveable Sockets ___________
(Number Required)

Parapet Wall Height _________ Is it Load Bearing? ______________ Other _______________________
(Explain)

Other Information Required

Roof Conditions: ____________________________ Describe Roof Access ______________________

Building Has Useable Rigging Yes ☐ No ☐ Location of Tieback: ______________________

Erection Required Yes ☐ No ☐ Location of First Drop: ____________________

Relocate Rigging Required Yes ☐ No ☐ Special Equipment Required: ______________

Pickup Required (Date & Time) Yes ☐ No ☐ Special Arrangements:____________________

Hazards	**Yes**	**No**
Electrical Lines		
Trees		
Broken Glass		
Other (Describe)		