

WORK INSTRUCTIONS ON OCCUPATIONS & WORKPLACES

| | DESIGNATION | | | SIGNATURE |
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INDEX

| Subject | Page |
|---|----------|
| Introduction | 3 |
| Electrician | 4 |
| Electrical Safety - Basic Information | 4 |
| Welding | 6 |
| Hot Work | 7 |
| Fumes And Gases | 7 |
| What are the hazards from welding gases? | 8 |
| Personal Protective Equipment and Clothing | 9 |
| Storage and Handling of Compressed Gas Cylinders | 12 |
| Example of a standing workbench design | 14 |
| What should be known about lighting and colour? | 14 |
| Electrical Safety | 14 |
| Fire Fighter | 16 |
| Plumber | 18 |
| Painter | 19 |
| Carpenter | 19 |
| Cleaning with Compressed Air | 20 |
| Conveyors | 21 |
| Conveyors-Safety | 21 |
| Use of Portable Grinders | 22 |
| Wheel Mounting on Portable Grinders | 23 |
| Use of Bench and Pedestal Grinders | 24 |
| Bench and Pedestal Wheel Mounting | 25 |
| Handling and Storing of Bonded Abrasive Wheels | 25 |
| Handling and Operating a Fork Lift | 26 |
| Safety for Operation and Maintenance of Transmission Line | 38 |
| Safe Working Practices General | 38 |
| Tools and Equipment | 40 |
| Signs and Designations | 42 |
| Accidents and First Aid | 42 |
| Safe Working Practices-Specific Group | 42 |
| Fire Protection | 45 |
| Division of Responsibility | 47 |
| Earthing (Grounding) | 49 |
| Clearing Apparatus for Work | 51 |
| Hold Order System | 52 |
| Permits-To-Work/Test and Minimum Access Distance (MAD) | 58 |
| Placing Apparatus in Service | 50 |
| Work on Circuit Broakers | 55 60 |
| Safety Practices | 61 |
| Work in Sub-stations and Switching stations | 01 C1 |
| Work on High Voltage Cables and Conduits | 04 |
| Propagation for Work on High Voltage Apparetus Containing (Operated by Compressed Air | 00 |
| | 09 |
| | 12 |

Introduction

This section includes specific types of workplaces. It describes the risk factors in each workplace that can cause repetitive motion injuries (RMIs) and ways to reduce these risk factors. This section will be expanded to include other kinds of workplaces and hazards associated with other occupations.

Electrician

What does an electrician do?

Electricians work in commercial, industrial or residential settings. Some of their main duties are to:

- Install, repair and maintain electrical systems
- Conform to building codes and other regulations
- Read, prepare or interpret blueprints and drawings
- Prepare cost estimates and documentation for clients
- Use, clean and maintain various equipment
- Supervise apprentices or other workers

What are some health and safety issues for electricians?

Electricians work in a variety of settings and may be exposed to several hazards, including:

- Lead, solvents, solder, and other materials
- Risk of fatal electrical shock
- Risk of electrical burns
- Working in confined spaces
- Welding hazards, including UV radiation
- Extreme temperatures
- Risk of pain or injury from awkward positions, repetitive manual tasks, or lifting heavy objects
- Moulds, fungi and bacteria
- Risk of infection from bird or rodent droppings
- Working at heights
- Risk of eye injury from flying particles
- Slips, trips and falls
- Working with various hand tools, power tools and equipment
- Stress

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- Shift work or extended work days
- Possible exposure to asbestos

What are some preventive measures for electricians?

- Keep tools and equipment in good working order.
- Use appropriate personal protective equipment for the task, including footwear.
- Keep work areas clear of clutter and equipment.
- Avoid awkward positions, and repetitive tasks, or take frequent breaks.
- Learn safe lifting techniques.
- Follow a recommended shift work pattern, and know the associated hazards.

What are some good general safe work practices?

- Follow correct procedures for:
 - Electrical safety
 - Lock-out/tag-out
 - Confined spaces entry
 - Working at heights
 - Lifting
 - Working with hand tools, and power tools
- Use, maintain and store personal protective equipment according to manufacturer's recommendations.
- Learn about chemical hazards, WHMIS and MSDSs.
- Know how to report a hazard
- Follow good housekeeping procedures.
- Follow company safety rules.

Electrical Safety - Basic Information

Why is it so important to work safely with or near electricity?

The electrical current in regular businesses and homes has enough power to cause death by electrocution. Even changing a light bulb without unplugging the lamp can be hazardous because coming in contact with the "hot" or live part of the socket could kill a person.

What kinds of injuries result from electrical currents?

There are four main types of injuries: electrocution (fatal), electric shock, burns, and falls. These injuries can happen in various ways:

- direct contact with the electrical energy.
- when the electricity arcs (jumps) through a gas (such as air) to a person who is grounded (that would provide an alternative route to the ground for the electricity).

- thermal burns including flash burns from heat generated by an electric arc, and flame burns from materials that catch on fire from heating or ignition by electrical currents. High voltage contact burns can burn internal tissues while leaving only very small injuries on the outside of the skin.
- muscle contractions, or a startle reaction, can cause a person to fall from a ladder, scaffold or aerial bucket. The fall can cause serious injuries.

What are some general safety tips for working with or near electricity?

- Inspect tools, power cords, and electrical fittings for damage or wear prior to each use. Repair or replace damaged equipment immediately.
- Always tape cords to walls or floors when necessary. Nails and staples can damage cords causing fire and shock hazards.
- Use cords or equipment that is rated for the level of amperage or wattage that you are using.
- Always use the correct size fuse. Replacing a fuse with one of a larger size can cause excessive currents in the wiring and possibly start a fire.
- Be aware that unusually warm or hot outlets may be a sign that unsafe wiring conditions exists. Unplug any cords to these outlets and do not use until a qualified electrician has checked the wiring.
- Always use ladders made of wood or other non-conductive materials when working with or near electricity or power lines.
- Place halogen lights away from combustible materials such as cloths or curtains. Halogen lamps can become very hot and may be a fire hazard.
- Risk of electric shock is greater in areas that are wet or damp. Install **Ground Fault Circuit** Interrupters (GFCIs) as they will interrupt the electrical circuit before a current sufficient to cause death or serious injury occurs.
- Make sure that exposed receptacle boxes are made of non-conductive materials.
- Know where the breakers and boxes are located in case of an emergency.
- Label all circuit breakers and fuse boxes clearly. Each switch should be positively identified as to which outlet or appliance it is for.
- Do not use outlets or cords that have exposed wiring.
- Do not use power tools with the guards removed.
- Do not block access to circuit breakers or fuse boxes.
- Do not touch a person or electrical apparatus in the event of an electrical accident. Always disconnect the current first.

What are some tips for working with power tools?

- Switch tools OFF before connecting them to a power supply.
- Disconnect power supply before making adjustments.
- Ensure tools are properly grounded or double-insulated. The grounded tool must have an approved 3-wire cord with a 3-prong plug. This plug should be plugged in a properly grounded 3-pole outlet.
- Test all tools for effective grounding with a continuity tester or a ground fault circuit interrupter (GFCI) before use.
- Do not bypass the switch and operate the tools by connecting and disconnecting the power cord.
- Do not use electrical tools in wet conditions or damp locations unless tool is connected to a GFCI.
- Do not clean tools with flammable or toxic solvents.
- Do not operate tools in an area containing explosive vapours or gases.

What are some tips for working with power cords?

- Keep power cords clear of tools during use.
- Suspend power cords over aisles or work areas to eliminate stumbling or tripping hazards.
- Replace open front plugs with dead front plugs. Dead front plugs are sealed and present less danger of shock or short circuit.
- Do not use light duty power cords.
- Do not carry electrical tools by the power cord.
- Do not tie power cords in tight knots. Knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.

What is a Ground Fault Circuit Interrupter (GFCI)?

A Ground Fault Circuit Interrupter (GFCI) works by detecting any loss of electrical current in a circuit. When a loss is detected, the GFCI turns the electricity off before severe injuries or electrocution can occur. A

painful shock may occur during the time that it takes for the GFCI to cut off the electricity so it is important to use the GFCI as an extra protective measure rather than a replacement for safe work practices.

GFCI wall outlets can be installed in place of standard outlets to protect against electrocution for just that outlet, or a series of outlets in the same branch. A GFCI Circuit Breaker can be installed on some circuit breaker electrical panels to protect an entire branch circuit. Plug-in GFCIs can be plugged into wall outlets where appliances will be used.

When and how do I test the Ground Fault Circuit Interupter (GFCI)?

Test the GFCI monthly. First plug a "night light" or lamp into the GFCI-protected wall outlet (the light should be turned on), then press the "TEST" button on the GFCI. If the GFCI is working properly, the light should go out. If not, have the GFCI repaired or replaced. Reset the GFCI to restore power.

If the "RESET" button pops out but the light does not go out, the GFCI has been improperly wired and does not offer shock protection at that wall outlet. Contact a qualified electrician to correct any wiring errors.

What is a sample checklist for basic electrical safety?

Inspect Cords and Plugs

• Check power cords and plugs daily. Discard if worn or damaged. Have any cord that feels more than comfortably warm checked by an electrician.

Eliminate Octopus Connections

- Do not plug several power cords into one outlet.
- Pull the plug, not the cord.
- Do not disconnect power supply by pulling or jerking the cord from the outlet. Pulling the cord causes wear and may cause a shock.

Never Break OFF the Third Prong on a Plug

• Replace broken 3-prong plugs and make sure the third prong is properly grounded.

Never Use Extension Cords as Permanent Wiring

- Use extension cords only to temporarily supply power to an area that does not have a power outlet.
- Keep power cords away from heat, water and oil. They can damage the insulation and cause a shock.
- Do not allow vehicles to pass over unprotected power cords. Cords should be put in conduit or protected by placing planks alongside them.

Welding

Overview of Types and Hazards

What is welding?

Welding is a joining process in which metals, or sometimes plastics, are heated, melted and mixed to produce a joint with properties similar to those of the materials being joined.

- Metals can also be cut or separated by a flame or an electric arc, or removed by "gouging" with an
 electric arc.
- Brazing is the joining of metals with a filler metal having a melting point above 450°C (842°F), but below the melting point of base metals.
- Soldering is the joining of metals using a filler metal with a melting point below 450°C (842°F). The joined metals can be different metals. The "filler"metals commonly used are lead-tin alloys.
- The heat in welding may come from a flame, an electric arc, friction or pressure.

Is there more than one type of welding process?

There are over 70 different welding processes. The most common of which are:

- Shielded Metal Arc Welding (SMAW), also known as Manual Metal Arc Welding, MMAW.
- Gas Tungsten Arc Welding (GTAW) or Tungsten Inert Gas (TIG) Welding.
- Flux Cored Arc Welding (FCAW).
- Gas Metal Arc Welding (GMAW), also known as Metal Inert Gas (MIG) Welding or hard wire welding.
- Plasma Arc Welding (PAW), Plasma Arc Cutting (PAC) and Gouging
- Submerged Arc Welding (SAW)
- Resistance Welding (RW) or spot welding.
- Air Carbon Arc Cutting and Gouging
- Oxyfuel Welding, Cutting and Heating (oxygen-acetylene [oxyacetylene] or oxygen-propane [oxypropane] mixtures are the most common fuel mixtures used).

What, in general, are the hazards associated with welding?

| | WELDING PROCESS | | | | |
|--------------------------|---|------------------------------|----------------|---------|--|
| HAZARD | PAW/PAC Air Carbon Arc Processes | SMAW GTAW GMAW FCAW | SAW | Oxyfuel | |
| Ergonomic | 1 | ~ | ~ | ~ | |
| Electric Shock | ~ | ~ | ~ | × | |
| Bright light | ~ | ~ | (\checkmark) | ~ | |
| Ultraviolet radiation | 1 | ~ | (∕) | × | |
| Toxic fumes and gases | 1 | ~ | (√) | ~ | |
| Heat, fire and burns | 1 | ~ | ~ | 1 | |
| Noise | ~ | × | × | × | |

✗ indicates no hazards, ✓ indicates hazard present, (✓) indicates hazard present if SAW flux is absent.

Hot Work

Why should I get a "Hot Work Permit"?

Working with ignition sources near flammable materials is referred to as "hot work." Welding and cutting are examples of hot work. Fires often are the result of the "quick five minute" job in areas not intended for welding or cutting. Hot work procedures include getting a hot work permit as one of the steps taken to ensure a fire is not started by welding or cutting in areas where there are flammable or combustible materials.

The National Fire Protection Association (NFPA) Standard 51B "Fire Prevention in the Use of Cutting and Welding Processes" serves as the basis for the fire codes and many fire prevention practices adopted by industry.

What are some precautions to take when working near combustible materials?

- Make sure that all equipment is in good operating order before work starts.
- Inspect the work area thoroughly before starting. Look for combustible materials in structures (partitions, walls, ceilings).
- Sweep clean any combustible materials on floors around the work zone. Combustible floors must be kept wet with water or covered with fire resistant blankets or damp sand.
- Use water only if electrical circuits have been de-energized to prevent electrical shock.
- Move all combustible materials away from the work area.
- If combustibles cannot be moved, cover them with fire resistant blankets or shields. Protect gas lines and equipment from falling sparks, hot materials and objects.
- Block off cracks between floorboards, along baseboards and walls, and under door openings, with a fire resistant material. Close doors and windows.
- Cover wall or ceiling surfaces with a fire resistant and heat insulating material to prevent ignition and accumulation of heat.
- Inspect the area following work to ensure that wall surfaces, studs, wires or dirt have not heated up.
- Vacuum away combustible debris from inside ventilation or other service duct openings to prevent ignition. Prevent sparks from entering into the duct work. Cover duct openings with a fire resistant barrier and inspect the ducts after work has concluded.
- Post a trained fire watcher within the work area during welding and for at least 30 minutes after work has stopped.
- Comply with the required legislation and standards applicable to your workplace.

Fumes And Gases

What are welding fumes?

Welding fumes are a complex mixture of metallic oxides, silicates and fluorides. Fumes are formed when a metal is heated above its boiling point and its vapours condense into very fine, particles (solid particulates).

Can the composition of welding fumes vary?

Yes, welding fumes contain oxides of the metals in the material being welded.

- Fluxes containing silica or fluoride produce amorphous silica, metallic silicates and fluoride fumes.
- Fumes from mild steel welding contain mostly iron with small amounts of additive metals (chromium, nickel, manganese, molybdenum, vanadium, titanium, cobalt, copper etc.).
- Stainless steels have larger amounts of chromium or nickel in the fume and lesser amounts of iron.
- Nickel alloys have much more nickel in the fume and very little iron.

How do coatings change the composition of welding fumes?

Vapours or fumes can come from coatings and residues on metal being welded. Some ingredients in coatings can have toxic effects. These ingredients include:

- Metal working fluids, oils and rust inhibitors.
- Zinc on galvanized steel (vaporizes to produce zinc oxide fume)
- Cadmium plating
- Vapours from paints and solvents
- Lead oxide primer paints
- Some plastic coatings

Metal Coatings - A Source of Hazardous Fumes



How do I remove the coatings?

- Remove coatings from the weld area to minimize the fume. The removal of coating will also improve weld quality.
- Use stripping products to remove coatings. Make sure to remove any residues before welding.
- Use wet slurry vacuum removal techniques for removing very toxic coatings.
- Do not grind coatings. Grinding dust may be toxic.

What are welding gases?

Welding gases are gases used or produced during welding and cutting processes like shielding gases or gases produced by the decomposition of fluxes or from the interaction of ultraviolet light or high temperatures with gases or vapours in the air.

What are examples of welding gases?

Gases used in welding and cutting processes include:

- shielding gases such as carbon dioxide, argon, helium, etc.
- fuel gases such as acetylene, propane, butane, etc.
- oxygen, used with fuel gases and also in small amounts in some shielding gas mixtures

Gases produced from welding and cutting processes include:

- carbon dioxide from the decomposition of fluxes
- carbon monoxide from the breakdown of carbon dioxide shielding gas in arc welding
- ozone from the interaction of electric arc with atmospheric oxygen
- nitrogen oxides from the heating of atmospheric oxygen and nitrogen
- hydrogen chloride and phosgene produced by the reaction between ultraviolet light and the vapours from chlorinated hydrocarbon degreasing solvents (e.g., trichloroethylene, TCE).

Gases are also produced from the thermal breakdown of coatings:

- Polyurethane coatings can produce hydrogen cyanide, formaldehyde, carbon dioxide, carbon monoxide, oxides of nitrogen, and isocyanate vapours.
- Epoxy coatings can produce carbon dioxide and carbon monoxide.
- Vinyl paints can produce hydrogen chloride.
- Phosphate rust-inhibiting paints can release phosphine during welding processes.
- Minimizing exposure to degreasing solvent vapours.

What are the hazards from welding gases?

Hazards from gases include:

- asphyxiation (lack of oxygen).
- fire or explosion.
- toxicity.

How can I prevent exposure to welding gases?

It is important to follow manufacturer's instructions, MSDSs, and safety protocols to minimize the hazards of welding gases.

- Use substitute materials such as water-based cleaners or high flash point solvents.
- Cover the degreaser baths or containers.
- Do not weld on surfaces that are still wet with a degreasing solvent.
- Do not weld near degreasing baths.
- Do not use chlorinated hydrocarbon degreasers.
- Have adequate ventilation in a workplace to prevent the displacement or enrichment of oxygen and to prevent the accumulation of flammable atmospheres.

Personal Protective Equipment and Clothing

Why is eye protection important?

Eye injury can occur from the intense light and radiation from a welding arc and from hot slag that can fly off from the weld during cooling, chipping or grinding.

- Protect your eyes from welding light by wearing a welder's helmet fitted with a filter shade that is suitable for the type of welding you are doing.
- ALWAYS wear safety glasses with side shields or goggles when chipping or grinding a work piece if you are not wearing a welding helmet.

What are the various components of eye protection for welders?

Eye protection is provided in an assembly of components:

- Helmet shell must be opaque to light and resistant to impact, heat and electricity.
- Outer cover plate made of polycarbonate plastic which protects from UV radiation, impact and scratches.
- Filter lens made of glass containing a filler which reduces the amount of light passing through to the eyes. Filters are available in different shade numbers ranging from 2 to 14. The higher the number, the darker the filter and the less light passes through the lens.
- Clear retainer lens made of plastic prevents any broken pieces of the filter lens from reaching the eye.
- Gasket made of heat insulating material between the cover lens and the filter lens protects the lens from sudden heat changes which could cause it to break. In some models the heat insulation is provided by the frame mount instead of a separate gasket.



What else should you know about eye protection?

- Choose a tight fitting helmet to help reduce light reflection into the helmet through the space between the shell and the head.
- Wear the helmet correctly. Do not use it as a hand shield.
- Protect the shade lens from impact and sudden temperature changes that could cause it to crack.
- Use a cover lens to protect the filter shade lens. Replace the cover lens if it gets scratched or hazy.
- Make sure to replace the gasket periodically if your helmet uses one.
- Replace the clear retaining lens to protect your eyes from broken pieces.
- Clean lenses periodically.
- Discard pitted or damaged lenses.

What should you know about filter shade selection?

For Arc welding, the correct filter shade is selected according to the welding process, wire diameter, and operating current. The table below gives the correct shade numbers for different situations.

ALWAYS use suggested shade numbers instead of minimum shades.

Shade Numbers for Arc Processes (from CSA W117.2)

| Process | Electrode Diameter (mm) | Current (Amperes) | Minimum Shade | Suggested Shade |
|---|-------------------------------|----------------------|------------------|--------------------|
| | < 2.5 | < 60 | 7 | - |
| SMAW | 2.5 - 4 | 60 - 160 | 8 | 10 |
| SMAW | 4 - 6.4 | 160 -250 | 10 | 12 |
| | > 6.4 | 250 - 550 | 11 | 14 |
| GMAW | | < 60 | 7 | - |
| and | | 60 -160 | 10 | 11 |
| ECAW | | 160 -250 | 10 | 12 |
| | | 250 -500 | 10 | 14 |
| Air Carbon Arc Cutting light heavy | | < 500 500 -1000 | 10 11 | 12 14 |

*In the United States use ANSI/AWS Standard F2.2 for selecting filter lens shades.

- Provide additional task lighting that suits welders' needs.
- Use the same shade as the welder's if you are directly observing the welding arc.
- Do not use gas-welding goggles for arc welding.
- Do not substitute modified glasses, sunglasses, smoked plastic or other materials for proper welding lenses.

For gas cutting, welding and brazing, the intensity of the light is much less than from arc welding. Lighter shade filter lenses are used with goggles in place of a helmet.



The correct shade numbers for oxyfuel cutting are shown in the table below.

| Process | Plate Thickness (in mm) | Minimum Shade # | Suggested Shade # |
|---------|----------------------------|-----------------|----------------------|
| Light | < 25 | 3 | 4 |
| Medium | 25 - 150 | 4 | 5 |
| Heavy | > 150 | 5 | 6 |

* In the US use ANSI/AWS Standard F2.2 for selecting filter lens shade.

Can you wear contact lenses when welding?

Dust particles or chemicals that can irritate the eyes may be present in many welding areas. Wearing contact lenses may not be advisable in such workplaces.

Reports of contact lenses being "welded" to the cornea (or lens of the eye) as a result of exposure to an arc flash have been proven to be incorrect. It is impossible for contact lenses to become "welded" to the cornea.

All workers in proximity to welding procedures must wear appropriate eye protection whether they are using contact lenses or not.

What measures can you use for skin protection from welding radiation?

- Wear tightly woven work-weight fabrics to keep UV radiation from reaching your skin.
- Button up your shirt to protect the skin on the throat and neck.
- Wear long sleeves and pant legs.
- Cover your head with a fabric cap to protect the scalp from UV radiation.
- Protect the back of your head by using a hood.
- Protect your face from UV radiation by wearing a tight-fitting, opaque welder's helmet.
- Make sure that all fabric garments are resistant to spark, heat and flame. Keep the fabrics clean and free of combustible materials that could be ignited by a spark.

What should you know about using respirators when welding?

Respiratory protection is needed when ventilation is not sufficient to remove welding fumes or when there is risk of oxygen deficiency.

Select and use respirators in compliance with your workplace regulation.

Seek expert advice and initiate a proper respiratory protection program.

What are some tips to know when using protective clothing?

- DO
 - Wear clothing made from heavyweight, tightly woven, 100% wool or cotton to protect from UV radiation, hot metal, sparks and open flames. Flame retardant treatments become less effective with repeated laundering.
 - Keep clothing clean and free of oils, greases and combustible contaminants.
 - Wear long-sleeved shirts with buttoned cuffs and a collar to protect the neck. Dark colours prevent light reflection.
 - Tape shirt pockets closed to avoid collecting sparks or hot metal or keep them covered with flaps.
 - Pant legs must not have cuffs and must cover the tops of the boots. Cuffs can collect sparks.
 - Repair all frayed edges, tears or holes in clothing.
 - Wear high top boots fully laced to prevent sparks from entering into the boots.
 - Use fire-resistant boot protectors or spats strapped around the pant legs and boot tops, to prevent sparks from bouncing in the top of the boots.
 - Remove all ignition sources such as matches and butane lighters from pockets. Hot welding sparks may light the matches or ignite leaking lighter fuel.
 - Wear gauntlet-type cuff leather gloves or protective sleeves of similar material, to protect wrists and forearms. Leather is a good electrical insulator if kept dry.
 - Direct any spark spray away from your clothing.
 - Wear leather aprons to protect your chest and lap from sparks when standing or sitting.
 - Wear layers of clothing. To prevent sweating, avoid overdressing in cold weather. Sweaty clothes
 cause rapid heat loss. Leather welding jackets are not very breathable and can make you sweat if
 you are overdressed.
 - Wear a fire-resistant skull cap or balaclava hood under your helmet to protect your head from burns and UV radiation.
 - Wear a welder's face shield to protect your face from UV radiation and flying particles.



DO NOT

- Do not wear rings or other jewellery.
- Do not wear clothing made from synthetic or synthetic blends. The synthetic fabric can burn vigorously, melt and produce bad skin burns.

Storage and Handling of Compressed Gas Cylinders

What should be done when storing compressed gas cylinders?

DO

- Check your fire code for guidelines regarding the storage of flammable gas cylinders.
- Store cylinders in a clearly identified, dry, well-ventilated storage area away from doorways, aisles, elevators, and stairs.
- Post "no smoking" signs in the area.
- Store cylinders in the upright position and secure with an insulated chain or non-conductive belt.
- Secure the protective caps.
- Ensure that the area is well ventilated. With outside storage, place on a fireproof surface and enclose in a tamper-proof enclosure.
- Protect cylinders from contact with ground, ice, snow, water, salt, corrosion, and high temperatures.
- Store oxygen and fuel gases separately. Indoors, separate oxygen from fuel gas cylinders by at least 6 metres (20 feet), by a wall at least 1.5 m (5 ft) high, or rated for 1.5 hour fire resistance.



What should be avoided in doing?

- Do not use a cylinder as an electrical ground connection.
- Do not fasten cylinders to a work table or to structures where they could become part of an electrical circuit.
- Do not strike an arc on a cylinder.
- Do not use a flame or boiling water to thaw a frozen valve. Valves or cylinders may contain fusible plugs which can melt at temperatures below the boiling point of water.

What should be done with empty or out of service cylinders?

- Mark or label them as "Empty cylinder" and store empty cylinders away from full cylinders.
- Return empties to the supplier.
- Remove regulators when not in use and store these away from grease and oil. Put protective caps on the fittings when in storage.
- Keep cylinders and fittings from becoming contaminated with oil, grease or dust.
- Do not use a cylinder that is not identified or if the label is not legible. The colours of industrial gas cylinders are not standardized.

How the cylinders should be moved?

- Remove the regulator and replace the valve protection cap before moving a cylinder.
- Move cylinders with appropriate trolleys. Use proper lifting cradles.
- Call the supplier to remove leaky cylinders immediately.

DO NOT

- Do not lift a cylinder by the valve cap. Never sling with ropes or chains or lift with electromagnets.
- Do not drag, slide, or drop cylinders. They can be rolled for short distances on their base.
- Never place cylinders on their sides as rollers to move equipment.
- Do not lay acetylene cylinders on their sides. If an acetylene tank has accidentally been left on its side, set it upright for at least one hour before it is used.
- Do not try to refill a cylinder or mix gases in a cylinder.



Cylinder Trolleys

When "crack" the cylinder should be done?

Before attaching the regulator, "crack" a secured cylinder by opening the valve slightly then closing it immediately to blow out dust or dirt from the valve outlet. Use two hands on the valve and stand at the side of the valve - never stand directly in front of or behind the valve outlet.

Do not crack fuel gases near ignition sources. Never crack hydrogen cylinders since the release of compressed hydrogen may ignite by itself.

What are some tips for a good working posture while welding?

- Learn to recognize symptoms of work-related musculoskeletal disorders (WMSDs; also called repetitive strain injuries or RSIs). Repeated uncomfortable postures and tasks can cause injury.
- Avoid awkward body positions which cause fatigue, reduce concentration and lead to poor welds which may need to be repeated.
- Always use your hand to lower your helmet. Do not use a "jerking" motion of your neck and head.
- Position yourself in a stable, comfortable posture.
- Position the welding item as flat as possible, on a horizontal surface, between waist and elbow height.
- Position scaffolding at a comfortable height to allow working in a seated position.
- Avoid working in one position for long periods of time.
- Work with material slightly below elbow level when working in a sitting position.
- Work with material between waist and elbow heights for comfort and precision when working in a standing position.
- Use a footrest if standing for long periods.
- Always store materials and tools within normal reach.
- Use positioning aids to accommodate work posture.





Turntable

Scissor Lift

Example of a standing workbench design

Standing Workbench Design



Seated Workbench Designs



What should be known before lifting cylinders manually?

- Find out the weight of an object before attempting to lift it. Do a few warm up stretches before lifting.
- Use a lifting aid if the object is heavy.
- Get help with heavy or awkward loads if a lifting aid is not available.
- Protect hands and feet in case the load falls.
- Use a trolley or a mechanical lift to lift or move compressed gas cylinders.
- Place forward foot around the cylinder if it must be lifted manually.
- Lower the cylinder across thigh by pressing down with rear hand while holding cylinder underneath and slightly beyond center point.
- Raise end to desired height.
- Push cylinder forward by rear hand.



What should be known when moving cylinders?

- Make sure the cylinder cap is secured.
- Tilt the cylinder slightly on its edge and roll it slowly in the direction desired. Move short distances only.
- Use a cylinder trolley for longer distances.
- Place one hand on top of the cap and the other hand on the shoulder of the cylinder.
- Always chain the cylinder to the trolley.

What should be known about lighting and colour?

Lighting

- Ensure general lighting is adequate to allow safe access and handling of equipment.
- Use additional task lighting for precision work.
- Avoid excessive glare from light sources or reflections.
- Prevent excessive contrast between the workpiece and background.

Colour

- Select matt finishes for welding area to avoid reflection of welding arc light, and to obtain a satisfactory level of lighting.
- Choose any colour except blue or turquoise; they reflect UV light.
- Reduce distraction by making piping, ducting or structural supports the same colour as the background, unless piping requires a second colour coding.

Electrical Safety

What should be known about electrical welding?

• Follow electrical safety procedures to prevent electrical hazards.

Electricity used in welding is available as:

- single phase, 220 V
- triple phase 440 V.

Power Supplies

All power supplies must meet the guidelines set by your local electrical utility or other appropriate body.

What are common electrical hazards?

Electric Shock

The human body conducts electricity. Even low currents may cause severe health effects. Spasms, burns, muscle paralysis, or death can result depending on the amount of the current flowing through the body, the route it takes, and the duration of exposure.

| Effects of Electrical Shock | | | | | |
|-----------------------------|-----------------|--|--|--|--|
| Effect | DC Current (mA) | | | | |
| Death | 1000 | | | | |
| Ventricular Fibrillation | 50+ | | | | |
| Paralysis of Diaphragm | 30-40 | | | | |
| Makes hands "clamp-on" | 15-20 | | | | |
| Involuntary Reflexes | 2+ | | | | |
| Perception | <1 | | | | |

Completion of Circuit through the Body

- If a person touches a live conductor, current may flow through the body to the ground and cause a shock.
- Increased electrical contact with the ground increases the risk of shock.
- Avoid standing in water, on wet surfaces, or working with wet hands or wearing sweaty garments.
- Small shocks could cause you to slip and fall, possibly from a high place.



Completion of an electric circuit through ground

What should be done in case of electric shock?

- Call for medical help.
- Do not to touch the victim with your "bare hands" until he or she is away from the live electrical source.
- Turn off the power at the fuse box or circuit breaker panel if an appliance or electrical equipment is the electrical source or, if you can do it safely, turn off the appliance or electrical equipment and unplug it. Just turning off the equipment is not sufficient.
- If the electricity cannot be turned off and the victim is still in contact with the electrical source, decide if you must move the victim or push the wire away from the victim (call for emergency help if the wire is a high voltage power line).
- Insulate yourself if you must move a victim away from a live contact wear dry gloves or cover your hands with cloth and stand on dry insulating material like cardboard, wood or clothes. Ensure you have good footing and will not slip or fall when trying to move the victim.
- Use a dry piece of wood, broom or other dry, insulating object or material to move the wire or power source away from the victim or push the victim off the live electrical source.
- Do not move the victim if there is a possibility of neck or spinal injuries (from a fall, for example) unless it is absolutely necessary.
- Give artificial respiration if the victim is not breathing.
- Give CPR if the victim's heart has stopped (only if you are trained in CPR).
- Cover burns with a sterile dressing. There may be a burn where the power source touched the victim and in the area where the electricity left the body (to ground). On the surface electrical burns may not look serious but deeper in the tissue the burn can be severe.
- Keep the victim comfortable, warm and at rest, and monitor breathing.

Fire Fighter

What should be known before reading about this occupation?

This profile summarizes the common issues and duties for fire fighters. Fire fighters may be called to any number of settings or workplaces. It is impossible to predict all of the possible hazards a fire fighter may encounter. This summary focuses on the major job duties that most fire fighters (those fighting primarily structural fires) would have in common.

What, briefly, does a fire fighter do?

Main duties of a fire fighter include:

- Respond to fire alarms, accidents (automobile, industrial, aviation, etc.), building collapses, acts of nature (tornados, floods, etc) and others.
- Rescue victims.
- Control fire using various equipment and methods (axes, water, chemical extinguishers, ladders, vehicles, boats, etc).
- Use proper techniques for first aid.
- Provide safety education to the public.

Specialized teams may be organized to respond to specific hazardous materials.

What are some health and safety hazards associated with being a fire fighter?

Hazards typically fall into one of six general categories as listed below. For more information on that issue, prevention, or how to work safely with a chemical or material, click on the links where provided throughout this document.

Biological

While helping victims of fire or accidents, fire fighters may be exposed to contagious and infectious diseases including blood borne diseases such as <u>AIDS</u>, hepatitis <u>B</u> and <u>C</u>.

Chemical

On the scene of a fire, there is exposure to various combustion products. The toxicity of the smoke depends greatly on the fuel (the materials or chemicals being burnt), the heat of the fire, and how much oxygen is available for combustion. Common combustion products include:

- carbon monoxide
- hydrogen cyanide
- nitrogen dioxide
- and many others

In addition, oxygen depletion from the air is common during fires. "Hypoxia" (the condition caused by little or no oxygen in the air) can result in a loss of physical performance, confusion and inability to escape.

Exposure to these hazards will also depend on the duties of the individual (e.g., those who enter the building during the fire versus those who clean-up after the fire has been extinguished).

Ergonomic

There are many situations where physical demands involve force, repetition, awkward postures and prolonged activities. These include:

- overexertion (reaching, carrying, etc.)
- walking or working on your feet for long periods of time
- <u>lifting</u>

Fire fighters will also work and train using heavy equipment, self-contained breathing apparatus (SCBA), and personal protective equipment which may require more effort to perform the same tasks.

Physical

<u>Heat stress</u> is common. Heat may come from various sources including the fire and surroundings, but heat is also produced by the body during work (exercise). This effect can be worsened by the properties of the protective clothing and continuous physical exertion.

Fire fighters can be exposed to excessive noise levels.

Fire fighters are also required to work outdoors a great deal of the time. As a result, they may be exposed to <u>extreme temperatures</u> (both cold and heat).

Safety

In a fire situation, there are many situations where there a risk of injury (including the fire itself, structures breaking, unstable floors, falling objects). Falls from heights are also common.

Fires can create dangerous situations such as

- sudden ignition of products creating "flashover"
- "backdraft" where air is introduced to an area that is superheated and oxygen starved

Driving to the scene may also introduce increased potential for traffic accidents due to speeds travelled and road/weather conditions.

Psychological

Fire fighters are exposed to critical events where there is often a grave or uncertain danger. Exposure to serious traumatic events (or consequence of the event) is another cause of stress. As with most emergency services, there will be long periods of quiet or routine interrupted abruptly by periods of intense stress or activity.

In addition, most firefighters work shifts or extended work days which can have health effects.

Are there any long-term health effects of being a fire fighter?

According to the International Labour Office (ILO), there have been some studies that have shown some long term health consequences from fire fighting. In other studies, similar connections could not be made. In either case, the need for working safely is extremely important.

Fire fighters may experience:

- Cancer, especially genito-urinary (including kidney, ureter and bladder) but also possibly brain cancer, and cancers of the lymphatic and hematopoietic (blood) system.
- Back injuries and other strains.
- Diseases such as AIDS and hepatitis.
- Cardiovascular disease due to a multitude of toxic substances when fighting a fire. For example, carbon monoxide exposure is directly linked with cardiac toxicity.

Under further study are:

- Chronic and lung diseases, which are thought to be in part due to the toxic gases produced during a fire, but also the level of physical activity required during intense periods of time.
- Lung cancer, which has shown a possible weak association.

(Source: Guidotti, T.L. "*Firefighting Hazards*." In Encyclopaedia of Occupational Health and Safety. 4th edition. Geneva: International Labour Office, 1998. Pages 95.4-95.9)

What are some preventative measures that can be taken?

Because of the wide variety of hazards a fire fighter may encounter, the need for extensive training and the role of experience are often the best way to prevent injury.

Other preventative measures include:

- Hand washing is extremely important for the reduction of infections.
- Learn about and use the correct "universal precautions" to prevent blood borne pathogen infection.
- Always use the correct personal protective equipment (PPE) or other barriers for the task.
- Learn safe lifting techniques.
- If a job requires work in an awkward position (e.g., with hands above shoulder level) be sure to take breaks where possible.
- Follow a recommended shift work pattern, and be aware of the hazards associated with shift work.
- Ask your workplace to establish safe procedures for working alone or develop procedures where this situation can be avoided altogether.
- Consider offering a debriefing or session after a critical event to help reduce the impact from stress.
- Stay fit from regular exercise and training. While it will help to make sure you can perform your job satisfactorily, it will also help reduce the likelihood of injuries.

What are some general safe work practices to know?

Fire fighters will need to know:

- the risks associated with blood borne diseases. (e.g., <u>AIDS</u>, hepatitis <u>B</u> and <u>C</u>)
- the correct "<u>universal precautions</u>" procedures to prevent blood borne pathogen infection
- <u>hand washing</u>
- proper selection, use, maintenance and storage of PPE, where appropriate
- selection of <u>footwear</u>
- prevention of <u>needlestick injuries</u>
- manual material handling (lifting) techniques
- information about shiftwork
- how to work alone (general information) and Working Alone Working With Patients
- working safely on ladders
- how to work safety with <u>compressed gases</u>

All workers should:

- follow company safety rules
- know about <u>WHMIS</u> and <u>MSDSs</u>
- know your <u>hazard reporting</u> procedures
- follow good housekeeping procedures.

Where can I get more information?

Because of the wide variety of situations where a fire fighter may work, and the vast range of activities done and materials encountered, all situations cannot be covered in this document.

NOTE: If you have health concerns, ask your doctor or medical professional for advice.

If you have any questions or concerns about your specific workplace, you can ask one or more of the following for help:

- your health and safety committee or representative
- your union
- your safety department
- your supervisor or manager
- check with your local library
- your local government department responsible for health and safety

Plumber

What does a plumber do?

A plumber is a person who installs, repairs and maintains plumbing fixtures or systems in businesses, industries or residences.

The main duties of a plumber are to:

- Measure, cut, shape, assemble and join various materials
- Use, clean and maintain various equipment
- Read, prepare or interpret blueprints and drawings
- Conform with building codes and other regulations
- Prepare cost estimates and documentation for clients
- Supervise apprentices or other workers

What are some health and safety issues for plumbers?

Plumbers work in a variety of settings, some of which may contain hazards. The main occupational hazards for plumbers to be aware of include:

- Potential infection from bird or rodent droppings
 - histoplasmosis
 - psittacosis
 - hantavirus
- Exposure to <u>lead</u>, adhesives, solvents, solder, sulphur dioxide, and other toxic or carcinogenic substances
- Proximity to <u>flammable or combustible</u> materials
- Working in <u>awkward positions</u>, or performing <u>awkward manual tasks</u>
- Lifting heavy or awkward objects
- Exposure to <u>extreme temperatures</u>
- Working in <u>confined spaces</u>
- Working at heights
- Risk of eye injury from flying particles
- Slips, trips and falls
- Working with various tools
- <u>Stress</u>
- <u>Shift work</u> or <u>extended work days</u>

What are some preventive measures for plumbers?

- Follow safety procedures for confined space entry, trenches and excavations.
- Use fall protection and other precautions when working at heights.
- Install and maintain good ventilation.
- Keep tools and equipment, and their safety features, in good working order.
- Use appropriate personal protective equipment for the task.
- Wear appropriate footwear.
- Keep work areas clear of clutter and equipment.
- Avoid awkward body positions and repetitive manual tasks, or take frequent breaks.
- Learn safe lifting techniques.
- Follow a recommended shift work pattern, and know the associated hazards.

What are some good general safe work practices?

- Practices safety procedures for:
 - Confined space entry
 - Working at heights
 - Working with hand tools, and power tools
 - Selection, use and maintenance of personal protective equipment
 - Selection of footwear
 - Lifting
 - Shift work
- Follow company safety rules.
- Learn about chemical hazards, WHMIS and MSDSs.

- Know how to report a hazard
- Follow good housekeeping procedures.

Painter

What does a painter do?

A painter applies paint and other decorative finishes to interior and exterior surfaces of buildings and other structures.

Some of the main duties of a painter are to:

- Prepare surfaces to be painted (includes scraping, removal of wallpaper, etc.)
- Determine what materials will be needed
- Use, clean and maintain various equipment
- Supervise apprentices or other workers
- Provide estimates and invoices for clients

What are some health and safety issues for painters?

Painters can work at a variety of workplaces, construction sites, homes, etc. and face a constantly changing set of hazards. The hazards include:

- Working at heights
- Ladders, platforms and scaffolds
- Working in confined spaces
- Risk of eye injury
- Slips, trips and falls
- Risk of injury from falling objects
- Exposure to moulds, fungi and bacteria
- Exposure to paint products, solvents, lead and other toxic substances
- Proximity to flammable or combustible materials
- Working in awkward positions, or performing repetitive physical tasks
- Standing for long periods of time
- Lifting heavy or awkward objects
- Exposure to heat and ultraviolet radiation
- Noise
- Stress
- Shift work or extended work days

What are some preventive measures for painters?

- Learn correct procedures for working at heights.
- Avoid awkward body positions or take frequent breaks.
- Learn safe lifting techniques.
- Keep tools and equipment, and their safety features, in good working order.
- Wear appropriate personal protective equipment and footwear.
- Keep work areas clear of clutter and equipment.
- Learn safety procedures for working in confined spaces.

What are some good general safe work practices?

- Practice safety procedures for:
 - Working at heights
 - Lifting
 - Repetitive physical tasks
 - Selection, use, maintenance and storage of personal protective equipment
 - Confined space entry
 - Follow company safety rules.
- Learn about chemical hazards, WHMIS and MSDSs.
- Know how to report a hazard
- Follow good housekeeping procedures.

Carpenter

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What does a carpenter do?

A carpenter builds or repairs various structures, working primarily with wood. Some of a carpenter's main duties are to:

- Measure, cut, shape, assemble and join materials.
- Read, prepare and interpret blueprints and drawings.
- Prepare cost estimates and documentation for clients.
- Conform to building codes and other regulations.
- Use, clean and maintain various equipment and tools.
- Supervise apprentices or other workers.

What are some health and safety issues for carpenters?

Carpenters face their own unique set of occupational hazards. These include the following:

- Use of various machinery and tools.
- Moulds, fungi and bacteria.
- Chemicals, solvents and other materials dermatitis, allergic reactions or respiratory problems.
- Cancer risk from wood dust.
- Flammable or combustible materials, including wood dust.
- Risk of pain or injury from working in awkward positions, performing repetitive tasks, or lifting.
- Extreme temperatures when working outdoors.
- Risk of eye injury from flying particles.
- Working at heights.
- Stress.

•

• Shift work or extended work days.

What are some preventive measures for carpenters?

- Install and maintain good ventilation.
- Keep tools and equipment in good working order.
- Clean up wood dust regularly.
- Wear appropriate eye protection, footwear, and other protective equipment for the task.
- Keep work areas clear of clutter and equipment.
- Learn safe lifting techniques.
- Avoid awkward postures or repetitive tasks, or take frequent breaks.
- Follow a recommended shift work pattern, and know the associated hazards.

What are some good general safe work practices?

- Work safely with all equipment:
 - Woodworking machines
 - Hand tools
 - Powered hand tools
- Use, maintain and store personal protective equipment as recommended by the manufacturer.
- Follow safe lifting techniques.
- Follow company safety rules.
- Learn about chemical hazards, WHMIS and MSDSs.
- Know how to report a hazard.
- Follow good housekeeping procedures.

Cleaning with Compressed Air

Is it a good idea to use compressed air to blow dirt off clothing or work surfaces?

No. Although many people know using compressed air to clean debris or clothes can be hazardous, it is still used because of old habits and the easy availability of compressed air in many workplaces. However, cleaning objects, machinery, bench tops, clothing and other things with compressed air is dangerous. Injuries can be caused by the air jet and by particles made airborne.

What are the hazards of using compressed air?

First, compressed air is extremely forceful. Depending on its pressure, compressed air can dislodge particles. These particles are a danger since they can enter your eyes or abrade skin. The possible damage would depend on the size, weight, shape, composition, and speed of the particles. There have also been reports of hearing damage caused by the pressure of compressed air and by its sound.

Second, compressed air itself is also a serious hazard. On rare occasions, some of the compressed air can enter the blood stream through a break in the skin or through a body opening. An air bubble in the blood stream is known medically as an embolism, a dangerous medical condition in which a blood vessel is blocked, in this case, by an air bubble. An embolism of an artery can cause coma, paralysis or death depending upon its size, duration and location. While air embolisms are usually associated with incorrect diving procedures, they are possible with compressed air due to high pressures. While this seems improbable, the consequences of even a small quantity of air or other gas in the blood can quickly be fatal.

Unfortunately, horseplay has been a cause of some serious workplace accidents caused by individuals not aware of the hazards of compressed air, or proper work procedures.

What should I use instead of compressed air for cleaning purposes?

A brush or a vacuum cleaner should be used instead.

How to use compressed air for cleaning, how can it be done safely?

The minimum air pressure that is still effective should be used. A "quiet" nozzle (i.e. one with low noise emission) should be selected. The nozzle pressure must remain below 30 psi (207 kPa) and personal protection equipment (PPE) must be worn to protect the worker's body, especially the eyes, against particles and dust under pressure. Air guns should also be used with some local exhaust ventilation or

facilities to control the generation of airborne particulates. When compressed air cleaning is unavoidable, hazards can be reduced by making adjustments to the air gun such as:

- chip guards that can deflect flying dust or debris,
- extension tubes that provide the worker a safer working distance, or
- air guns equipped with injection exhausts and particle collection bags.

Conveyors

How are conveyors used in industry?

Conveyors are common equipment found in industry. They are used to move products and supplies in and out of a work site, from one part of the plant to another, and between workstations. In all kinds of assembly operations, ranging from microelectronics to the automotive industry, conveyors, whether powered or unpowered, roller or belt, overhead or floor, are literally the backbone of the production system.

The entire work process revolves around the conveyor. Its height, width, speed and position in relation to the worker all modify the overall workload and the way workers do their job. To lessen the likelihood for adverse effects of long hours spent at a conveyor of any type, some ergonomic and design issues have to be considered.

How to work safer with a conveyor?

- Wherever the tasks at the conveyor require wide-ranging bodily motion and/or physical exertion, then the work should be done from a standing position;
- Conveyor height should be determined by the degree of exertion required and the dimensions of the objects being worked upon. A range of between 65 cm and 120 cm can accommodate the majority of the workforce and a variety of tasks. More information on working in standing positions can be found in our OSH Answers section under:
 - Working in a Standing Position
 - Working in Standing/Sitting Positions
 - Fish Processing
- Conveyor height for precision work such as microelectronic assembly should be from 95 cm to 120 cm, ideally 5 cm above one's elbow height;
- Seating such as that described in the following OSH Answers documents, plus elbow supports are highly recommended;
 - Working in a Sitting Position -- Alternative Chairs
 - Working in Standing/Sitting Positions
- Conveyor height for light work should be about 5 to 10 cm below one's elbow height. Seating is optional.
- Conveyor height for heavy work should be about 20 to 40 cm below one's elbow height. Seats for other than resting are not recommended;
- Regardless of whether they work while sitting or standing, workers should have adequate knee and leg clearance;
- Aisles should be wide enough so that the workers could perform their tasks without obstruction;
- Small racks or shelves for containers should be within easy reach; containers should be tilted to avoid repetitive awkward movements;
- Consider installing tool balancers where heavy powered hand tools are used;
- The pace of a conveyor should be set between the capabilities of the most- and least -skilled worker; the highest speed should not exceed 10 m/min;
- For assembly work the workers should have some control over the pacing their tasks;
- Consider installing anti-fatigue matting. It may alleviate tiredness and feet problems might arise from working long hours on hard floors;
- Conveyors, even if the work is done from only one side, should be accessible from both sides. This is for maintenance, housekeeping, and emergency reasons;
- Where people need to move over the conveyor, a crossover (pedestrian bridge) should be built, with appropriate guards installed.

Conveyors – Safety

What should I know when working at or near a conveyor?

When working near any conveyor:

- Wear hard hat and safety shoes.
- Tie back (and tuck in) long hair.
- Know the location of the emergency "shut-off" devices and how to use them.
- Do not wear loose clothing or jewellery.
- Do not climb on the conveyors.

What are some safety tips for working near a gravity conveyor?

Gravity conveyors include those that have rollers, wheels or chutes where objects move by gravity or momentum only.

Do

- Guard pinch points on rollers and wheels and between the conveyor and receiving table.
- Provide adequate guardrails along sides to prevent the largest and smallest objects to be handled from falling off.
- Provide retarders (friction areas) if heavy objects are conveyed.
- Ensure there are warning devices near the receiving areas if you cannot see the packages moving on the conveyor.
- Ensure draft checks (fire doors) are installed where conveyors pass through fire walls or floors.

What are some tips when working at a "powered" conveyor?

"Powered" or "power" conveyors include belts, live rollers, slats and buckets.

Do

- Position yourself so that you are not hit by objects moving down the conveyor.
- Ensure that you can see the conveyor system when you are at the operating controls.
- Ensure that guards are in place for all moving parts of the drive system and for the conveyor.
- Guard all pinch points between the conveyor system and fixed objects.
- Locate handrails around low level conveyors and areas where conveyors pass through the floor/ceiling.
- Locate emergency stop cut-off switches near the operator and along the length of the conveyor at approximately 30 metres (100 feet) apart (or closer).
- Ground belts on belt conveyors to prevent static buildup.

Do Not

• Do not service the conveyor without following lock-out procedures.

What are additional tips when working with other types of conveyors?

When working with aerial conveyors:

• Make sure that guards are in place to protect people working below from falling objects.

When working with bucket conveyors:

• Make sure that both vertical and horizontal bucket conveyors are totally enclosed.

When working with pneumatic conveyors:

- Familiarize yourself with control devices and release valves to cut off air flow in the event of blockage.
- Shield joints and access points to prevent material from being thrown in the event of gasket failure.
- Ensure that screening is in place at the suction end to prevent large objects from being sucked in.

When working with portable conveyors:

- Use only weatherproof electrical components.
- Make sure power cables are located where they will not be walked on or run over.
- Make sure that sideboards are high enough to prevent large items from falling and smaller items from being thrown by the wind.
- Chock the wheels on trucks and railcars that are being loaded or emptied by portable conveyors.
- Do not exceed the rated load capacity of the conveyor.

Are there issues, other than safety, I should know about?

Yes. If working at a conveyor or belt, repetitive motions, reaching, and lifting may lead to Work-Related Musculoskeletal Disorders (WRMD) especially when movements are done quickly and for a long period of time.

Use of Portable Grinders

What safety precautions should be followed when using a portable grinder?

- Guards must be provided and adjusted to protect you. Replace damaged guards because if an abrasive wheel breaks while rotating, it can cause a serious injury.
- Clean and service grinders according to manufacturers' recommendations. Record all maintenance for grinders.
- Ensure that a machine will not operate when unattended by checking the dead-man (constant pressure) switch.
- Wear safety glasses, goggles, and face protection to protect against flying particles. Gloves, aprons, metatarsal safety boots, and respiratory protection may be required, depending on the work.

When and how should the speed of the wheel be checked?

- The maximum speed in revolutions per minute (rpm) is marked on every wheel. Never exceed this speed.
- Check that the wheel speed marked on the wheel is equal to or greater than the maximum speed of the grinder.
- Measure the speed of any new machine. Take several readings.

- Measure the speed of governor-controlled air-driven grinders after twenty hours of use or every week, whichever comes first. Measure the speed after any repairs.
- Measure the speed of electrically driven grinders monthly and after repairs.

What should be done when using portable grinders?

- Check that grinders do not vibrate or operate roughly.
- Use racks or hooks to store portable grinders.
- Stand away from the wheel when starting grinders. Warn co-workers to do the same.
- Inspect all wheels for cracks and defects before mounting.
- Insure that the mounting flange surfaces are clean and flat.
- Use the mounting blotters supplied.
- Run newly mounted wheels at operating speed for 1 minute before grinding.
- Wear appropriate eye, ear and face protection. Use other personal protective equipment or clothing, as required under the circumstances.

What should be avoided when using portable grinders?

- Avoid using grinders near flammable materials.
- Do not clamp portable grinders in a vise for grinding hand-held work.
- Do not use any liquid coolants with portable grinders.
- Do not force wheels onto a grinder or change mounting hole sizes.
- Do not tighten the mounting nut excessively.

Wheel Mounting on Portable Grinders

How to mount straight wheels?

- Inspect and conduct "a ring test" before mounting a wheel.
- Check the flanges for distortion or abrasion. When flanges are distorted or warped contact area is reduced.
- Flanges must not be reversed.
- Use blotters to cushion flange pressure.
- Do not use flat washers or other filler materials in place of flanges.
- The fixed and loose flanges should have the same diameter and have undercut relief. The minimum flange size is 1/3 of the wheel diameter.



How to mount cup wheels?

• For cup wheels, use a flat unrelieved flange with a threaded hole mounting. This flange prevents strain on the bond that anchors the bushing to the wheel cup.



What should be v

g wheels?

• For cone and plug wheels, the common cause of breakage occurs when that the spindle threads are either too short or too long for the tapped hole in the wheel.



How should depressed centre wheels be mounted?

- Replace any worn or bent reusable adapters. A damaged adapter will not mount properly.
- Do not reuse "throw away" adapters.
- Ensure that the grinder spindle shoulder runs true. The adapter must tighten against this shoulder. Use spacers provided with adapters if the spindle is too long.
- The wheel will wobble if the shoulder is not square with the spindle, or if the adapter does not tighten against the shoulder. This can result in wheel breakage and injuries to the operator or a nearby worker.



Use of Bench and Pedestal Grinders

What safety procedures should be followed when using bench and pedestal grinders?

- Fasten pedestal and bench grinders securely.
- Ensure all the guards are in place and secure before using a grinder.
- Adjust tool rests to within 3 mm (1/8 in.) of wheels. Never adjust rests while wheels are moving. Work rest height should be on horizontal centre line of the machine spindle.
- Maintain 6 mm (1/4 in.) wheel exposure with a tongue guard or a movable guard.



- Stand to one side of the grinder until the wheel reaches operating speed.
- Bring work into contact with the grinding wheel slowly and smoothly, without bumping.
- Apply gradual pressure to allow the wheel to warm up evenly. Use only the pressure required to complete a job.
- Move the work back and forth across the face of the wheel. This prevents grooves forming.
- Wheels are made only for grinding certain items. Do not grind rough forgings on a small precision grinding wheel.



- Dress wheels regularly. Do frequent, light dressings rather than heavy dressings.
- Support dressing tools to apply leverage without undue effort. With revolving cutter dressing tools
 use the lugs as anchors.
- Replace worn wheels if you cannot dress it.
- Ensure the grinder speed does not exceed the operating speed marked on the wheel.
- Visually inspect wheels for possible damage before mounting.
- Wear proper personal protective equipment:
- eye, ear and face protection,
 - metatarsal safety boots, where required,
 - respiratory protection may be required, depending on the work.
- Wear gloves only where necessary.

What should be avoided when using bench and pedestal grinders?

- Do not use a wheel that has been dropped.
- Do not grind wood, plastics and non-iron metals on ordinary wheels.

- Do not leave grinding wheels standing in liquids. The liquid can cause balance problems.
- Do not grind on the side of a regular wheel.

Bench and Pedestal Wheel Mounting

How to mount an abrasive wheel?

• Follow the manufacturer's recommendations when handling, grinding, maintaining and storing abrasive wheels.



- 1. Ensure you have the correct type and size wheel for the machine by checking the markings on both. The machine spindle speed must not be greater than the speed marked on the wheel.
- 2. Examine the wheel for cracks or chips and perform the "ring test." Replace the wheel, if faulty.
- 3. Do not force a wheel onto the machine spindle or change the size of the mounting hole.
- 4. Maintain even pressure from both flanges against the sides of the wheel. Check flanges with a straight edge. Worn or warped flanges must not be used.
- 5. Maintain a clearance (undercut relief) of at least 3 mm (1/8 in.) to prevent pressure on the wheel near the hole.
- 6. Check the surface of the abrasive wheel and flanges to ensure that no particles are present.
- 7. Use paper blotters between a wheel and flanges to take up slight wheel surface roughness.
- 8. Ensure mounting pilot(s) is rounded with length about 2/3 width of the wheel.
- 9. Extend the threaded section well inside the loose flange.
- 10. Tighten grinding wheels just enough to prevent them from slipping. Over tightening the spindle nuts or clamping screws can damage the wheel and grinder parts. With multiple screw mounting flanges, tighten the bolts uniformly. Start by barely tightening a screw, "snug-up" opposite screw and, in a crisscross manner, continue until all mounting screws are uniformly tight.



11. Place the threads (force of the work b that allows the nut to tighten because of the

- 12. Replace all guards.
- 13. Before turning on the power, the operator should turn the wheel by hand to check for appropriate wheel clearance.
- 14. Warn all persons to stay clear of the area where the wheel is used.
- 15. Stand to one side and test the wheel. Start and run the wheel for at least 1 minute. If any undue vibration occurs, switch off immediately and make adjustments. Never adjust moving machinery

Handling and Storing of Bonded Abrasive Wheels

What safety precautions should be followed when using abrasive wheels?

- Select the right wheel for the job. It is important for safety. A wheel is dangerous when used for work for which it was not designed. Booklets from wheel and machine manufacturers provide technical information on wheel selection and proper use.
- Use only wheels marked with the type of wheel and maximum speed in revolutions per minute (rpm).

- Inspect the wheel upon receipt.
- Examine the wheel for any signs of damage.
- Use "ring test" to check wheels. Ring tests do not apply to small wheels 10 cm (4 in.) diameter and smaller.

What is the "ring test?"

• The ring test is one way to check if the wheel is in proper working order. Tap wheels gently with a nonmetallic tool such as a plastic screwdriver handle or wooden mallet. A wheel in good condition will emit a metallic ring. Reject any a wheel that sounds dead or cracked.



How to handle and store the abrasive wheels?

All abrasive wheels are fragile.

- Handle wheels carefully. Avoid dropping or bumping.
- Transport wheels in containers designed to provide support for the wheels if they are too heavy to carry by hand.
- Do not pile other items such as tools on top of wheels.
- Store wheels in racks or bins with dividers for different types of wheels.
- Place straight or tapered wheels on end in a cradle or chocked position to prevent rolling.
- Never store wheels near excessive heat or cold, in contact with oil or moisture, or in drawers with loose tools.
- Follow the manufacturer's instructions for length of time a wheel should be stored and how to store thin wheels.

Handling and Operating a Fork Lift

Common Factors in Forklift Accidents

What factors contribute to forklift trucks accidents?

Many work-related factors can cause accidents. Grouping them into specific categories may help to analyze accidents and, eventually, to prevent them.

What factors of work organization can contribute to forklift trucks accidents?

- Lack of training or improper training of workers who have to operate forklift trucks.
- Production factors such as speed or stress.
- Lack of proper tools, attachments and accessories.
- Improper assignment of forklifts and operators.
- Poor maintenance of forklifts.
- Age of forklifts.

What behavioural and operational factors can contribute to forklift trucks accidents?

• Improper backing up techniques.

- Improper turning.
- Improper warnings to others about a forklift in use nearby.
- Poor communication during shared tasks, or in shared spaces.
- Riding or giving rides on forklift or load.
- Parking the forklift improperly.
- Improper blocking of wheels on semi-trailers or railway cars.
- Horseplay; stunt driving; jerky, erratic driving.
- Inadequate servicing of the forklift.

How can workplace design contribute to forklift trucks accidents?

- Narrow aisles.
- Crowded, cluttered aisles.
- Obstructions at intersections and doors.
- Volume of traffic in work area.
- Walking and working in the general area of forklift operations.

- Other workplace conditions such as noise, odours, toxic gases, dust, or poor lighting.
- Many ramps with different surfaces.
- Condition of loading dock.

What characteristics of the load create a hazard?

- Poorly stacked or piled on the pallet.
- Pallets in poor repair.
- Load too heavy.
- Load unstable or blocking vision.

What mechanical conditions or design features increase the risk for forklift accidents?

- Malfunction of brakes.
- Malfunction of steering.
- Malfunction of clutch, shift linkage, or transmission.
- Malfunction of mast assembly.
- Leaks in hydraulic systems or transmission.
- Safety devices lacking, inadequate, or malfunctioning.
- Emissions from forklifts.
- "Blind spots" or obstructions blocking driver's view.
- Poor layout of controls and displays.

Fork Safety

How often should the forks of forklift trucks be inspected?

Under normal operating conditions, forks should be inspected daily and every six months. **Daily**: Operators should make visual inspection of forks during the pre-start-up check, giving special attention in looking for permanent distortions and cracks.

Six months: A thorough inspection of forks should be done every six months, preferably by a trained individual, to check for any cracks and distortion. Forks may need inspections more often, depending on the use of the equipment.

What are some important points of a periodical (six months) fork inspection?

- Check fork blades for wear. Forks are constantly subjected to abrasion by concrete floors, steel shelving, etc. This abrasion can reduce the thickness of a fork until it cannot lift loads up to the designed capacity.
- Check for distortion. Forks can be bent out of shape. Depending on distortion, some forks can be straightened. The fork manufacturer is best qualified to correct this. Your local forklift supplier can make the arrangements.
- Check for cracks in heel and hanger. Cracks may appear on forks where attachments are welded on or in the inside radius of the bend area. Periodic inspection using a magnetic particle or dye penetrant test can detect cracks. Approved grinding methods may grind out and polish these blemishes, depending on the depth of the crack. Contact your forklift supplier or the manufacturer for additional information.
- Replace, when necessary, with good quality forks. When ordering or reordering forks, make sure you are getting high quality forks that will do your lifting jobs safely. Insist on forged forks or ones with an upset heel.
- Use the proper forks. Custom-designed forks may be needed for:
 - 1. unusual lifting conditions
 - 2. spark-free areas
 - 3. high heat furnace areas
 - 4. special object lifting
 - 5. Contact your forklift supplier for assistance.



What are some things you should not do to forklift forks?

• Do not overload the forks. Operators should be aware of the capacity of the forklift and the capacity of the forks. Overloading may bend and weaken forks.

- Do not repair your own forks. No one but the fork manufacturer should undertake the repair of forks.
- Do not modify forks without consulting with your forklift supplier.

Maintaining Truck Control

How do you maintain control when handling pallets?

- Ensure that forks are:
 - level
 - high enough to go into the pallet
 - the proper width to provide even distribution of the weight
 - all the way under the load

How do you maintain control when lifting, tilting, and stacking a load?

- Lift the load straight until it is clear, then tilt back.
- Watch that the load does not catch on adjacent loads or obstructions.
- Do not raise or lower the forks before you stop the lift truck and set the brakes.
- Ensure that the forks are free of the load before backing up.

How do you maintain control when traveling?

- Tilt loads backwards.
- Travel with forks as low as possible from the floor and tilted back.
- Match speed to driving, load and workplace conditions.
- Obey posted traffic signs.
- Decrease speed at all corners, sound horn and watch the swing of both the rear of the lift truck and the load.
- Watch for pedestrians.
- Avoid sudden stops.



- Travel in reverse when a load blocks your vision and always look in the direction of travel.
- Check for adequate overhead clearance when entering an area or when raising the forks.
- Watch out for the following dangers on the floor or roadway: oil spots, wet spots, loose objects, or holes, rough surfaces, people, and other vehicles.
- Approach at an angle when crossing railroad tracks.
- Maintain a safe working limit from all overhead power lines

How should you steer to maintain control?

- Has the load carried by the front wheels.
- Turn with the rear wheels.
- Do not turn a lift truck steering wheel sharply at fast speeds.
- Do not overload a lift truck. It can cause a loss of steering control.
- Do not add extra weight to a counterweight to improve steering.



- Face the rear.
- Sound horn before moving.
- Go slowly.
- Stop when vision is limited or blocked. Sound the horn and go slowly.

How do you maintain control when traveling up or downhill?

- Keep the forks pointed downhill without a load.
- Keep the forks pointed uphill with a load.
- Do not turn until on level ground.

How should you park the forklift truck?

- Secure lift truck when left unattended.
- Park in an approved location.
- Set the brakes.
- Lower the forks or load to the floor.
- Neutralize the controls.
- Turn off the motor switch.
- Disconnect battery or go through propane shut-down procedures.

Loading and Unloading Vehicles

What vehicles can you load and unload using forklift trucks?

Forklift trucks provide (secure) the efficient loading and unloading of straight trucks, tractor trailers, railway cars and elevators.

How should you prepare the work area for using a forklift truck for loading/unloading operation?

- Set the vehicle's brakes up.
- Chock the vehicles' wheels.
- Install fixed jacks to support a semi-trailer that is not coupled to a tractor to prevent it from upending.
- Post signs warning not to move a vehicle.
- Check that the height of the vehicle's entrance door clears the forklift height by at least 5 cm (2 in.).
- Make sure floors can support the combined weight of the forklift and the load.
- Inspect interior of a vehicle for the following: trash, loose objects and obstructions; holes or weak floors; poor lighting; and low overhead clearance.
- Install anti-slipping material in any area that could be a hazard because of weather conditions.
- Ensure that docks and dock plates are clear of obstructions and not oily or wet.
- Protect gaps and drop-offs at loading docks.
- Use dock levelers.

What should you do to load (unload) vehicles using a forklift truck?

- Keep forks pointed downhill when traveling without a load on a ramp.
- Keep forks pointed uphill when traveling with a load on a ramp.



- Stay clear of edges of docks, rail cars or ramps. Have edges clearly marked.
- Do not tow or push railway cars or trucks with a forklift.
- Do not operate forklifts inside vehicles for long periods without ventilation.
- Make sure that the dock plate is properly secured and can support the load before driving over it. (Load weight should be clearly marked.)
- Drive carefully and slowly over the plate. Do not spin wheels.

What should I do when using a forklift truck in an elevator?

- Do not enter any elevator unless specifically authorized to do so.
- Before entering any elevator, ensure that the forklift plus load weight does not exceed the elevator capacity.
- Approach the elevator slowly, stop at a safe distance from the elevator gate and enter squarely.
- Neutralize the forklift controls, shut off a motor, and apply the brakes.

Load Handling

How should you load the forklift truck?

• Do not exceed the recommended load limit of your lift truck. Each lift truck has a maximum load limit. The load limit is shown on the data plate of the lift truck.

| F | ORK | LIFT | | | | |
|---------------------|--------------|--|--------|------------------|---|----------------------------------|
| SERIAL NO. | D90 | 842678 1 | 04 5 | ; | | |
| CAPACITY 1800 kg | | | | | | Load Limit (kg) |
| AT 60 CM LOAD C | ENTRE WIT | TH UPRIGHTS | VERT | ICAL | 1 | Load Centre (cm) |
| TYPE G | | MAXIMU KILOGRAMS 1 800 FOUR RATING WI SEE ATTACHME | MTRATI | NG B • 365 | | — Height forks will lift (cm) |
| DO NO | F T EXCEE | D RATING | ì | | | |

- Position the load according to the recommended load centre. The load limit of the lift truck decreases as the load centre is raised.
- Do not add extra weight to counterbalance an overload.
- Keep loads close to the front wheels to keep lift truck stable



How should you insert the fork when loading the forklift truck?

- Keep the mast of the forklift in an upright position before inserting the forks into a pallet.
- Level the fork before inserting it into the pallet.
- Insert the fork all the way under the load.
- Adjust the fork as wide as possible to fit the load and to provide a more even distribution of weight.
- Space the fork evenly from the centre stringer of the pallet to balance the load.
- Do not protrude the fork past the back of a pallet when stacking in tight areas.



- Ensure that the load is secured before moving. If it is not, pile the load again or strap the load to skid.
- Ensure that loads on pallets are stable, neat, cross-tied if possible, and evenly distributed.
- Remove damaged pallets from service.



How should you raise the load?

When a load is raised, the lift truck is less stable.

- Check that the overhead clearance is adequate before raising loads.
- Do not raise or lower the fork unless the lift truck is stopped and braked.
- Lift loads straight up or tilt back slightly.
- Do not lift a load that extends above the load backrest unless no part of the load can possibly slide back toward the operator.
- Attend the controls of the forklift truck when a load is elevated. In other words, the operator must stay on the forklift when the load is in a raised position.

Daily Checks

When should an operator inspect the forklift truck?

An operator should inspect the forklift truck every day before using or before each shift.

What does a daily inspection involve?

The operator should carry out a visual check ("circle" check) before starting the forklift. After completing the visual pre-start check, the operator should do an operational pre-use check.

What should an operator inspect during the visual pre-use check?

- General condition and cleanliness.
- Floor -- clear of objects that could cause an accident.
- Overhead -- no obstructions.
- Nearby objects to avoid as you drive away.
- Fire extinguisher -- present and charged.
- Engine oil level, fuel level, radiator water level (LPG, gas and diesel forklifts).
- Battery -- fully charged; check cables for exposed wires; battery plug connections not loose, worn
 or dirty; vent caps not clogged; electrolyte levels in cells; holddowns or brackets keep battery
 securely in place.
- Bolts, nuts, guards, chains, or hydraulic hose reels not damaged, missing or loose.
- Wheels and tires -- check for wear, damage, and air pressure, if pneumatic tires.
- Forks -- forks not bent; no cracks present; positioning latches in good working condition; carriage teeth not broken, chipped or worn.
- Chain anchor pins -- not worn, loose or bent.
- Fluid leaks -- no damp spots or drips.
- Hoses -- held securely; not loose, crimped, worn or rubbing.
- Horn -- working and loud enough to be heard in working environment; other warning devices operational.
- Lights -- head lights and warning lights operational.
- Seatbelt and/or operator restraint device (if equipped) -- belts and restraints work properly; no visible wear or damage; anchors, buckles, etc. function properly.



What should an operator inspect during the operational pre-use check?

• Foot Brake -- pedal holds, unit stops smoothly.

- Parking Brake -- holds against slight acceleration.
- Deadman Seat Brake -- holds when operator rises from seat.
- Clutch and Gearshift -- shifts smoothly with no jumping or jerking.
- Dash Control Panel -- all lights and gauges are operational.
- Steering -- moves smoothly.
- Lift Mechanism -- operates smoothly (Check by raising forks to maximum height then lowering forks completely.)
- Tilt Mechanism -- moves smoothly, holds (Check by tilting mast all the way forward and backward.)
- Cylinders and Hoses -- not leaking after above checks.
- Listen for any unusual sounds or noises.
- A simple daily check list is given at page 39 of 39 of this document.

Report any problems identified in daily check to the supervisor immediately.

Professional Operator Who can operate the forklift?

In general, forklift trucks should be operated only by experienced workers who are trained, certified or licensed as professional operators. Some jurisdictions specify that only a "competent" person may operate powered lift trucks and others may specify a minimum operator age (eg. 18 years or older). Consult your local occupational health and safety authorities for more information.

What should an operator do when operating the forklift truck?

- Know the recommended load limit of the forklift and never exceed it.
- Know how to assess the weight of the load to be lifted.
- Do a visual and operational check of the forklift at the start of the shift.
- Always inspect and wear any seat belt or operator restraint device/system when these devices are available on the forklift truck.
- Check for adequate overhead clearance before raising the load.
- Operate a forklift smoothly when stopping, starting, lifting and tilting.
- Know the blind spots of the lift truck with and without a load.
- Keep pedestrians away from a forklift in operation.
- Stop when anyone crosses the route being traveled. Lower the load to the floor, and wait until clear.
- Operate only as fast as conditions safely permit.
- Wear leather gloves when moving or shifting loads or when checking skids.
- Wear fully laced safety boots to give impact protection when moving loads or skids and to provide ankle support when mounting and dismounting lift truck.
- Remain alert and prepare for the unexpected.
- Note anything that affects the normal operation of the forklift and tell the supervisor immediately.
- Keep hands, arms, head, feet and legs inside the confines of a moving forklift.
- Stay in the truck in case of overturn.
- Report any collisions, damage or near-miss accidents to a supervisor immediately.

What should an operator avoid when operating a forklift truck?

The operator should avoid:

- Trying to move or adjust any part of the load, the forklift or the surroundings when on the forklift.
- Lifting a load that extends above the load backrest unless no part of the load can possibly slide back toward the operator.
- Allowing anyone but the operator to ride on the forklift.
- Using pallets elevated by forklifts as an improvised working platform.
- Allowing anyone to stand or walk under the elevated part of any forklift, whether loaded or unloaded.

Batteries

What is important to know about batteries?

Lead-acid batteries contain sulfuric acid and only trained and authorized personnel should handle them. When talking about lead-acid batteries, people usually call sulfuric acid "battery acid" or the "electrolyte". An electrolyte is general term used to describe a non-metallic substance like acids such as sulfuric acid or salts that can conduct electricity when dissolved in water.

- Use extreme care to avoid spilling or splashing the sulfuric acid solution. It can destroy clothing and burn the eyes and skin.
- Always wear splash-proof goggles and protective clothing (gloves and aprons). A face shield may also be necessary.

Batteries can weigh 30 to 60 lb (about 14 to 27 kg) so practice safe lifting and carrying procedures to prevent back injuries. Use a battery carrier to lift a battery, or place hands at opposite corners. Only work with or charge batteries if you have been trained to do so.

What do I do if I splash some battery acid in my eyes or skin?

- Use an emergency eyewash/shower station if solution is splashed into the eyes.
- Immediately flush the contaminated eye(s) with clean, lukewarm, gently flowing water for at least 30 minutes, by the clock, while holding the eyelid(s) open.

- If irritation persists, repeat flushing. Neutral saline solution may be used as soon as it is available.
- DO NOT INTERRUPT FLUSHING. If necessary, keep the emergency vehicle waiting.
- Take care not to rinse contaminated water into the unaffected eye or onto the face.
- First aiders should avoid direct contact. Wear chemical protective gloves, if necessary.
- Quickly transport the victim to an emergency care facility. Flush any area of your body contacted by battery acid immediately and thoroughly.

If the skin is splashed with acid,

- As quickly as possible, flush the contaminated area with lukewarm, gently flowing water for at least 30 minutes, by the clock.
- If irritation persists, repeat flushing. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting.
- Under running water, remove contaminated clothing, shoes and leather goods (e.g., watchbands, belts).
- Transport the victim to an emergency care facility immediately.
- Discard contaminated clothing, shoes and leather goods.

What should I do after handling batteries?

- Rinse off your gloves well before removing them. Then rinse the apron to remove any battery acid that may have contaminated it.
- Wash yourself with soap and water immediately after servicing a battery.
- Neutralize spilled or splashed sulfuric acid solution with a baking soda (sodium bicarbonate) solution, and rinse the spill area with clean water.
- Keep tools and other metallic objects (including jewellery) away from the tops of batteries.

What should I know when charging a battery?

- Charge batteries in a designated, well-ventilated area.
- Do not attempt to recharge a frozen or damaged battery.
- Follow the manufacturer's recommendations for charging rates, connections and vent plug adjustment. Properly maintained vent caps will reduce the chance of electrolyte spray.
- Unplug or turn the charger off before attaching or removing the clamp connections. Carefully attach the clamps in proper polarity to the battery.
- Rinse off batteries and clean terminals before recharging.
- Fill sulfuric acid (electrolyte) to the prescribed level before charging to reduce the possibility of the electrolyte heating up excessively. If water is added, use distilled water, not tap water.
- Turn off the charger before disconnecting the cables from the battery.

What are some safety tips to know when servicing batteries?

- Keep metal tools and other metallic objects away from batteries.
- Inspect for defective cables, loose connections, corrosion, cracked cases or covers, loose holddowns and deformed or loose terminal posts.
- Replace worn or unserviceable parts.
- Tighten cable clamp nuts with the proper size wrench. Avoid subjecting battery terminals to excessive twisting forces.
- Use a cable puller to remove a cable clamp from the battery terminal.
- Remove corrosion on the terminal posts, hold-down tray and hold-down parts.
- Use a tapered brush to clean dirt from the battery terminals and the cable clamps.
- Use a battery carrier to lift a battery, or place hands at opposite corners.
- Do not lean over a battery.

How the battery charging area should be constructed?

Work areas when working with or charging batteries should:

- Have good ventilation to diffuse gases and prevent explosions.
- Be constructed with acid-resistant materials (racks, trays, floor, tools, etc.).
- Have face shields, aprons and gloves of the appropriate chemical-resistant materials readily available.
- Have emergency eyewash or shower stations close by, with no obstructions along the path (storeg materials, doors, etc.).
- Have equipment and supplies for flushing, neutralizing, and cleaning spilled chemicals, acid and electrolyte solutions near by.

Can batteries explode?

Yes, hydrogen gas is produced during normal battery operation. This easily ignitable gas can escape through the battery vents and may form an explosive mixture in the atmosphere around the battery if ventilation is poor.

- Keep sparks, flames, burning cigarettes, and other ignition sources away at all times.
- Do not break "live" circuits at the terminals of batteries.

What should I know about filling batteries?

• Keep battery deposits off your body when cleaning terminals by brushing debris away from the body.

- Do not fill battery cells above the level indicator. Use a self-levelling filler which automatically fills the battery to a predetermined level.
- Do not squeeze the syringe so hard that the water splashes acid from the cell opening.

What are some tips for handling battery solutions?

- Pour concentrated acid slowly into water: Do NOT add water into acid the water tends to sit on top of the heavier (more dense) acid. The water can become hot enough to spatter.
- Use nonmetallic containers and funnels.
- Recap any electrolyte container and store it in a safe place at floor level.
- Do not store acid in hot locations or in direct sunlight.
- Do not store electrolyte solution on shelves or any location where the container can overturn.
- Do not squeeze or puncture a container with a screwdriver or other instrument. The acid solution may splash on face, hands, or clothing.
- Do not fill a new battery with electrolyte solution while it is in the vehicle. Fill the battery while it is on the floor, before installation.

What should I know about using booster cables?

Sparks created from booster or jumper cables can ignite a flammable mixture of hydrogen in air causing an explosion.

Before using jumper cables:

• Wear eye protection.

- Make sure that the two vehicles are not touching each other.
- Turn off the ignition switches of both vehicles.
- Extinguish all cigarettes, cigars, and other sources of flame or ignition. Remember, explosive mixtures of hydrogen are always present in the cells of batteries.
- Remove the filler caps from both batteries to vent the dangerous hydrogen gas. This is not necessary if the vehicles are equipped with maintenance-free batteries.
- Do not charge or jump a frozen battery.
- Check vehicle/equipment service manual for specific requirements.

WARNING:

When connecting or disconnecting jumper cables, use extreme care in handling the clamps. Do not allow cables to touch each other, nor to touch the frame or body of either vehicle. This will prevent sparks that can cause an explosion.

- Avoid contact with the revolving cooling fans when disconnecting the cables.
- After removing the booster cables, replace the filler caps on both batteries.

How do I boost a negatively grounded battery?

The vehicle is NEGATIVELY grounded when the cable attached to the NEGATIVE post of the "dead" battery is also attached to the engine block.

To connect cables:

- Clamp one end of the red cable onto the positive post of the "dead" battery.
- Clamp the other end of the red cable onto the positive post of the booster battery.
- Clamp one end of the black cable onto the negative post of the booster battery.
- Clamp the other end of the black cable onto the engine block below and away from the "dead" battery.
- Start the engine of the booster vehicle, then the engine of the "dead" vehicle.
- To disconnect cables:
- Remove the black negative clamp from the engine block of the vehicle with the "dead" battery.
- Remove the black negative clamp from the booster battery.
- Remove the red positive clamp from the booster battery.
- Remove the red positive clamp from the "dead" battery.

How do I boost a positively grounded battery?

The vehicle is POSITIVELY grounded when the cable attached to the POSITIVE post of the "dead" battery is also attached to the engine block.

To connect cables:

- Clamp one end of the black cable onto the negative post of the "dead" battery.
- Clamp the other end of the black cable to the negative post of the booster battery.
- Clamp one end of the red cable onto the positive post of the booster battery.
- Clamp the other end of the red cable onto the engine block below and away from the "dead" battery.
- Start the engine of the booster vehicle, then the engine of the "dead" vehicle.
- To disconnect cables:
- Remove the red positive clamp from the engine block of the vehicle with the "dead" battery.
- Remove the red positive clamp from the booster battery.
- Remove the black negative clamp from the booster battery.
- Remove the black negative clamp from the "dead" battery.

Why should you follow safety precautions when charging batteries?

Lead-acid batteries contain sulfuric acid and only trained and authorized personnel should handle them. When talking about lead-acid batteries, people usually call sulfuric acid "battery acid" or the "electrolyte". An electrolyte is general term used to describe a non-metallic substance like acids like sulfuric acid or salts that can conduct electricity when dissolved in water.

Lead-acid batteries can produce explosive mixtures of hydrogen and oxygen gases when they are being charged.

- Charge batteries only in approved, ventilated battery-charging areas.
- Install a safety shower and an eyewash station in a battery-charging area.

What are some precautions to use when handling battery acid?

- Wear splash-proof goggles and protective clothing (gloves and aprons). A face shield may also be necessary when handling sulfuric acid in an open system.
- Do not store acid in hot locations or in direct sunlight.
- Pour concentrated acid slowly into water: do not add water into acid. Use nonmetallic containers and funnels.
- Use extreme care to avoid spilling or splashing the sulfuric acid solution. It can destroy clothing and burn the eyes and skin.
- Use an eyewash station if the sulfuric acid solution is splashed into the eye.
- Neutralize spilled or splashed sulfuric acid solution with a baking soda solution, and rinse the spill area with clean water.

What do I do if someone gets sulfuric acid on their skin?

- Avoid direct contact. Wear chemical-resistant protective clothing, if necessary.
- As quickly as possible, flush the contaminated area with lukewarm, gently flowing water for at least 20-30 minutes, by the clock.
- If irritation persists, repeat flushing. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting.
- Under running water, remove contaminated clothing, shoes and other leather goods (e.g., watchbands, belts).
- Transport the victim to an emergency care facility immediately.
- Discard contaminated clothing, shoes and leather goods.

What do I do if someone gets sulfuric acid in their eyes?

- Avoid direct contact. Wear chemical-resistant gloves, if necessary.
- Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for at least 20-30 minutes, by the clock, while holding the eyelid(s) open. Neutral saline solution may be used as soon as it is available.
- DO NOT INTERRUPT FLUSHING. If necessary, keep the emergency vehicle waiting.
- Take care not to rinse contaminated water into the unaffected eye or onto the face.
- If irritation persists, repeat flushing.
- Quickly transport the victim to an emergency care facility.

Why is there a danger of exploding batteries?

The charging of lead-acid batteries can be hazardous. When batteries are being recharged, they generate hydrogen gas that is explosive in certain concentrations in air (the flammability or explosive limits are 4.1% to 72% hydrogen in air). The spark-retarding vents help slow the rate of release of hydrogen, but the escaping hydrogen may form an explosive atmosphere around the battery if ventilation is poor. The ventilation system should be designed to provide an adequate amount of fresh air for the number of batteries being charged. This is essential to prevent an explosion.

- Always keep sparks, flames, burning cigarettes, and other sources of ignition away from the battery recharging area.
- Wear protective eye wear when working near batteries.
- Do not break "live" circuits at the terminals of batteries.

What should I do when charging batteries?

- Check the electrolyte level before recharging. If the battery has been outside in cold weather, make sure that the battery is not frozen before recharging it.
- If the electrolyte is covering the top of the plates, do not add more water. Recheck the fluid level after the battery has been recharged. If water is added, use distilled water, not tap water.
- When vent plugs may need adjustment, follow manufacturers' instructions carefully.
- If the battery has sealed vents, do not recharge the battery with a current greater than 25 amps.
- To reduce the possibility of explosions, follow the recommendations of the recharger manufacturer for attaching and removing cables and for operating the equipment properly. Generally, this includes unplugging or turning off the charger before connecting or disconnecting the clamp connections. Carefully attach the clamps to the battery with the proper polarity (positive [+] clamp, usually red, to the positive terminal and negative (-) clamp, usually black, to the negative terminal).
- Ensure that area is ventilated when the batteries are being charged.
- If the battery becomes hot or if the electrolyte spits out from the vent, turn off the recharger temporarily. Resume recharging using a lower current or charging rate.

What should I do when servicing batteries?

- Keep metal tools and jewelry away from the battery.
- Inspect for defective cables, loose connections, corroded cable connectors or battery terminals, cracked cases or covers, loose hold-down clamps and deformed or loose terminal posts.
- Replace worn or unserviceable parts.
- Check the state of charge of non-sealed and sealed batteries with an accurate digital voltmeter while the engine is not running and lights and other electrically-powered equipment are turned off. Also check the electrolyte levels and specific gravity in each cell of non-sealed batteries. Follow the battery manufacturer's recommendations about when to recharge or replace batteries.
- Tighten cable clamp nuts with the proper size wrench. Avoid subjecting battery terminals to
 excessive twisting forces.
- Use a cable puller to remove a cable clamp from the battery terminal.
- Remove corrosion on the terminal posts, hold-down tray and hold-down parts.
- Use a tapered brush to clean battery terminals and the cable clamps.
- Wash and clean the battery, battery terminals, and case or tray with water. The corrosive acid can be neutralized by brushing on some baking soda (sodium bicarbonate) solution. If the solution does not bubble, the acid is probably neutralized. Rinse the battery with water to remove the baking soda solution.
- To prevent electric shocks, never touch or come in contact with both terminals at the same time. If baking soda solution is applied with a cloth, remember that these solutions can conduct electricity.
- When battery cables are removed, ensure that they are clearly marked "positive" and "negative" so that they are reconnected with the correct polarity.
- Use a battery carrier to lift a battery, or place hands at opposite corners. Remember, batteries can weigh 30 to 60 lb (about 14 to 27 kg) so practice safe lifting and carrying procedures to prevent back injuries.
- Use self-leveling filler that automatically fills the battery to a predetermined level. Never fill battery cells above the level indicator.
- Do not squeeze the syringe so hard that the water splashes acid from the cell opening.

Maintenance

What safety procedures should you follow when servicing a forklift truck?

- Permit only qualified persons to service and maintain equipment.
- Wear proper personal protective equipment. Wear goggles when grinding. Wear face shields, aprons, gloves and rubber boots when handling lead-acid batteries or working around battery-charging equipment. Wear leather gloves when changing LPG fuel tanks.
- Disconnect all batteries before doing any work.
- Before servicing LPG forklifts:
- 1. Shut off the tank fuel valve.
- 2. Run the engine until it stops.
- 3. Disconnect the tank from the hose.
- Block the forklift securely when removing wheels.
- Support the forklift hood in upright position or remove to do work.
- Keep the work area clean and well lit.
- Clean spilled oil or hydraulic fluid immediately.
- Check all tools before using.
- Remove all tools and parts before starting the engine.
- Handle batteries with care.
- Avoid contact with battery terminals with hoisting chains, tools and metal objects.
- Cover the battery top with some insulating material.
- Attach a chain hoist to the counterweight before removing it from a forklift.
- Check the bolts holding the counterweight to the body and replace any worn or missing bolts.
- Find out why a forklift is in for repairs before starting or driving it.
- Check the operator's daily checklist before making repairs.
- Inspect by magnetic particle testing the main mast welds and forks annually or when cracks appear.
- Inspect by magnetic particle testing all hoses, couplings, fittings and connections to the cylinders in the main mast assembly and the tilt control system.
- Inspect forks for distorted, twisted or bent sections. If defects are found, test the area of concern.

What should you not do when servicing a forklift truck?

- Do not leave parts, creepers, cans, tools or other obstacles around.
- Do not lift beyond your capacity. Use hoist or leverage tools to lift or move heavy parts or equipment.
- Do not smoke, weld or light a match around refueling and battery-charging areas.
- Do not start a forklift if it is on a lift hoist or wheel stands.
- Do not work on forklift attachments unless you are familiar with their operation.
- Do not work beneath elevated forklift trucks or forks unless they are securely supported by approved blocks.
- Do not run LPG, gas or diesel forklifts in unventilated areas.



FORKLIFT TRUCK – DAILY CHECKLIST

| BEFORE START-UP | | |
|---|--|--|
| Check hydraulic fluids | | |
| Hydraulics lines | | |
| Fuel | | |
| Check Tyres | | |
| Check for Leaks under the Truck | | |
| Check Horn | | |
| Check Mast | | |
| Inspect for signs of General Damage | | |
| Inspect Mirrors for Damage | | |
| Check condition & adjustment of seat | | |
| Oil | | |
| Battery | | |
| Coolant | | |
| Check Belts | | |
| Check lights | | |
| Check Reversing Signals | | |
| Check Hydraulic Cylinders | | |
| Inspect Forks for any Signs of Damage | | |
| Check load-capacity plate is fitted, legible & correct | | |
| AFTER START-UP | | |
| Check all pedals & controls for smooth operation | | |
| Check brakes for proper operation | | |
| Parking brake for proper operation | | |
| | | |
| - This checklist does not cover all hazards associated with forklifts | | |
| - Conduct risk assessments to identify forklift hazards | | |
| - Follow strictly this dally checklist | | |

Safety for Operation and Maintenance of Transmission Line RIGHT OF WAYS

Right of ways, permits which may be necessary for operation and maintenance of the lines (Transmission) should be obtained by PGCB with the assistance of the Magistrate. (The electricity Act 1910 Articles 18 clause 3 and Electricity Rules 1937 and amendments thereof as reference).

All laws, ordinance and requirements of the Republic and local governing bodies, utilities and railways should be complied with in obtaining these documents & should be kept in a permanent file.

Danger Trees

In approximately level terrain trees which would reach within 5 ft (1.524m) of a point underneath the outside conductor are examples of danger trees.

As directed by the Engineer portions of the right of way must be cut so that stamps will not prevent the passage of tractors and trucks along the right of way.

Sketch below indicating danger trees along side, of right of way which should be removed or topped. Permission to do so must first be secured.



Safe Working Practices General General Rules

Every employee must exercise care in the performance of his duties to ensure maximum safety for himself, his fellow employees and the Public.

NO MATTER WHAT WORK IS TO BE PERFORMED, THE FIRST CONSIDERATION MUST BE THE SAFETY OF THE MEN.

Horseplay or practical joking will not be tolerated. Any violation of this rule will be treated as a serious offence.

Where any work is being carried out which might create a hazard to other employees or to the public, suitable and clearly visible barriers must be installed and, if necessary, and employee stationed as a watchman to provide additional protection.

It is the duty of every employee to report to his foreman or immediate superior any unnecessary risk or hazard which exists in the area. Where an immediate hazard exists, he should warn his co-workers of the danger.

Two or more employees must be present when an element of danger exists in the work being performed. All precautions must be taken to safeguard the employee.

It is the right of every employee to be protected, and he may request any extra protection in methods, additional temporary grounds, equipment or time which in his opinion, is required. If the man in charge is undecided as to the reasonableness of the employee's request for extra protection, he should grant the extra protection, or obtain instructions from his supervisor.

When any employee considers himself unqualified, to undertake a job, or believes his interactions will result in danger to himself or his fellow employees or damage to apparatus, he must so advise his immediate supervisor,

Personnel must not approach the vicinity of live lines or equipment, unless their duties require them to do so.

No employee shall touch or interfere with any electrical conductors or electrical apparatus unless under direct orders from the supervisor in charge.

Employee must not use equipment with which they are unfamiliar.

The fore man should know at all times the location and nature of all the work being done by his men.

Be neat in your work. Do not leave loose materials lying around. Tools, plants, ropes, wires etc., must always be picked up and stored. The job is not complete until this is done. Good housekeeping and safety go together.

Stations and Divisional officer must see that the home and office telephone numbers of the following parties are readily available in all control rooms and other central points.

- Local Fire Brigade
- Station Security Chief
- All Local Supervisory Staff
- Local Hospitals
- Local Police Station
- ✤ DGM.
- PGCB head Office.
- ✤ LDC

DGM'S are required to see that Work Council or Safety meetings are held regularly, when possible. Prior to undertaking any new project, a special meeting is to be held with those immediately concerned to outline the scope of the project and unusual circumstances and/or special precautions which may be necessary. Meetings should be held after each total or serious accident and the reasons should be analyzed.

Nails or other projecting objects, which may endanger employees or other, must be removed or rendered harmless.

Hatchways, pits, manholes etc, must be guarded or roped of when the covers have been removed.

Compressed air must never be used for cleaning or dusting clothing. When using compressed air, or working in the vicinity of compressed air equipment, extreme care must be exercised that an air jet is not directed towards anyone's body. Fatal accidents have occurred as a result of carelessness when using compressed air. Horseplay with compressed air is strictly forbidden.

When using hot lead or solder, safety goggles must be, and every precaution should be taken to prevent spattering. Workmen should not place a cold wet ladle in hot lead or solder, nor pour it on a moist or wet surface. When soldering is being done at a height, care must be taken to prevent solder from failing on persons or equipment below. Safety goggles must also be worn while doing any welding/cutting job.

Care must be exercised in handling gasoline and other flammable liquids, When handling such liquid, exposed flames and sources of static electricity such as belt drives, must be avoided. Fumes given off, even in small proportions, can produce a most dangerous explosion.

When men are working above or around deep water, a serviceable lifebuoy and /or boat must be available in the immediate area. Life jackets are to be worn where practicable.

A diver must always be attended by at least two other employees. The pump supplying air to divers must be kept in good condition at all times.

Vehicle Operation

Employees authorized to operate PGCB vehicles must be familiar with all traffic laws which apply in the territory where the employees drive, and the rules outlined in PGCB instructions.

All drivers of PGCB vehicles will be subjected to a 'Driver's test' before being authorized to drive and as frequently thereafter as required.

Vehicles drivers shall operate vehicles in a safe and courteous manner in order to prevent injury to themselves and others, and to maintain good public relations.

Before driving any vehicle, the driver is to make sure the vehicle is in good operating condition. **Ladders**

Ladders must be equipped with ladder shoes and must be secured against slipping by at least one of the following methods:

- 1. Tying or fastening top and bottom.
- 2. Cross board or hooks, at the top of the rails.
- 3. In certain instances it may be sufficient to have the bottom or the ladder held by another employee.

4. Types of ladders to be used should be specified with insulation class. The slope of a ladder in use is very important. Straight portable ladders shall be placed at a safe angle to prevent breaking or slipping. The best angle for ladders is about 75 degrees with the horizontal.

The distance "B" should be about one-fourth the ladder length "A". In other words, place the base of the 12-foot ladder 3 feet from the object it leans against. Employees shall face ladders when ascending or descending them and shall have both hands free for use on either rungs or rails.

The hoisting rope of extension ladders must be tied in such a manner as to prevent collapse of the ladder in the event that the rung supporting the hook breaks.



Ladders must be kept in first class condition and before use, must be inspected for unsound rungs, cracks and splinters in the side rails.

Ladders with metal reinforcement must not be used on any work around electric circuits or equipment, and they must not be allowed on PGCB'S property.

Care should be exercised in selecting a ladder to make sure it has a suitable length for the particular work involved. Ladders must not be used as a scaffold or platform support.

Ladders should be hung vertically for storage. When this is not possible and they are stored in the horizontal position they should be properly supported at intervals to prevent sagging. When not in use they should be protected from the weather.

Elevated Structures.

Any employees required to work on elevated supports such as ladders, scaffolds, bo sun chairs etc., must first inspect such support and make they will withstand the strain to which they may be properly subjected. Material must not be allowed to accumulate on such supports. Overloading of such support must be prevented during the progress of the work.

Safety belts or harnesses with rope must be used when working on elevated structures, roof, girders, sloping roofs, river crossing carriages, dams or other places where a slip could lead to a serious accident.

When working in elevated positions, tools and materials must be so secured that they cannot fall accidentally.

Built-up scaffolding must conform to the Bangladesh Building code. Great care must be used in the moving and erection of metal or scaffoldings over two meters in height must have a guard rail 90 cm. high. Overloading must be prevented.

Trench Excavation

When men are required to work in an excavation in soil over 1.5 meter deep and when the depth is greater than the width, shoring is required to prevent killing.

Whenever one or more men are working in excavation which exceed two meters in depth, at least one man shall be in attendance outside of the excavation to render assistance in case of need and a ladder must be provided as a means of exit.

Material shall not be stored nor vehicles allowed to approach within 1.5 meter from the edge of the trench so that stability of the walls of the trench will not be endangered by vibration.

Personal and Protective Clothing and Equipment.

Finger rings of any kind should not be worn by employees engaged in manual work.

Loose clothing must not be worn when work in around moving machinery. A one-piece overall suit is most suitable.

Heavy shoes preferably safety shoes, should be worn when operating power lawn movers and when handling heavy material and equipment. Light or sloppy footwear must not be worn on the job. All rubber boots worn on the job are to be of the safety toe type.

Safety hats must be worn by all employees whenever danger from falling tools or other material exists and in all cases when so stipulated by the supervisor in change.

Suitable goggles, guards of shields must be worn by employees while engaged in chipping, spray or overhead painting, grinding, sandblasting, handling of acid or caustic solutions and at all times when there is any likelihood of eye damage from foreign particles, dangerous heat or light rays.

Welding goggles or hand shields must be used when doing any electrical welding, gas welding, or acetylene torch work and suitable screens must be placed around the work for the protection of others. A fire extinguisher must be within reach of the welder whenever welding is being carried out.

When work involving the use of safety belts is contemplated, no work is to commence until they safety belts of all employees

Hand gloves should be worn when doing any electrical works.

TOOLS AND EQUIPMENT.

All tools, equipment and clothing of a workman shall be subject to inspection at any time and if any article is deemed unsafe by the controlling officer or supervisory personnel, its use be discontinued until repaired or replaced.

Any tools or equipment and edged tools must be properly protected or stored when not in use.

Metallic tapes, metal rules or metal edged rules, are prohibited for general use in generating stations, substations or around any electrical apparatus, When the use of such tools is absolutely necessary they may be used but only with the permission of the work must be carried out under the direct supervision of the supervisor.

When a machine or apparatus is equipped with guards and it becomes necessary to remove such guards for maintenance work on the machine itself, the guards must be replaced immediately the work is finished. Two or more men must be employed when carrying long pieces of material such as pipes, hand bars scaffolding, ladders, etc. near switchboard, panels or any live electrical conductor or apparatus so as to eliminate any chance of accidental jarring of relay panels or contact with live Parts. Minimum length requiring these precautions may vary from 1.5 meter to 3 depending on the place of work.

Portable lights must be equipped with proper guards and care must be taken to see that guards, lamps plugs and sockets and wires are not defective.

Flashlights normally used inside sub-station buildings generating stations must be fully insulated and made of a nonconducting material. In special cases such as line work or outdoor bus inspection a metallic type or higher power portable light may be used.

Any electrical apparatus such as small motors, power tools, lamp cords or extension lights which are in an unsafe condition are not to be used.

The sides of emery wheels are not to be used unless they are designed for such work and are properly equipped with washers and guards. When changing grinder wheels, the rated r.p.m. of the wheel must correspond with the rated rpm of the tool.

Switch sticks, Earth sticks and buzz Sticks.

Sticks must be of an approved design and inspected before use. Defective sticks must be tagged "Out of order" and reported on a station trouble Report for immediate repairs.

Sticks must be stored indoors or in a weatherproof covering outdoors. They must be hung vertically or supported horizontally throughout their entire length. They must have free air space to neighboring walls and must never be left on the floor or ground.

Switch sticks, Ground sticks & Buzz sticks should be periodically tested and repaired or replaced if found bad. A duplicate of each type of switch stick must be kept available in the station in case of breakage.

Wire Ropes/Fibre Ropes

Wire rope has almost superseded fiber rope and chains for hoisting and haulage purposes. The type of wire rope to use depends upon the intended use and the degree of flexibility desired.

1. Standard Wire Hosting Rope consists of 6 by 19 wire strands and a fiber core; made of iron, cast steel, mild plow steel, plow steel, or special plow steel. The breaking strength of standard wire hoisting rope, in tons, is shown in the following tabulation. (The breaking strength may be divided by the factor of safety to obtain the safe load). Safety factor is the ratio of ultimate strength of rope to the safe working load.

| Diameter in | Weight per | Breaking strength (tons) |
|-------------|-------------|--------------------------|
| mm (inches) | meter in KG | plow steel |
| 6.35(1/4) | 0.148 | 2.5 |
| 9.52(3/8) | 0.342 | 5.5 |
| 12.70(1/2) | 0.595 | 9.4 |
| 15.87(5/8) | 0.937 | 14.4 |
| 19-05(3/4) | 1.340 | 20.6 |
| 22.22(7/8) | 2.380 | 28.0 |
| 25.40 (1) | | 36.5 |

2. Extra-Flexible Wire Hosting Rope for use with smaller sheaves and drums such as usually found in hoists and derricks, consists of 8 by 19 wire stands and one fiber core.

The breaking strength of this rope is approximately 90 percent of the strength of the standard wire hosting rope given in the preceding tabulation.

3. Special-Flexible Wire Hoisting Rope consists of 6 by 37 wire stands and one fiber core. it is extremely flexible and is specially adapted to high-speed service on cranes or where sheaves are small. The breaking strength is approximately the same as that of standard wire hoisting rope.

| Minimum Factors of Safety for | or Wire rope |
|-------------------------------|--------------|
| Slings | 8 |
| Derricks, Cranes | 6 |
| Tow Ropes | 4 |

Wire ropes are permanently weakened if they are stressed when kinked. To uncoil new wire rope from a reel, the reel should be placed on a spindle and the rope unwound by pulling it out in a straight line.

Wire ropes should not be bent around corners when attaching them to a load.

Thimbles should always be used when a loop is formed at the end of a wire rope.

Lubrication of a wire rope is important.

WHEN TO DISCARD WIRE ROPE

6.1 Wire ropes shall be inspected at the time of installation and once each week thereafter, when in use and should be removed from hoisting or load-carrying service when any one of the following conditions exists:

1. When three broken wires are found in one strand of 6 by 7 wire rope.

2. When marked corrosion appears.

3. When wire rope has been idle for 3 months or more and subject to water, moisture, dampness etc. shall be removed from hoisting or load-carrying service.

4. Any wire rope shall be removed from load-carrying service when the number of broken wires found in more than one strand strands amount to more than 4 percent.

Fiber ropes are made principally of manila fiber, sisal fiber, and hemp. Constant care and frequent inspection are imperative in the use of rope as the interior fibers may be broken or ground to powder, while the exterior fibers may indicate that the rope is worn but little.

1. Pure manila rope is the strongest and most reliable of the fiber ropes and should be used wherever high tensile strength is required. New manila rope is hard but pliant. It is of yellowish color with a silvery or pearlish luster and has a silky feel when drawn through the hand

2. The breaking strength, working strength. and weight of standard manila rope (3 strand) with safety factor equal to 5 is shown in the following tabulation:

| Diameter in | Weight per | Strength |
|-------------|-------------|-------------|
| mm (inches) | meter in KG | Breaking KG |
| 6.35(1/4) | 0.020 | 600 |
| 12.70(1/2) | 0.075 | 2,650 |

| 19.05(3/4) | 0.167 | 5,400 |
|-------------|-------|--------|
| 25.04(l.0) | 0.270 | 9,000 |
| 31.75(11/4) | 0.418 | 13,500 |
| 38.10(11/2) | 0.600 | 18,500 |
| 50.80 (2) | 1.080 | 3,100 |

When a table of strength is not available, an approximation of the working strength of rope may be obtained by squaring the numerator of the diameter in eighths and multiplying by 20. This gives strengths somewhat lower than those given in the table.

1. Sisal rope has about 60 to 70 percent of the strength of manila rope. Good grade sisal rope is yellowishwhite, sometimes with a greenish tint,

2. Hemp rope is nearly as strong as manila, and is slightly more resistant to atmospheric deterioration. It is of a dark gray colour and is much softer than manila rope.

Wet rope deteriorates rapidly unless dried properly. All fiber ropes are easily damaged by acids and care must be exercised to prevent rope coming in contact with acid.

Signs and Designations.

All equipment, electrical or otherwise, involved in the operation of the system, is to be marked with its proper name and/or number for the purpose of identification.

The supervisory staff at every location must make sure that adequate signs and designations kits at all control points for disconnecting switches and that these signs and designations are in accordance with station standards. In particular, attention should be given to adequate designation for switches in cubicles or where two or more control handles are operated from the same switching platform. When switches are mounted in cubicles, designation is required both inside and outside of the cubicle. In case of switch cubicles feeder designations should be clearly written in bold letters both in front and back of the cubicles.

Each protection and all lines and switches on relay panels, control panels, and in junction boxes etc. are to be properly identified. This includes current and potential circuits.

In the case of air, and water suppliers all valves shall be identified and storage tanks shall be marked with the name of their contents as well as the capacity and /or pressure of each.

When people are working on any cable or line fed by any cubicle, caution notices like "Do Not Operate", "Men working etc. Please see appendix-"B" are put temporary on such cubicles after drawing out/lowering the switch in the cubicles.

Accidents and First Aid.

All employees must be thoroughly familiar with first aid practices.

All employees must be familiar with PGCB approved methods of respiration (Please see WI-OHS-06-Physical Agencies).

At each attended station, first aid kits must be kept readily accessible and properly maintained at all times. The first aid kits to be used should be in accordance with established standards.

All PGCB vehicles must carry first aid kits in accordance with established standards.

When working far from a vehicle or station where first aid suppliers are not available, the men must carry a first aid kit. Supervisor is responsible for seeing that the contents or these first aid kits are complete and in good condition.

At each station or circle the Manager/ Deputy Manager/ Assistant Manager will appoint employees who will be responsible for seeing that contents of the first aid kits are complete, and in good condition. No change is to be made in the first aid equipment, medicines or methods without authorization.

All injuries, no matter how slight, must be treated as soon as possible. All major burns must be treated by a doctor eventually. All eye injuries must be treated by a doctor. **03L.08** Treatment of injuries must be carried out by methods shown in the authorized first Aid Handbook and as pre-scribed by the PGCB instructors.

All accidents, however slight, must be reported and the appropriate forms completed in accordance with Standard Instructions. All accidents should be investigated immediately after the occurrence and the causes by identified and reported to the person/committee responsible for updating these regulations/Codes.

A fatal or serious accident must be reported immediately, by telephone if possible, to the station or Manager or his assistant, who in turn will see that the proper persons are notified. Field accidents are required under the law to be reported to Govt. of Bangladesh in their prescribed proforma within certain period (Format in MISCELLANEOUS).

Safe Working Practices-Specific Group

Special Regulations Concerning Operators

The first consideration of an operator must be the operation of the station or division under his care and it must take precedence over any other duties assigned to him expect those necessary to protect human life. NO MATTER WHAT WORK IS TO BE PERFORMED,

THE FIRST CONSIDERATION MUST BE THE SAFETY OF THE MEN.

Operators must not interchange shifts unless permission has been obtained from the supervisor-in-charge. Operators must not vacate their posts until arrival of their relived unless authorized to do so by the supervisor-in-charge. Any extended delay in relief should be reported to the supervisor-in-charge.

Working more than 12 consecutive hours by prearrangement is forbidden. In any case, a relief must be provided as soon as possible after 12 hours of work.

Except when special arrangements have been made, an operator must finish his shift, even though his relief comes in early. In the event of station troubles at the time of shift change, the out-going operator will be in charge and will be responsible until the trouble is over or is sufficiently under control to permit handing over to the incoming operator. Records and reports pertaining to such troubles must be completed before the outgoing operator leaves.

When changing a shift, incoming and outgoing operators shall sign a daily form recording the time of the transfer of responsibility. Each operator shall sign in the presence of the other, the incoming operator signing last and recording the time on the form. The transfer shall become effective on being signed by the form. The transfer shall become effective on being signed by the incoming operator and before singing, he must be certain that he is familiar with all existing Conditions. The outgoing operator must make certain that the incoming operator is made familiar with all existing conditions.

When their are two operators on duty and one wishes to leave the control room, be must advise the other man place or place he intended route through the station and the particular the operators' protection.

During times of stress or unusual conditions the operator-in-charge has the right to call upon any employee for help without prior appeal to the man's supervisor. he must however, advise the supervisor at the first opportunity.

At night or at any time when supplementary lighting is required operators must carry an approved electric flashlight or lantern when making their rounds of inspection. These flashlights or lanterns must be inspected by the operator at the beginning of the shift and defective ones reported for immediate repair or exchange.

The Operator-in-charge, upon taking shift, must make an inspection of the plant and equipment as soon as possible, and make at least one more inspection during the later half of this shift. This is in addition to the usual rounds of inspection by himself or his subordinates.

Any condition of apparatus or equipment which in the opinion of the operator, requires immediate attention or repair is to be reported to the supervisor in charge without delay. If service is likely to be affected, the system operator must also be advised immediately.

If, in the opinion of the operator-in-charge, the equipment must be taken out of service immediately to avoid serious damage, the operator is authorized to do so, on his own responsibility.

In all cases, the operator-in charge must make out a report covering defective or damaged apparatus or unusual conditions occurring during his shift. When reporting troubles, operators must make a clear distinction between actual fact and personal deductions or conclusions.

Sale Working Practices Electrical Workers

Rubber gloves protected by leather gauntlets are to be used for electrical work only where the possibility or leakage or induction presents a hazard which cannot be eliminated by proper grounding, The use of rubber gloves does not replace the use of proper grounding procedures as laid down in this code.

All rubber gloves must be tested by an approved testing station prior to issue and every month thereafter. All gloves considered defective and replacement, accompanied by report as to how the gloves become damaged

Employees must never use their fingers to test for live circuits of any voltage. Circuits of less than 250 volts may be tested by lamp or other approved safe testing device. Extreme caution must be taken when testing circuits with portable testing equipment.

Men working in or on open transformers must remove all objects from their pockets. All tools must be attached to suitable hand lines so that the tools may be withdrawn if accidentally dropped inside the transformers. Before actually removing manhole covers or bushings from a transformer, all materials and tools must first be removed from the top of the transformer or securely tied. Suitable containers must be provided for the material removed from the transformers, It is the responsibility of the man-in-charge to check that all of these precautions are taken.

The use of a blow torch acetylene or any open flame, is absolutely prohibited in or on open transformers, without the approval of the superintendent of the division involved

When work must be carried out in switch rooms or confined spaces where exit could be obstructed by fire of other occurrence, adequate fire-fighting apparatus must be kept handy and other employee posted where he can be of assistance in case of an emergency.

Only full insulated flashlights or extension lamps are to be used when working behind switchboards, bench boards, relay panels, etc.

Particular care must be taken to prevent accidental contact of metallic objects such as key chains, metal pencils, belt buckles, wristwatches, metal zippers, necessary tools, etc. with live wires or terminals.

After cutting or disconnecting relay or control circuits, the ends of the wires should be taped or otherwise insulated in order to avoid accidental contact with persons other circuited or ground.

When working on current transformer secondary circuits for test or removal of instrument, etc. current transformers must be short circuited between the transformer and the location of any work to be done. In no case, should a live current transformer be allowed to become open circuits on the secondary side.

The use of blowtorches and open flames should be avoided behind or under switchboards or relay panels, Two or more men must be employed when carrying long pieces of material such as pipes, hand bars, scaffoldings, ladders, etc. near switchboards, panels or any live electrical conductor or apparatus so as to eliminate any risk of accidental jarring of relay panels or contact with live parts. Minimum lengths requiring these precautions may vary from 1.22 meter to 3.04 meters depending or the place of work. Every precaution must be taken to ensure the identification of electrical circuits before cutting or interfering with them in any way.

Before any work is started in the vicinity of relay panels or on apparatus equipped with gas detector relays which could cause tripping of this equipment, a HOLD ORDER must first be obtained from the operator in charge. This applies particularly to drilling in relay panels, drilling or chipping concrete or other work which might cause vibration. Dusting of relay covers is not to be carried out without a HOLD ORDER (Permit to work) from the operator in charge.

When removing potential transformer fuses of 6600 volts and above and when it is impossible to clear the circuit, an approved stick must be employed. Employees must keep the maximum possible clearance from the live parts.

In stations where it is necessary to handle fuses of several different potentials, the fuse sticks or tongs must be positively identified so that there can be no possibility of error in the choice of appliance. After use, the fuse stick or tongs must be returned to the proper rack.

A dangerous charge can be retained by static capacitor after it has been disconnected from the normal power source. Before any work is static capacitors, even if equipped with discharge coils, a short circuit and ground must be applied and maintained for the duration of the work. Where fuse sare employed in capacitor installations and work is to be carried out between the fuses and capacitor, the short circuit and ground must be applied on the capacitor side of such fuses.

Safe working practices: Linemen

When attaching his safety strap, the lineman must see that it is placed in such a way that it connot slop off the pole or tower. The strap snaps must be checked to make sure they are properly in place and the strap tested with the man's weight before releasing his hold with his hands.

Two safety straps should never be fastened together to reach around a large pole. An approved extension should be used.

When erecting or revolving poles or structures a suitable number of guys and or braces must be attached to the pole or structure in order to prevent uncontrolled movement.

All old or weak poles must be guyed or braked before climbing.

Linemen must not climb or work on a pole above the bottom of an open ground lead gap if the circuit on the pole is energized. If work is to be carried out above the bottom of the gap them the gap must be bridged metallically by means of an approved grounding jumper. The jumper must be connected to the groundside first and then connected to the upper and of the gap. When disconnecting the jumper, the upper end must be disconnected first.

When climbing poles, the linemen must, when possible, climb on the same side as the ground lead, so that neither his hands nor any part of his body will touch the ground lead.

When working in elevated positions material or tools must never be thrown-a bucket or hand line must be used.

The practice of leaving spare material temporarily on towers or poles is to be discouraged as much as possible. When it becomes necessary to leave spare material in elevated positions, it must be well secured in place.

On poles and structures objects such as long bolts, spikes, etc. which may cause accidents should be cut off or removed.

Groundman or others must not stand directly under towers or poles when work is proceeding above.

Poles, towers or structures are not to be used to secure guy wires from other poles, etc. without the approval of the superintendent or his foreman.

Insulted clips on field telephones or test sets must be kept in good condition at all time. When a test set is to be the lineman must climb part way up the pole to insulate himself from ground when doing this he must keep clear of the ground lead on the pole. Or steel tower lines, when using the test set, rubber gloves must be used if no insulated platform has been provided.

When stringing conductors in the immediate vicinity of normally energized circuits, such circuits should be cleared and grounded whenever practicable. When it is impractical to ground circuits in the immediate vicinity of conductor stringing, a Permission For live line Work is required on the energized circuits which are nearby.

When new wires must be strung or old wires pulled out, near energized lines, the conductors being worked metal pulleys. It is preferable that pulleys be grounded.

When bare wire is run directly off the reel, it shall be run over metal snatch blocks which are grounded and arranged so that the wire makes a positive contact at all times.

When stringing wire or cable it must be kept under full positive control at all times and permanent ties made as soon as possible.

When pulling wire or cable in the vicinity or energized circuits every effort must be made to avoid bodily contact with the bare conductor being pulled. hand lines must be employed for this operation.

Carrying of hand tools on the lineman's body belt is to be discouraged. If it is absolutely necessary to carry them, then, such tool or tools must be securely, tied to the body belt so they cannot accidentally fall down.

Fire Protection

Organization and Responsibility.

It is essential that the employees at each station shall be organized in such a way that the fire extinguishing equipment shall be used to the best advantage and that fire fighting activities shall be carried out with a minimum of confusion.

It is the duty of every employee to eliminate fire hazards. In event of fire, an employee must render all possible assistance to extinguish it.

The Manager/DM/AM of each Division/station shall nominate chief and deputy fire chief for the station or Division, who will be responsible directly to Manager/DM/AM for performance.

The fire protection duties of the Chief Fire Officer are as follows:-

1. To be responsible for the training of the station personnel in the application and operation of each type of fire fighting equipments. This must include the operating staff.

2. To make sure that the proper apparatus is available at the place where fire is likely to occur and that all personnel are acquainted with the location of such equipment and its use.

3. To be responsible for fire fighting equipment being in operating condition at all times and that proper fire protection inspections are made monthly and the fire Inspection, forms completed properly and checked by the Manager/DM/AM having jurisdiction before forwarding to the main office Dhaka.

4. To make sure that fire fighting equipment is not obstructed or hidden by any changes which may take place in the station.

5. To point out to the Manager/DM/AM where fire hazards in unprotected locations exist and make recommendations where necessary.

6. To make sure that safe working practices as regards fire hazards are followed.

7. To take change of fire fighting operations in co-operation with the operator-in-charge.

8. To see that "No Smoking" signs are installed in places where there is danger of explosive gases being present, such as battery and oil storage rooms.

9. To set up actual fire fighting practices at least four times a year to assure that all employees are familiar with the use of fire fighting equipment. In addition, at least six test runs per year must be carried out to assure that proper equipment is available and in working order.

10. If for any reason any fixed fire fighting equipment is removed from service under the authority of a Permit-to-Work (HOLD ORDER) then when it has been returned to service the fire chief must inspect and check the system to ensure that all valves and any other associated equipment are in a proper are in a proper operating position and condition.

A layout showing the location of fire fighting equipments must be displayed in a suitable place.

In the event that nominated fire officer is away, the operator-in-charge will assume the duties of the fire officer.

Precautions Against Fire

Rages, either clean or dirty, are to be regarded as distinct fire menace and must only be kept in covered cans or receptacles especially provided for that purpose.

Combustible material such as packing boxes, excelsior etc. must not be left lying around but should be disposed of immediately.

To prevent the possibility of an explosion, gasoline, benzene, paints and other volatile liquids must not be poured in to station drains. Such liquids must be taken outside, dumped into a properly prepared pit and burned under proper control. They must never be poured down drains.

Smoking is not permitted nearer storage or in any oil processing rooms. The use of open flames or sparking devices in such areas in prohibited in order to prevent explosions. Electrical wiring in any oil processing room has to be in perfect condition so that no that no spark occurs. It should be periodically checked. Smoking is strictly prohibited in this area.

Whenever insulating oil is being filtered or handled, a fire extinguisher of proper type must be in the immediate vicinity.

All oil hoses must be of an approved type and properly earthed to reduce the accumulation of static electricity when handling oil or other flammable liquids.

In general one should always be aware. If static electricity when using a filter press, and the container in which the oil is to be filtered should be carefully earthed.

When working near opening or manholes in the tanks of apparatus containing oil such as transformers, oil circuit breakers, regulators, oil such as transformers, oil circuit breakers, regulators, oil storage tanks etc. open flame lights and sparking devices must not be used because of the possibility of gas formation and consequent explosions. Vapour proof extension lamps with guards in proper conditions are to be used.

Volatile and flammable liquids including paint solvents are to be stored in proper containers and in appropriate areas or building provided for such storage. When used, the above liquids must be contained in proper safety cans equipped with a flame arrester screen at the filler and at the spout opening, Dispensing plunger cans must be used when cleaning and sponging with flammable liquids. Paints are to be stored in metal storage cabinets.

A fire extinguisher must be readily available where flammable liquids are being used.

Fuses must not be plugged or replaced by anything except fuse wire of the proper size and suitable capacity. Should fuses continue to blow when inserted this definitely indicates troubles which must be located, isolated and repaired.

General Rules

At all attended stations there must be a distinctive alarm to indicate a fire.

This alarm is to be used only in the case of fire drill.

No fixed fire fighting equipment may be modified or taken out of service without the knowledge and authorization of the station or Divisional officer, the operator-in-charge and, if possible the fire chief Any modifications or changes to the fire fighting equipment must be entered in the station log.

Whenever work is to be performed on the fixed fire fighting equipment such as the multi tire or sprinkler systems, fire pumps fire alarms or the controls of any of any of the foregoing, a Permit-to Work (HOLD ORDER) must be obtained.

Any new equipment or changed condition of old equipment of different methods of using equipment should be promptly explained in local instructions issued by the station or Divisional Officer.

Procedure in Case of Fire.

Any employee becoming aware of a fire on PGCB property will proceed as follows --

1. Sound the fire alarm where possible.

2. Notify the operator-in-charge.

3. Call for assistance immediately from any employee.

4. Cal the fire service department only if authorized to do so.

5. Use appropriate fire tightening equipment and direct the fire fighting with the personnel available until relieved by the fire chief or deputy fire chief. Procedures and equipment used must be as outlined in the Fire Fighting Manual.

6. To avoid danger to personnel, no attempt should be made to fight a fire on equipment operating at 400 volts or above without first having the equipment properly de-energized.

This does not apply to remotely controlled fire extinguishing equipment which can be operated before the electrical apparatus is cleared.

Special equipment such as breathing apparatus and fire protective suits should be used only when strictly necessary and then only be authorized, trained personnel accompanied by another person acquainted with fire fighting practices.

When the fire alarm is sounded, all available men must report immediately to the location assigned for this purpose.

Fire Fighting

Periodical inspection/test and demonstration must be carried out. The following check list is furnished to remind of more important things to look for if one is called upon to make fire prevention inspection:

1. Electrical Equipment: Switches, Insulation, Fuses, Earthing.

2. Matches or Smoking: Confined to places permitted. Safety matches only used.

3. Heat Hazards: No combustible material in contact with steam pipes, furnaces, flues etc. Ashes in metal containers.

4. Flammable liquids: Stored in approved places, Safety Cans used, Tanks, Drums and Cans in good order. No leak.

5. Oil and paint: Stored in approved places, No leaks, Dripping properly disposed of

6. Combustible Materials: Stored in approved bins or containers.

7. Only Rags and Waste: All in approved metal receptacles.

8. Gas: No leaks, turned off when not in use.

9. Refuse: In approved Containers, Disposed daily.

10. Lockers and Closets: Kept neat. No accumulation of rubbish.

11. STANDPIPE AND FIRE HOSE. All fire hose shall be kept properly connected to the standpipe at all times, nozzle attached and ready for instant use.

12. FIRE TRUCK. The truck should be in perfect condition to start on instant warning and its tank must be full of water.

Pumps, hose, nozzle and other fixtures must be ready for instant use. Periodical checks and demonstration must be made. All personnel shall be alert and ready for any emergency.

Fire Fighting equipment: In place easily accessible, in working order, Sprinkler valves open, Sprinkler head unobstructed, alarms in working order, If Fire Truck, Tank full water, Pumps, Hose-nozzle etc. in proper condition, and personnel alert and ready Refill extinguishers as soon as they are:

I) CARBON DIOXIDE AND DRY POWDER shall be kept properly filled according to the MANUFACTURER'S specifications and inspected at least annually. Carbon dioxide extinguishers shall be weighed at regular intervals as reprimanded by the manufacturer.

ii) SODA ACID EXTINGUISHERS shall be inspected periodically and emptied and recharged at least once every 12 months. Each extinguisher shall bear a Card a giving the date of the last recharge. Extinguishers of this type shall be used only on free burning fires and under no circumstances on energized electrical equipments.

III) FOAM TYPE EXTINGUSHERS are effective for oil fires. They shall not be used to extinguish electrical fires, foam extinguishers shall be emptied and, recharge at least once every year and have card attached showing date of each recharge.

iv) FOG EXTINGUSHERS. Water Under Pressure, when discharged through special nozzles, produces at for which is very effective in extinguishing all types of fires. As the name implies, the water in fine spray and not a solid stream. It is especially efficient in extinguishing fires involving transformers, oil switches and burning combustibles near electrical equipment. Before directing fog near energized high-voltage

conductors, allow air and scale to clear from system and see that fog, not a solid steam, is produced. Keep clearance of over 3 meter from energized high-voltage conductors up to 132 kilo volts.

Classification of Fires

Classification of fires is the systematic arrangement in classes of the various substances that as fuels produce heat by combustion, as follows:

Class A-Ordinary materials such as wood, paper and textiles.

Class B – Flammable liquids such as oils and greases.

Class C-Live electrical equipment

Class A Fires: Fires coming under the "A" classification are fires with ordinary materials such as wood, paper, textiles, rubber, rubbish etc. These fires are generally handled best with a good solid stream of water to break up and penetrate the burning material. On most ordinary fires any of the common class A extinguisher which use large percentages of water may be used, such as

Class A Extinguisher: Soda- acid extinguishers, antifreeze pump-tank extinguishers,

Calcium chloride extinguishers Foam extinguishers, Loaded steam extinguishers Fire pails.

The action of all the above extinguishers is by cooling the burning substance below its ignition temperature and by excluding of these methods. Some types tend to inhabit oxidation by chemical action.

Class B Fires: Flammable/inflammable (identical in meaning) liquids do not themselves burn or explode, but as pointed out previously, the gases or vapors formed when they are heated and evaporated explode; that is, the change of state from liquid to gas must first occur. As long as they are in a liquid state with no vapors being given off there is little or no hazard. for the more volatile liquid, such as gasoline, storage in a closed container is a necessity. In order for any vapor to explode it must have the correct vapor-air ratio, just as in the carburetor of a car. When the engine is choked with gas the mixture is too rich, and fails to ignite. The same hold true in gasoline storage.

The danger is when the gas is being poured from one container to another, thus giving the vapors the chance to mix with the correct amount of air to form an explosive mixture.

The same circumstances hold true for all flammable oils when enough heat is present to release vapors from the liquid.

Class B Extinguisher: With the above facts in mind, flammable liquid fires may be fought with any of the following.

Class B extinguisher: Water with a fog nozzle Chemical or mechanical foam Carbon dioxide (C02) Dry Chemicals.

Keeping in mind that a flammable liquid is not hazardous as long as it is not hot enough to give off vapors which can mix with the oxygen in air and burn two things can be done:

(a) The liquid can be cooled down to the point where no vapors are given off; and 9(b) The supply of oxygen can be blanketed out. Both of these can be accomplished with any one of the Class B extinguisher listed above some flammable liquids off vapors at temperature ordinarily considered cold for example, gasoline vaporizes at -450 F or Lower.

The use of Water with a fog nozzle works very effectively on a flammable liquid, as it completely covers the burning surface with a fine spray which cools the surface, dilutes the flammable vapors, or emulsifies the flammable readily mix with water will form either a foam or an emulsion having proportion of water.

Class C fires: In fighting an electrical fire there are two important things to be taken into consideration: namely, damage to the equipment far beyond what the fire could do, and danger to the individuals fighting the fire. To avoid these two possibilities, de-energize the circuit and use only the types of extinguisher recommended for Class C fires, as follows:

Class C Extinguisher: Carbon tetrachloride/Carbondioxide (C02) Dry chemicals water with fog nozzle.

For small electrical fires, such as fires in insulation of cables, windings on motors, etc. any one of the first three class C fire extinguishers may be used before the circuit is de-energized without danger to the operator or to the electrical equipment, due to the fact the extinguishing agent is a non-conductor. Deenergize the circuit as soon as possible.

Division of Responsibility

Responsibilities of Load Dispatchers and System Operators.

The load dispatcher and system operator are responsible for efficiently coordinating the operation of the stations and transmission lines of PGCB high voltage power system (from 132 KV and above) in order to assure continuous and satisfactory service to the customers.

The load dispatcher is responsible for allocating loading to all generating stations and for the general safe allocation of load over the interconnected electrical systems. He also responsible for maintaining power interchange over the system, for load frequency control and for general hydraulic and thermal operation in an economic manner.

The system operator is responsible for system electrical operation, system voltage and var control, line and equipment loading and the maintenance of service to customers, he has to simultaneously consider continuity, quality and economy while operating the system.

The load dispatcher and/or the system operator have jurisdiction over the release of lines or apparatus when such release affects, or might affect, the operation of the system.

The load dispatcher and system operator in carrying out their system operating functions are bound by the operating regulations as set forth in this standard operating code.

Responsibilities of the operators-in-charge.

The shift in charge is responsible to the Manager for the station or division. He must be familiar with these standing instruction or orders which apply to his duties under his supervision.

The shift in charge is responsible for the safety of equipment under his supervision and will follow these rules and regulations and must exercise good judgment in case of emergency. When it is apparent that equipment must be taken out of service immediately to avoid serious damage, this should be done without the decay necessary to advice anyone. However, as soon as conditions permit, the supervisor in charge must be notified together with the system operator. In certain instances it may be possible to keep the equipment in service until it can be released with minimum inconvenience to the system service.

The Shift in charge is responsible for the enforcement and observance of these Standing Instructions in the station or division under this supervision as far as they affect his duties and the duties of his subordinates, he is also responsible for seeing that any equipment or apparatus is in safe operating condition before it is returned to service.

The shift in charge must co-operate with other persons in the application of the rules. Should any conflict or doubt arise as to the division of responsibility outlined in these Regulations the matter must be referred to the operators immediate supervisor.

The shift in charge in responsible for safety of people working on feeders to the extent that they should which on or off, earth the feeder on request of foreman in charge of the workers.

Responsibilities of the Foremen.

Foreman will be held responsible for the general safety of the men under their jurisdiction and must see that all reasonable precautions are taken for their protection.

When work is to be done by employees of the Production Organization of equipment located in plants of subsidiary allied or outside companies the Foreman must make himself familiar with the Hold Off system and regulations of these companies and govern himself accordingly. Understand circumstance the Foreman must see that no work is done under conditions which are contrary to the principles laid down by this standard operating code.

Foreman must see that equipment or apparatus released for repair is in a safe condition before returning it to the jurisdiction of the operating staff for service.

All foremen are responsible for seeing that all tools safety appliances and equipment used by the men under their supervision are of an approved design and acceptable according to PGCB'S standards where they apply and that they are maintained in good condition at all times. Regular periodic inspections must be made by the foreman of the tools and equipment used and a record of such inspection kept on the forms provided for this purpose.

In small stations where there is no Foremen the local supervisor will assume the responsibilities of foreman outlined above.

When two more men are working on a job and they are under the immediate direction of a foreman one of the men must be appointed by the supervisor or foreman as "charge hand and the man will then assume the responsibilities of the foreman for that job.

Responsibilities of Site-in-charge.

When persons are to carry out work where an element of danger may be introduced due to their lack of familiarity with the equipment of working area, a watchman (Site in Charge) will also be employed when work is to be carried out by any group of men where there is an element of danger due to the proximity of live apparatus or other hazards. Manager must issue a list of men authorized to act as watchmen in their station or Division.

Under the jurisdiction of the man in charge it is the duty of the watchman to see that.

1. The men under his care do not inadvertently move out of the safe working zone.

2. Dangerous move of men or materials are prevented.

3. All personnel wear appropriate personnel safety equipment. 4. All necessary safeguards are provided and maintained.

5. All hazards are eliminated as far as possible.

6. All hazards which cannot be eliminated are fully explained to the men.

7. Unauthorized personnel do not enter the danger area.

8. He wears an Identification Badge.

The Site-in-charge must be on the job before any work is started. If he is called away or has to leave for any reason work must stopped until he has returned or another Site-in-charge is appointed.

If the work has been stopped for more than 45 minutes and always after meal periods the watchman must ascertain from the man in charge that he has checked with the operation to see that working conditions have remained uncharged during the interval or that no unusual circumstances have occurred which might render the job more hazardous.

When workman has permission to leave his work he must report to the Site-in-charge when leaving and returning.

The Site-in-charge must be advised of all changes in location of work and in the number and locations of protective grounds and safeguards.

A watchman must not be required to watch more than 10 men at any one time. Under certain circumstances it may be necessary to limit the number to one or two workmen. The number of the men in the gang must not be changed without first notifying the watchman.

The watchman is directly responsible to the Operator in-charge for the safety of the men in so far as all hazards are concerned. The engineer-in-charge must have the work stopped if the watchman considers working conditions too hazardous. Any disagreemention this point must be referred to a higher authority before work is resumed.

In the case of immediate of urgent danger the watchman has the authority work instantly.

The presence of the watchman dose not relieve the man in charge for the safety of his men from his responsibility

When a watchman is required in connection with a HOLD ORDER, the operator and the man in charge are jointly and separately responsible for seeing that a watchman appointed and the operator must give him the same warnings as to restrictions, limitations, and dangerous features as are given to the holder of the HOLD ORDER. He must be supplied with and must wear a Identification badge during his appointment.

Manager must issue a list of men authorized to act as watchmen in their station or Division HOLD ORDER will not be issued to men acting as watchmen except in the case where they are the PGCB's representatives on a job being carried out by a contractor, customer of other than Department employees. **Responsibilities of Local Supervisors.**

When word "supervisor" as here used, refers to the ranking man of a station or Division such as station or DM, AM, J.A.M. or other such employee who exercises local executive or administrative duties delegated by the Manager or the Department.

The local superintendent is responsible for efficient station operation and the maintenance or all physical assets under his jurisdiction. All other supervisors under his direction are available to assist him in discharging these responsibilities.

It is the duty and responsibility of such supervisors to see that all workmen are familiar with the General Regulations and Standard Operating Code of the Department and that workmen use safe working methods, tools and equipment.

In the case of temporary employees, the Local Supervisor must see that they are properly instructed according to the training manual prepared for this purpose and that they are also made familiar with the General Regulations as applied to their duties.

Local Supervisor are responsible for keeping each other and all employee under their jurisdiction informed concerning all matters which may affect the safe and efficient function of the station or Division under their supervision.

If it becomes necessary for a Local Supervisor to give orders directly to workmen, he immediately assumes the responsibilities or the Foreman or charge hand.

the Local Supervisor must advise the Foreman or charge hand concerning such orders at the earliest opportunity.

The station or Division Manager or his representative must make every effort instruct his men in accident prevention and the importance of continuity of service.

In the various chapters throughout this Code, station or System Manager are made responsible for certain approvals or decisions. In the Manager's absence, DM/AM or "supervisor on duty" will assume these responsibilities.

EARTHING (GROUNDING)

GENERAL

Earthing systems are of great importance for protective purposes. Any failure to carry out effective earthing exposes persons to the risk of shock or burn. All metal work which encloses, supports, or otherwise is associated with electrical conductors and apparatus, unless designed to be energized must be connected with earth.

PERMANENT EARTHING.

Permanent Earthing of Equipments shall be as specified in station and Transmission Line Standards.

Temporary installations of electrical equipment must be properly earthed in the same manner as permanent equipment.

The secondary circuits of low voltage transformers supplying local lighting or power should be earthed as required by the Electricity Act 1910.

The casings of all electrically operated tools, weather portable or stationary, must be properly earthed whenever feasible before employees are permitted to operate them.

TEMPORARY EARTHING

Special care should be exercised to avoid bodily contact with normally live electrical circuits unit they have been properly earthed.

Temporary earthing of electrical equipment, cleared for work, will safeguard employees from electrical shock or burns in the immediate vicinity of the temporary earths.

Temporary earthing is to be carried out by means of portable earths (ground or earth sticks) in substation and generating station work, it is permissible to use earth switches if they are at the location of the work.

Portable earths (ground or earth sticks) must conform to the specifications in station and Transmission line standards.

As far as practical, no man should work at a point where he is out sight of the earths which protect him. When work is to be carried out on transmission lines/distribution lines, protecting earths must be applied on all phases at the immediate location of the work. If this is not possible, the earths must be applied on ail phases on both sides of the work and as close to the work as possible. This applies whether or not earth switches have been used.

When it is necessary to cut a line, bus bar, loop, or to repair a broken conductor or damaged loop, earths must be place on all phases on each side of the work and as close as possible to it.

Should there be any switches between the work and the earth point, earths must be applied on the side of the switch or switches adjacent to the work, unless such switch are securely locked in the closed position and a "Men Working" tag attached to the operation control point or points.

There must not be any fuses in the circuit between the protecting earths and the location of the work

Permanently installed single or double pole earthing switches do not provide completed earthing of there phases circuits, the other conductor or conductors must be earthed as well.

Before any apparatus or circuit is earthed for work, it must first be satisfactorily tested for "no voltage" on all phases using an approved device suitable to the voltage in question.

When installing temporary earths on transmission lines/distribution lines and other electrical apparatus, the step-by procedure detailed below must be strictly followed:

1. Test each phase for "No voltage"

2. Attach the earth clamp to the earthing point.

3. Securely attach the safety chain loop around the earthing

4. Place the conductor clamp of the earth stick on the conductor using the insulating stick.

When removing temporary earths, the step-by-step procedure detailed below must be strictly followed:

1. Remove the conductor clamp from the conductor using the insulating stick.

Then:

Detach the safety chain.
Remove the earth safety chain

Caution: Employees must, take care to avoid contact with the bared during the period when they are actually making or breaking the earth connection with the conductor.

Employees who are used in the application of temporary earths must be trained and periodically checked concerning their knowledge of the proper method of application and removal of temporary earths (earth sticks).

No work must proceed on or near the electrical conductors of any transmission lines/ distribution lines, bus bar, or other electrical apparatus, operating at a nominal voltage of 400 volts or above, unless all conductors have been properly earthed. This does not apply when PERMISSIONS are issued live station work.

Insulated cables and certain other electrical apparatus such as heavy current, low voltage equipment, where earths might be more of a hazard than a safety precautions, and/or in cases where it is not practicable to apply proper earths, they may be exempted from these regulations. The station or Divisional officer must issue a local operating instruction, stating clearly, within limits which apparatus under his jurisdiction is exempt from the general earthing regulations must clearly define the precautions which are to be taken.

Telecommunication Equipment, Relay and other such circuits which are exposed to induced voltage or accidental contact with power circuits must be earthed for work. The station or divisional officer will issue local operating instructions covering the procedures to be used when work is to be done on such circuits.

Authority and Responsibility of Temporary Earths

Any Temporary earth installed by the operator or ordered installed by the operator for permit-to-work purposes must be considered solely under the control of the operator and no one must interfere in any way with these safeguards.

If desirable a maintenance man may install additional temporary earths on equipment covered by his permit-to-work in force. Linemen are obliged to install their own temporary earths.

The man in charge is responsible on the completion of the job, for the removal or all temporary earths placed by himself or by his orders. All temporary earths must be counted on their installation and removal in order to check that all have been removed.

It is in the right of every employee to be protected and he may request additional temporary earths which in his opinion are required if the man in charge is undecided as to the reasonableness of the employee's request of extra protection, he should grant the request for extra protection or obtain instruction from his supervisor.

NO MATTER WHAT WORK IS TO BE PERFORMED, THE FIRST CONSIDERATION MUST BE THE SAFETY OF THE MEN.

Earthing Equipment for use on High Voltage Apparatus:

Approved Portable Earthing leads for use as circuit Main Earths.

1. The portable EARTING leads, that are to be used as CIRCUIT MAIN EARTHING shall be of such a size and design so as to be capable in use of carrying the full rated short circuit earth current if a LIVE circuit, was in error closed on to them at the position where had been applied.

2. The choice of the cross sectional size of such leads will depend on the short circuit levels of the electrical system which they are to be used. However in practical terms the voltage of the electrical system and the rating of the installed switchgear, can generally be used to determine the cross sectional size that will be adequate.

3. The choice of fittings for line, earth end clamps and the length of the leads will depend on the APPARATUS on which the portable EARTHING leads are to be applied.

4. Leads for use in sub-stations with exposed HIGH VOLTAGE conductors shall be of a length suitable to reach from the DEAD conductors to the nearest substation EARTH bar. The line and clamps shall be of a design suitable to enable an effective condition to be made at both ends.

5. Leads for use on wood pole over head lines conductors, shall be of a design suitable for applying a line end clamp to each conductor and effectively terminating at the other end on a junction, from which a lead of sufficient length and size connects to EARTING rods which can be driven into the earth.

6. If portable EARTHING leads are required as CIRCUIT MAIN EARTHS on steel tower overhead lines, then those specified for use in sub-stations with exposed HIGH

VOLTAGE conductors can be used providing that the line end clamps are suitable for applying to the overhead conductors and the earth end clamps are suitable for Connecting to steelwork of the tower.

Approved Portable Earthing leads for use as Additional Earths

1. An overhead line circuit which has been DEAD, ISOLATED and EARTHED at each end, can have dangerously high voltages induced onto its conductors from adjacent circuit on a double circuit overhead line or by natural phenomena.

2. The effects of this induced voltage can be completely removed when ADDITIONAL EARTHS are correctly fitted at, or near, the point of work on the conductors. If a break is to be made in the conductors of an overhead line circuit, then ADDITIONAL EARTHS shall first be applied, as dangerously high voltage can occur across the break.

3. The portable EARTHING Leads, that are to be used as ADDITIONAL EARTHS, shall be of such a size and design so as to be capable in use of preventing and induced voltage, at the point of work, on a already EARTHED conductor.

4. The choice of the length *of* such leads, their cross sectional size and design features, line and earth end clamps shall depend on whether they are to be used on wood pole or steel tower overhead lines.

5. For wood pole line it may be practicable, and operationally prudent, for the same portable EARTHING leads, as specified for CIRCUIT MAIN EARTHS to be used as ADDITIONAL EARTHS.

6. The portable EARTHING leads for use as ADDITIONAL EARTHS on steel tower overhead lines, may be of a smaller cross sectional size than that required for CIRCUIT MAIN EARTHS duties, but shall be of sufficient length to span from the overhead conductors to be steelwork on the body of the tower. The fine and earth end clamps shall be of a suitable design for this purpose.

Clearing Apparatus for Work

Regulations concerning the clearing of Apparatus for work

Clearing apparatus for issuing HOLD ORDER (Permit to work) requires the almost care to avoid overlooking some source of back feed in the case of electrical equipment. In the case of mechanical equipment, the possibility of some valve gate or safety block not being in the correct position must not be overlooked.

When clearing electrical apparatus for work, it must be isolated from all possible sources of potential by an adequate visible air gap.

When clearing transformers or regulators for work or when any work is to be carried out on or around such equipment, special precautions must be taken to see that the gas detector relay trip circuits, thermal trip circuits or other such protective devices are properly blocked before starting any work.

Equipment such as circuit breakers, concealed blade disconnects etc. which do not provide a clearly visible air gap, must not be employed as a means of isolation.

Isolators Incorporated in the mechanism of oil poured or air blast circuit breakers must not be used for this purpose. Some means must be provided to establish an air gap. e.g. open loops removal of bus section, etc.

Draw out types of metal clad circuit breakers provides satisfactory isolation when removed.

The gaps must be visually inspected to make certain that the circuit is fully open all phases.

When a motor or air operated disconnector is used to isolate equipment covered by a HOLD ORDER, the disconnect switch must be blocked positively in the open position where the mechanism is suitable, the disconnection switch must be mechanically disconnected from the motor or air mechanically and blocked and locked in the open position.

All fuses in the control circuit must be removed and/or the source of air supply to the operating mechanism shut off, air in the supply line drained off and the controller tagged. If a disconnect switch can't be blocked positively in the open position, it must not be used to isolate equipment covered by a HOLD ORDER.

When clearing electrically remote controlled equipment, all fuses of all control circuits involved must be removed on all legs.

In the case if equipment containing stored energy such as compressed spring, compressed air, etc, the energy must be released whenever practicable before a HOLD ORDER is issued.

When shutting off pipelines supplying air, oil or water to equipment being cleared, drain valves should be left open.

When clearing any apparatus for work, MAN WORKING, tags must be installed on all switch handles, controllers, fuse blocks, valves and all other control gear whose operation affects or might affect the apparatus being cleared for work. Grounding of all cleared electrical apparatus is to be carried out.

In all cases when clearing a relay protection for work, reference must be made to the standard and local operating instruction applicable to each location.

Protection from HV Back feed.

Equipment that is protected by a 'Work Clearance' may be prone to High Voltage back feed. It may occur in a dead bus through LV side of transformer connected to the bus if LV side is connected to a bus fed from other sources also. These things are sometimes overlooked which should be considered seriously for safety of the persons working.

Hold Order System (Permit To Work) System General Description

The purposed or the standard HOLD ORDER system is to give protection to employees when working on electrical or other equipment. All types of HOLD ORDER may only be issued by the operator-in-charge. The HOLD ORDER gives authority for definite work to be done on specified apparatus and guarantees that certain conditions with be maintained which this work is being carried out.

A HOLD ORDER may be issued in any one of the following forms:

- a) Clearance for work
 - 1. Written clearance for work
 - 2. Verbal clearance for work
- b) Permission for work:
 - 1. Written work and test permit,
 - 2. Verbal work and test permit,
 - 3. Verbal Permission for work on live lines
 - 4. Verbal permission for work on live station equipment.
 - 5. Verbal Permission for work on relay protections control, metering and
 - communication circuits.

Regulations concerning the HOLD ORDER system

No one is permitted to change, adjust, disturb or in any way interfere with apparatus which is in service or which is being held in reserve and ready for immediate service without the knowledge and permission of the operator-in-charge.

Before any work is started on transmission lines, station, equipment or any apparatus including protection, control, metering, communication, fixed fire fighting equipment and pressurized systems, whose shutdown or removal from service affects or might affect the operation of a station or a system, the man in charge must first obtain a HOLD ORDER from the operator-incharge, irrespective of and in addition to any previous arrangements made or order issued by the operator's supervisors or any other person. No HOLD ORDER will be issued to anyone not directly associated with the station or Division unless special arrangement has been made with the Manager/DM/AM.

The applicant for HOLD ORDER must advise the operator as to:

- 1. The type of HOLD ORDER required.
- 2. The apparatus to be covered by the HOLD ORDER.
- 3. The nature of the proposed work.
- 4. The estimated time of completion.

In addition the applicant must give any other information which is necessary for a complete under standing between himself and the operator.

A verbal WORK/TEST PERMIT must not be issued to an operator for subsequent reissue. It must be issued directly to the man in charge of the work.

With the exception of a WORK/TEST PERMIT it is permissible for an operator in charge to obtain a verbal HOLD ORDER from the system operator and them to issue subsequent HOLD ORDER to the men in his own station or jurisdiction.

Station or Divisional Officer must issue a list of men capable and authorized to receive each type of HOLD ORDER on specified lines and equipment. A copy of this list must be supplied to all operating headquarters having jurisdiction in that area. The operators will issue HOLD ORDER only such authorized persons. The list must be reviewed and if necessary revised every six months.

All personnel authorized to take verbal HOLD ORDER by telephone or radio must be supplied with a diagram of the line or apparatus involved, showing the clearance points. When issuing and returning verbal HOLD ORDER they must be repeated back to avoid any misunderstanding.

The DM/AM of the station or Manager must see that the operation personnel of Divisions/Stations are made familiar with the PGCB'S regulations, concerning the HOLD ORDER system. These Regulations must be strictly adhered to at all times when HOLD ORDER is being issued on the PGCB's equipment.

Only one WORK/TEST PERMIT may be issued on any given place of equipment at one time. Special care must be exercised to ensure that the number of HOLD ORDER issued on any one specific place of apparatus is kept to a minimum. NOT more than four HOLD ORDER are to be issued on a specific place of apparatus at the same time unless special arrangements have been made. All HOLD ORDER issued on the same line or place apparatus are to be grouped and recorded in sequence on the station log. Also, appropriate separate operating diagram pins are to be used for each HOLD ORDER.

At attended station, the operator, before issuing any HOLD ORDER, must accompany the applicant to the cleared apparatus pointing out the location of all protecting grounds and warn him of any features which area hazard to personnel or service and which should be guarded against, in the case of remote unattended stations or lines, the same warnings must be given verbally.

In the case of a supervisory controlled station, verbal HOLD ORDER are to be use and some of the necessary switching may be required to be done by the applicant under orders of the operator in charge. In these instances, the applicant must be familiar with the equipment concerned, standard and /or local Operating instructions and must adhere strictly to the rules regarding the use of Switching Order Forms. The operator instructions must be followed explicitly.

After a HOLD ORDER has been issued, the operating staff must not make use of the specified apparatus until all HOLD ORDER on that apparatus have been properly returned and accepted. For live line and live station work, see Section 09K.

Workmen are permitted to transfer from one type of HOLD ORDER to another as often as desired provided the proper procedures, especially the WORK/TEST PERMIT limitations, are always followed and that the limitations and governing conditions of each type of HOLD ORDER are strictly observed.

The operator must register in red ink the issuing and return of all HOLD ORDER in the station or office log sheets and log books giving:

1. Time.

2. Name of person to whom the HOLD ORDER was issued.

3. Designation of the apparatus or line and the limiting points between which the HOLD ORDER applies.

In addition, the operator must insert the appropriate pins on his pin diagram indicating the limits of the line or apparatus on which the HOLD ORDER has been given.

The operator after issuing a HOLD ORDER may demand its return under urgent or unforeseen circumstances. If the man in charge, to whom the HOLD ORDER was issued, considers the apparatus unsafe for use or his work so advanced that the apparatus cannot be made available for service immediately, then he must refuse to return his HOLD ORDER. The matter must then be referred to the station or Divisional Officer.

If, after completion of the work on which a HOLD ORDER has been issued, the holder leaves without returning same to the operator, such holder will be personally responsible for returning the HOLD ORDER properly signed at whatever hour it may be required. If due to accident, sickness or any other reason it is impossible for the holder to return a HOLD ORDER, the apparatus must not be placed in service by the operator, without the approval of the station or Division Officers concerned who will take immediate steps to advise the holder and all other persons concerned.

After the work has been completed, the man in charge must notify each of the employees under his charge on that job to remain clear and that he intends to return his HOLD ORDER. The man in charge must see that his own grounds and/or safeguards, if any, are removed but must not interfere with the grounds and/or safeguards, if any installed by the operator or other parties. The HOLD ORDER must then be properly returned to the operator in charge stating the number of temporary grounds installed and removed. No further work must be done unless a new HOLD ORDER is obtained.

While a HOLD ORDER is in force the holder of any type of HOLD ORDER must report frequently to headquarters. At least one report should be made every two hours unless other arrangements have been made. While a HOLD ORDER is in force, if the work is discontinued for more than 45 minutes, and always after meal periods, the holder, prior to restarting work, must report to the operator either in person, by telephone or by VHF/Mobile, in order to make certain that no changes have been made in his absence which would make conditions in vicinity of his work more dangerous than before. For live line work HOLD ORDER see Section 09H.

With the exception of live line work, a HOLD ORDER must not be issued to allow work to be carried out on an open disconnect or any other type of air break switch has one side alive except when absolutely necessary and then, only with the approval of the station Divisional Officer.

If, after all normal precautions have been taken, there still remains an element of danger which requires that the work

be very carefully supervised HOLD ORDER is to be issued except with the approval of the station or district superintendent.

When retuning a HOLD ORDER on circuit breakers or disconnecting switches, they must be left in the open position, unless arrangements to the contrary have been made. In returning a HOLD ORDER, the holder must specify the operation of the apparatus involved.

When returning any HOLD ORDER the workman must advise the operator of any changes which have been made which might affect the operation of the equipment.

Such advice should be made in writing, it possible when necessary with explanatory sketches. Such information must be recorded in the station log and the supervisor in charge advised.

When all HOLD ORDER have been properly returned, the operator will remove all ground and safeguards installed by him or the operator on their shifts. He must then see that all tags and danger signs are collected and when possible, make a thorough visual inspection over the area covered by the HOLD ORDER and if desired; take the necessary steps to return the apparatus to normal service.

When a watchman is required in connection with a HOLD ORDER, The operator and the man in charge are jointly and separately responsible for seeing that the watchman is appointed and the operator must

give him the same warnings as to restrictions, limitations, and dangerous features as are given to the holder of the HOLD ORDER he must be supplied with and must wear a identification Badge during his appointment.

Manager (Divisional Officer) must issue a list of men authorized to act as watchmen in their station or division. HOLD ORDER will not be issued to men acting as watchmen except in the case when they are the PGCB'S representatives on a job being carried out by a contractor, customer or other than Department employees.

When HOLD ORDER have been issued on line feeding a particular area no HOLD ORDER will be issued on other circuits feeding the same area if there is danger of jeopardizing service.

Regulation covering a Written Clearance for Work

The written CLEARANCE FOR WORK is to be used at attended stations where the apparatus concerned is under the jurisdiction of the station operator, and when the work to be done does not require that the apparatus be operated or energized during the course of the work and when the original safety precautions taken by the operator will be maintained.

It gives authority to the holder to work on the specified apparatus. It is also a guarantee that the apparatus has been taken from service, will remain out of service, cleared for work and that the operator-in-charge has taken all precautions for the protection of men, equipment and service as required by this Code. In the case of apparatus at all stations the operator will be responsible for the closing of ground switches and/or having temporary grounds applied where required by this Code, in the case of transmission lines, the operator will have the live terminations grounded where ground switches have been provided and will advice the applicant whether the line is or is not grounded.

It is the duty of the recipient to apply his own temporary grounds at the location for the work.

The type of card to be employed for a written CLEARANCE FOR WORK is shown in Appendix A. It consists of two portions body and stub, with certain printed instructions and space for definite entries by the operator and the applicant for the CLEARANCE FOR WORK, each of whom keeps his half of the card while the job is in progress. When issued, the body and stub must bear the same date, time and card number.

It is permissible to issue more than one written CLEARANCE FOR WORK at the same time on the same apparatus. When two or more foremen are to work independently on the same equipment, a separate CLEARANCE FOR WORK must be obtained by each Foreman. If however, one foreman is appointed to take complete responsibility for the supervision and safety of all parties, then for all practical purposes there is only one foreman and a single CLEARANCE FOR WORK can be employed.

When more CLEARANCE FOR WORK are out on the same or related apparatus and it becomes necessary to make a test or a trial, such testing is only to be carried out after all CLEARANCE FOR WORK have been returned to the operator and cancelled.

Regulations covering a Verbal CLEARANCE FOR WORK

A verbal CLEARANCE FOR WORK is to be employed in connection with work on transmission lines or at unattended or semi-attended stations where the operator has not been qualified to issue HOLD ORDER on equipment remote from an attended station where it is impractical for a written CLEARANCE FOR WORK card to be employed. A verbal CLEARACNE FOR WORK will in general be governed the regulation covering the issue of a written CLEARANCE FOR WORK.

To avoid overlooking any verbal CLEARANCE FOR WORK, the operator's section of a CLEARACNE FOR WORK card must be filled in and the holder's stub marked to indicate that a verbal CLEARANCE FOR WORK has been issued to a specific employee. This CLEARANCE FOR WORK card must be retained until the verbal CLEARANCE FOR WORK has been returned.

Application of HOLD ORDER System to Lines and Line Equipment at

Attended Stations when a Combination of Written and Verbal HOLD ORDER Is employed.

When it is required to work on lines, line disconnecting switches, line entrances or other apparatus on the lines at an attended station, where the station operator has not complete jurisdiction as to the assuring of CLEARACNE FOR WORK on such equipment, the procedure outlined below will be employed.

The employee in charge of the work must apply to the station operator for a written CLEARANCE FOR WORK.

The station in charge of the work must apply to the station operator or Divisional Officer/Operator, who has jurisdiction as to HOLD ORDER on that line for verbal CLEARANCE FOR WORK.

The System Operator, after having the apparatus prepared for the CLEARANCE FOR WORK, will issue a verbal CLEARANCE FOR WORK to the station operator.

The station operator will log the receipt or the verbal CLEARACNE FOR WORK. He will then follow in all respects the procedure with reference to the issuing of CLEARANCE FOR WORK, after which he will issue a written CLEARACNE FOR WORK to the applicant. In addition, the operator will write across the face to both sections of the card.

"VERBAL CLEARANCE FOR WORK on

received from

When the work is finished and CLEARANCE FOR WORK cards have been returned, the station operator will see that all grounds and safeguards, other than those placed under instruction from the system Operator / Divisional Officer, are removed and it is safe to place the line/equipment back in service. The station operator must not interfere with any ground switches closed, or safeguards applied, under instructions from the system operator without their consent.

The station operator will then return the verbal CLEARANCE FOR WORK to the operator from whom it was received and log the return of such CLEARANCE FOR WORK.

When entering a verbal CLEARAFNCE FOR WORK, the station operator must always advise the system or Divisional Officer/Operator as to the position of all ground switches involved.

Regulations covering a Written Work Permit

The written WORK/TEST PERMIT is to be used at attended stations where the apparatus concerned is under the jurisdiction of the station operator and when the work requires the apparatus to be operated or energized during the course of the work or when the nature of the work is such that the precautions taken by the operator cannot be maintained for the duration of the job.

This WORK PERMIT gives authority to the holder to carry out work and tests on specified equipment it guarantees that the holder is the only party working on that equipment and that condition will not be changed by the operator except at the request of the holder.

The type of card to be employed for a written WORK PERMIT is shown in Appendix A. It consists or two portion, body and stub, stub, with certain printed instructions and space for definite entries by the operator and the applicant for the WORK PERMIT each of whom shall keep his half of the card which the job is in progress. When issued, the body and stub must bear the same date, time and card number.

A WORK PERMIT must be issued by the system operator or operator in charge directly to the applicant.

It is forbidden to issue a WORK PERMIT if the apparatus concerned is already covered by another HOLD ORDER. After a WORK PERMIT has been issued on a place of apparatus, under no circumstances is any other HOLD ORDER to be issued on this same equipment or apparatus.

When a WORK/TEST TEST PERMIT is issued, the apparatus must be handed over to the applicant with the same safeguards in place as would apply for a CLEARANCE FOR WORK. The applicant, after he has obtained the WORK/TEST PERMIT grounds and other safeguards as placed by the operator as he considers necessary for the progress of his work in so doing, he automatically relieves the operator of and personally assumes responsibility for any consequences resulting from the removal of such safeguards. In connection with the actual work and tests to be carried out the following limitations will apply:

1. The primary control devices or the apparatus, located in the control room, must be manipulated only by the operator or his delegate.

2. The apparatus worked upon must on no account be allowed to become connected to or in any way involved with other apparatus not covered by the WORK/TEST PERMIT, without the consent of the operator.

3. Request by the holder for changed conditions must be entered on the operator's portion of the WORK/TEST PERMIT.

4. At the request of the holder and at he operator's discretion, the latter will remove the ground and safeguards provide, if that interfere with the work. If the operator refuses the request the matter must be referred to the local superintendent.

Regulations covering a Verbal WORK/ TEST PERMIT

A verbal WORK/TEST PERMIT is to be employed in connection with work on transmission lines or at unattended, or semi-attended substations where the operator has not been qualified to issue HOLD ORDER, on equipment remote from an attended station where it is impractical for a written WORK/TEST PERMIT card to be employed. A verbal WORK/TEST PERMIT will in general be WORK/TEST PERMIT.

To avoid overlooking any verbal WORK/TEST PERMIT, the operator's section of a WORK/TEST PERMIT card must be filled in and the holder's stub marked to indicate that a verbal WORK/TEST PERMIT has been issued to a specific employee. This WORK/TEST PERMIT card must be retained until the verbal WORK/TEST PERMIT has been returned.

Regulations covering a Verbal Permission for work on or Near Live Lines

These regulations are drawn up to cover live line work on lines energized at 66 KV and above. Their express objective is to protect personnel which carrying out this work. If communication is lost with operating personnel during such work, a prolonged outage of an important circuit could easily result. All personnel involved in live line work must realize the importance of continuity of service.

It is imperative that while this work is being performed a channel of direct communication must be set up between the workman in charge and operating headquarters and this communication channel must be maintained throughout the duration of the work if at all possible. If it is impossible to maintain communication with headquarters then special arrangements must be made and the live line must be buzzed at intervals as requested by the operating staff. If a line being buzzed is found dead, an immediate report is to be made to the operator in charge so as not to delay the restoration of service.

Live line work is defined as follows:

1. Hot stick work such as changing insulators.

2. Pole top mirror inspection.

- 3. Buzzing insulators.
- 4. Live insulator washing.
- 5. Resetting poles with the line energized.
- 6. Inspection of tower tops.
- 7. Painting tower tops.
- 8. 1 R drop testing of conductor joints.
- 9. Work on overhead ground wires.

In brief, live line work includes all work of any kind on energized lines above a point one meter below the bottom cross arm in the case of structures with pin type insulators, or work on any kind above the elevation of the bottom conductor in the case of structures with suspension type insulators. This does not apply to special structures such as river crossings where work may be permitted above the conductors at the discretion of the officer concerned.

A verbal PERMISSION FOR LIVE WORK is to be employed when it is desired to on or near an energized line.

A verbal PERMISSION FOR LIVE LINE WORK Gives Authorization for specific work on a given line. When verbal PERMISSION FOR LIVE LINE WORK is issued for work on a double circuit tower, a PERMISSION FOR LIVE LINE WORK is issued for work on a double circuit tower, a PERMISSION FOR LIVE LINE WORK must be taken not only on the line being worked on but also on the adjacent line. When a HOLD ORDER has been taken to work on one circuit of a double circuit line, PERMISSION FOR LIVE LINE WORK must also be taken on the adjacent line.

For live line maintenance work involving the use of hot line sticks, only one PERMISSION FOR LIVE LINE WORK per line will be granted. Up to four PERMISSION FOR LIVE LINE WORK on the same line may be granted for buzzing and mirror inspections and the other types of live line work.

Specific conditions for live line work are:

1. Automatic reclosing features must be blocked on a line which a verbal PERMISSION FOR LIVE LINE WORK is in force.

2. Relay protective features and device must be in service on a line which a verbal PERMISSION FOR LIVE LINE WORK is in force.

3. Live Line Permit for Work tags must be attached to all circuit breaker controllers of the line before a verbal PERMISSION FOR LIVE LINE WORK is issued.

4. Large green pins must be placed on the station and system operating pin diagrams.

Note: The operator issuing the verbal PERMISSION FOR LIVE LINE WORK will notify all other operators concerned that until further notice, the designated line is not to be tested,

5. While live line work is in progress every effort should be made to prevent an automatic outage of the line concerned. For this reason, which such work is in progress, permission should not be granted for work on the line relay protection, the line breaker automatic ground switch or other features or devices associated with the line protection.

6. In the case of an automatic outage of a line on which a verbal PERMISSION FOR LIVE LINE WORK has been issued, the operator must not reclose the line until the man in charge of the live line work has been contacted and warned to have his men stand clear.

7. During the progress of the work, should there be any evidence to indicate the loss or possible loss of normal potential on the lines or equipment concerned, the foreman or man-incharge must report to the system operator or operator in charge as quickly as possible. This applies whether or not anything has occurred at the site of the work which might have caused an interruption on the equipment, such delays in the restoration of normal service.

8. When work is to be discontinued for any length of time, the verbal PERMISSION FOR LIVE LINE WORK must be returned and a new verbal PERMISSION FOR LIVE LINE WORK must be obtained before work is resumed. If the job site is left in an abnormal condition, special arrangements must be made to keep in contact with the operator.

9. The holder of a verbal PERMISSION FOR LIVE LINE WORK or his messenger will keep in frequent contact with operator-incharge. In case where the linemen are out of contact with headquarters, the line must be buzzed at least once every hour and an immediate report made to headquarters if a line is found dead.

Refer to the LIVE LINE WORK INSTRUCTIONS for special precautions covering live line work.

Regulations covering a verbal Permission for work on or Near Live Station Equipment.

These regulations are drawn up to cover work on or near live station apparatus energized from its normal source and connected to the system net work. Live station work is defined as follows:

1. Mirror inspection with hot sticks.

2. Testing live bushings.

3. Washing live bushings and insulators.

4. Phasing checks.

5. Testing for voltage indication, exclusive of voltage testing prior to grounding.

In brief, live station work includes al cases where work is to be done on or near live apparatus operating at 600 volts or above.

A verbal PERMISSION FOR LIVE STATION WORK must be obtained when it is desired to work on or near live station apparatus.

A verbal PERMISSIN FOR LIVE STATION WORK gives authorization for specific work on a given place of equipment when a verbal PERMISSION FOR LIVE STATION WORK is issued, and there is the possibility of hazard from adjacent apparatus a PERMISSION must also be taken on the adjacent apparatus.

When high voltage testing is to be carried out, the area or locality of the test must be properly fenced or roped off and tagged and if in an area of ordinary thoroughfare guards should be stationed to direct traffic and prevent unauthorized persons from passing through the danger area.

Temporary high voltage test leads must be distinctly marked with "Danger" signs or other distinctive markers which are clearly visible.

Regulation covering a verbal permission for Work on Relay Protection, Controls, Metering and Communication Circuits.

The above PERMISSION FOR RELAY WORK cover all features of the station wiring including associated circuits external to the station which in any way might affect the operation of the system and are tested as follows:

1. A verbal PERMISSION FOR RELAY WORK, for work on relay protections and associated wiring.

2. A verbal PERMISSION FOR CONTROL WORK, for work on equipment control devices and wiring.

3. A verbal PERMISSION FOR METERING WORK, for work on metering equipment and associated wiring.

4. A verbal PERMISSION FOR COMMUNICATION WORK FOR work on communication and carrier circuits, which are in any way connected to relay protection, control or metering circuits.

Before any work is performed on the above mentioned apparatus except the routine changing of meter charts, a verbal PERMISSION FOR RELAY WORK must be obtained from the operator in charge. When such PERMISSIONS are issued it shall be the duty of the operator in charge to notify the system operator and other interested parties.

Before issuing a verbal PERMISSION FOR WORK on the above mentioned equipment it is the responsibility of the operator in charge to see that the equipment has been properly blocked so that no unauthorized tripping will take place. It is his further responsibility to see that proper procedure as detailed in Standard and Local Operation Instructions.

Before a verbal PERMISSION FOR RELAY WORK is issued for work on a specific protection, the front and back of adjacent relay panels must be covered to prevent accidental tripping by workmen. When relay panels are arranged back to back, the panel opposite one to be worked on must also be covered.

When it is necessary to work in relay rooms or adjacent to relay protection panels where no verbal PERMISSION FOR WORK is required, this work may be done only with the authorization or one of the supervisory staff, after the operator in charge has been notified.

Irrespective of the above, before any work is started in the vicinity of relay panels or on apparatus equipped with gas detector relays which could cause tripping of this equipment, a HOLD ORDER must first be obtained from the operator in charge. This applies particularly to drilling metering panels, drilling or chipping concrete or other work which might cause vibration. Dust clearing of relay covers must not to be carried out without a HOLD ORDER from the operator in charge.

No work on the above mentioned equipment is to be undertaken without the prior approval of a member of the supervisory staff of the station(s) or division concerned.

In the case of a PERMISSION FOR COMMUNICATION WORK on a communication or carrier circuit which is in any way connected to relay protected, control or metering circuits involving two or more station. it is the duty of the operator the PERMISSION to advise the other station or stations concerned and the system operator.

Men Working Tags

These are red colored tags as shown in Part Caution Notices/Tags. These tags are to be installed at all controlling points of apparatus on which a CLEARANCE FOR WORK or a WORK/ TEST PERMIT is being issued and are only to be installed and removed by the operator-in-charge or on his order. If desirable a miniature tag may be used on the bench board controller.

Each tag must be initiated and dated by the person installing it.

These tags are never to be used as a substitute for the "Live permit for Work", "Danger" "Out of Order", or "Abnormal Conditions" tag.

Line Permit for Work Tags

These are green colored tags as shown in Part Caution Notices/Tags. These tags are to be installed on all circuit breaker controllers of apparatus on which a PERMISSION FOR LIVE LINE WORK or a PERMISSION FOR LIVE STATION WORK is being issued and are only to be installed or removed are by operator in charge or on his order. If desirable a miniature tag may be used.

Each tag must contain installation date & the initial of the person installing it.

These tags are to be installed only when a PERMISSION FOR LIVE LINE WORK is being issued and are not to be removed until the PERMISSION has been returned.

"Danger" signs/Tags

These black and red signs shown in Part Caution Notices/Tags. must be used to indicate danger in the immediate vicinity of the point marked. They may be installed by the operator or the work as required. They are to be used only in areas where actual danger exists.

Each sign must be initialed and dated by the man installing it.

Abnormal Conditions Tags

These blue colored tags as tags as shown in Part Caution Notices/Tags, to be attached to apparatus which do not operate in its normal manner. Such a tag do not prohibit the use of the apparatus marked, it indicates that special caution should be exercised and that the equipment should not be used unless its limitations are understood. If desirable a miniature tag may be used.

This tag may be used by both operators and maintenance men, but must not be placed on any apparatus under the jurisdiction of the operator-in-charge without his consent.

Each tag must be initialed and dated by man installing it.

This tag must not be revived until the abnormal conditions have been corrected and all interested parties notified.

"Out of Order" Tags

These are yellow colored tags as shown in Part Caution Notices/Tags. These are to be used to indicate faulty apparatus, building accessories, or any equipment which must kept out of service because of some defect.

This tag may be used by both operators and maintenance men but must not be placed on any apparatus under the jurisdiction of the operator-in-charge without his consent.

Each tag must be dated and initiated by the man installing it.

This tag must not be removed until the "Out of Order" conditions has been corrected and all interested parties notified.

Do Not Operate Tags

Each Disconnecting Switch will have individual tags. The tagging of isolating devices that are common junction point between multiple clearances is shown:



Miniature Tags

In the case of bench board and supervisory controls, miniature tags of the type previously outline may be used in a holder of approved design and when using this type of tag, each tag must be initiated and dated by the person installing it.

Operating Pin Diagrams

Operating diagram pins are of different colors and shapes. They are to be used in conjunction with operating pin diagrams at ail locations to give operators an indication of the status of the equipment under their jurisdiction.

PERMITS-TO-WORK/TEST AND MINIMUM ACCESS DISTANCE (MAD)

Authority for issue

1. Permit to WORK/ TEST shall only be issued with the sanction of the control engineer. Who shall retain in his custody a written record of the issue of each Permit-to-WORK/ TEST and its cancellation.

2. A Permit to WORK/ TEST shall be issued by the Senior Authorized person under whose supervision the work is initiated before any work is carried out on any apparatus after it has once been connected to and remains part of a high voltage system.

3. A MAD shall be issued by a Senior Authorized Person or an Authorized Person specially authorized to do so. A MAD shall be issued when verbal instructions are not considered sufficient.

4. Excavation Permit A for declaration endorsed by all relevant departments of PGCB issued prior to work permit to the person in charge of the proposed excavations to ensure that all underground services and power cables are identified and safe methods of excavation are followed.

Procedure for Issue and Receipt

1) A WORK / TEST permit or MAD shall be issued to the person in charge of the work, who after reading its contents shall sign on its receipt and it's duplicate shall be retained to the person issuing the Permit to WORK / TEST or MAD.

2. The person to whom a Permit to WORK/TEST or MAD is issued shall be a Competent Person who shall retain the Permit to WORK/TEST or MAD in his possession at all times whilst work is being carried out.

3. The person in charge to whom a Sanction-of -Test is issued shall be an Authorized Person who shall retain the Sanction for Test in his possession at all times whilst tests are being made.

4. Where more than one working Party is concerned a Permit-to-Work or MAD shall be issued to the Competent Person in charge of each Working Party.

Precautions during Progress of Work

1. The apparatus isolated and earthed for work under the terms of a Permit-to-Work shall remain so until the Permit-to-Work has been cleared, returned to a Authorized Person, and cancelled.

2. The apparatus isolated and earthed for testing under the terms of a Sanction-for-Test must not be connected to the system without the sanction of the Control Engineer. The recipient of the Sanction-for-Test will be responsible for coordinating all testing operations on the isolated equipment and for ensuring safety during the tests. He may without further reference to the Control Engineer remove and replace earths as necessary and carry out tests including making live the apparatus concerned from a testing supply. This does not mean that the recipient of the Sanction-for-Test must make the tests personally.

Procedure for Clearance and Cancellation

1. When work on apparatus for which a Permit to WORK/TEST has been issued is suspended or completed the recipient shall sign the clearance and return the Permit to WORKITEST to Senior Authorized Person who shall cancel it and inform the Control Engineer.

02. Where more than one Permit to WORK/TEST has been issued for work on High Voltage Apparatus associates with the same Circuit Main Earths the Control Engineer shall ensure that all such Permit to WORK/TEST have been cancelled before the Circuit Main Earths are removed.

03. When work for which a MAD has been issued is suspended or completed the recipient shall sign the clearance and return the MAD for clearance and return the MAD for cancellation to a Senior Authorized Person specially authorized to do so.

PLACING APPARATUS IN SERVICE

Returning Apparatus to Service.

Before returning any apparatus to service the operator must be informed of any change which has been made of the equipment and be guided accordingly.

In the case of major restrictions the station or division incharge and the system operator must be advised. If necessary, written instructions regarding procedures to be followed will be issued.

Generators, Transformers, lines or other Electrical apparatus whose correct operation depends upon Definitely fixed connections, and whose connections may possibly have been altered during the work, must not be placed in service until the necessary phasing, polarity, ratio and continuity checks have been made. When such alterations can affect the paralleling of two individual circuits, this paralleling must be physically proved before the equipments is paralleled in normal operation.

When synchroscopes, synchronizing connections or their associated potential transformers have been disturbed or their connections altered, a positive test for "in phase" indication and rotation must be made before they are returned to service.

In returning relays to service the procedures as given in standard and local operating Instructions must be followed.

Before starting any apparatus after repairs have been carried out, the operator must inspect the equipment to assure himself that all loose material or obstructions between stationery and moving parts have been removed.

After being returned to service, all repaired apparatus must be carefully watched for signs of trouble which may be indicated by instruments odor, noise, vibration, overheating or other unusual conditions.

Placing New Apparatus in Service.

New lines or station apparatus must not be placed in service until a thorough inspection and proper tests have been made by the station or testing & commissioning department. Such new apparatus must not be placed in service without the knowledge and approval of the station or testing & commissioning authority concerned the operation-in-charge and the system operator. The time and date of placing new apparatus in service must be accurately recorded.

When placing new major power equipment in service for the first time, in attended or unattended stations, it must be kept under close continual observation to ensure that it is operating satisfactorily. This period of observation must be a minimum of 48 hours. Circumstances may dictate a much longer period.

PLACING APPARATUS IN SERVICE

Returning Apparatus to Service.

Before returning any apparatus to service the operator must be informed of any change which has been made of the equipment and be guided accordingly.

In the case of major restrictions the station or division incharge and the system operator must be advised. If necessary, written instructions regarding procedures to be followed will be issued.

Generators, Transformers, lines or other Electrical apparatus whose correct operation depends upon Definitely fixed connections, and whose connections may possibly have been altered during the work, must not be placed in service until the necessary phasing, polarity, ratio and continuity checks have been made. When such alterations can affect the paralleling of two individual circuits, this paralleling must be physically proved before the equipments is paralleled in normal operation.

When synchroscopes, synchronizing connections or their associated potential transformers have been disturbed or their connections altered, a positive test for "in phase" indication and rotation must be made before they are returned to service.

In returning relays to service the procedures as given in standard and local operating Instructions must be followed.

Before starting any apparatus after repairs have been carried out, the operator must inspect the equipment to assure himself that all loose material or obstructions between stationery and moving parts have been removed.

After being returned to service, all repaired apparatus must be carefully watched for signs of trouble which may be indicated by instruments odor, noise, vibration, overheating or other unusual conditions.

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New lines or station apparatus must not be placed in service until a thorough inspection and proper tests have been made by the station or testing & commissioning department. Such new apparatus must not be placed in service without the knowledge and approval of the station or testing & commissioning authority

concerned the operation-in-charge and the system operator. The time and date of placing new apparatus in service must be accurately recorded.

When placing new major power equipment in service for the first time, in attended or unattended stations, it must be kept under close continual observation to ensure that it is operating satisfactorily. This period of observation must be a minimum of 48 hours. Circumstances may dictate a much longer period.

WORK ON CIRCUIT BREAKERS

General Precautions

Before entering a circuit breaker compartment, all persons must obtain the consent of the operator in charge and be accompanied by the operator, if possible or by a responsible person designated by local instructions.

If necessary, measuring, cleaning or other work may be done around a live circuit breaker only with the approval of the incharge, if there is any danger what so ever of contact being made with any live parts to inadvertently operating the breaker. PERMISSION FOR LIVE STATION WORK must be obtained and a watchman must be appointed.

The operator must take the following special precautions before issuing a HOLD ORDER of any type of circuit breaker:

1. If possible, breaker should be open.

2. Remove the D. C. control supply fuses at the controller or the interposing relay panel.

3. Remove the A.C. supply to tank or control cabinet heaters.

The following precautions must be taken by the workman in charge after receiving a HOLD ORDER on a circuit breaker.

1. Satisfy himself that the conditions of the HOLD ORDER have been fulfilled.

2. Install mechanical blocking where required, to prevent unauthorized movement of the mechanism.

3. In the case of pneumatically operated breakers shut off the air supply and exhaust the tanks, leaving the exhaust valve open.

4. If possible, operate the trip and close circuits at the breaker itself.

5. Check that the A. C. supply to control cabinet heaters has been removed.

The holder of a HOLD ORDER may operate a circuit breaker by hand under the authority of a CLEARANCE FOR WORK but a WORK / TEST PERMIT must be taken out before energizing any circuits or operating the breaker either electrically or pneumatically.

Where it is necessary to work in a circuit breaker in a bus chamber. or room which contains two more such breakers, suitable barriers must be taken that material to be used in the work does not block any exit.

When work has been completed on a circuit breaker and before returning the HOLD ORDER to the operator in charge, the man in charge of the work must assure himself that all his safeguards such as mechanical blocking and barriers have been removed. He must also make sure that any valves or electric circuits which have been operated in the course of the work are restored to the position in which they were originally received, unless other arrangements have been made.

Work Inside Oil Circuit Breaker Tanks.

When work necessitates going inside an oil circuit breaker, another man must be detailed to stay in the immediate vicinity of the manhole to render any aid that may be required.

This outside man must see that no safeguards are removed or changed without the consent of the man inside the tank.

The mechanism must not be moved, except on definite instructions from the man in the tank and this man must be warned before any movement is made.

Matches, oil or gas lanterns, sparking devices or other open lights must not be used near manholes or inside tanks, because of possible explosion due to the presence of explosive gases. Smoking is strictly prohibited inside a tank.

Under normal conditions the breaker tank should be vented for at least 15 minutes before the workman enters the tanks. Under abnormal conditions (excessive fault operation, hot oil, etc.) tanks are to be vented by forced air.

Special Precautions Relating to Minimum-Oil Type Circuit Breaker.

An isolating switch incorporated in the Minimum-oil circuit breaker is not acceptable for the purpose of clearing the breaker for work.

As the operating springs are under tension in both the open and closed positions of the breaker, extreme care must be taken when adjusting the operating mechanism to avoid accidental operation which may cause physical injury

When working on the contacts of these breakers, the stored spring tension should be released by closing and tripping the breaker mechanically, after the control circuit has been opened at the breaker.

When it is necessary to dismantle the operating mechanism in the control cabinet the main spring tension should be completely released by means of the ratchet gear.

Special Precautions Relating to Air Blast circuit Breaker.

All parts of an air blast circuit breaker must be considered as live, with exception of the control cabinet. Exposed live metal parts to these breakers must be painted a brilliant red as a warning. Where it is desirable to indicator voltages, only the extreme top of the breaker is to be painted. Also the word DANGER should be painted in white in same conspicuous place.

When it is required to operate an air blast circuit breaker for test, all personnel, in the vicinity should be warned and men working on the breaker ordered to stand clear. Where employees are exposed to the air blasts from the breaker, goggles must be worn.

An isolating switch incorporated in the air blast circuit breaker is NOT acceptable for the purpose of clearing the breaker for work.

When working on an air blast circuit breaker where an electrical disagreement feature exists, the control switch and disagreement switch must be opened in each phase control cabinet at breaker.

Air blast circuit breaker, which has pneumatically operated mechanism, must never be blocked mechanically while pressure remains in the breaker storage tank or tanks. Mechanical blocking may result in personal injury or damage to the breaker.

SAFETY PRACTICES

General safety precautions

Work on High Voltage Apparatus

No person shall carry out work in any description on any part of High Voltage Apparatus unless the parts of the apparatus on which he works are

a. Dead

b. Isolated and all practicable steps taken to lock off from live conductors.

c. Efficiently connected to earth:

i) At all points of disconnection of supply to such apparatus, or

ii) Between such points and the points(s) of work:

d. Screened where necessary to prevent Danger and Caution and Danger Notices fixed.

e. Released for work by the issue of an Electrical Permit-to-Work or sanction-for-Test.

f. No person shall carry out work of any description on any part of High Voltage Apparatus unless the person is fully conversant with the nature and the extent of the work to be done.

It is the duty of the person issuing the Electrical Permit-to- Work or Sanction-for-Test to ensure that the provisions listed above are complied with. If the senior authorized person is not at the location of the work then the confirmation, that the safety precautions are completed, shall be obtained by the senior authorized person by telephone or radio contact with the responsible Control Engineer. Provided that if the clearances specified in Rule 8.6.1 are maintained, adjustments, cleaning and painting of earthed metal enclosures, and of structures may be carried out from ground level under a Limitation-of-Access. Similar work carried out from above ground level shall be done under and Permit-to-Work. Making live or dead by signal or prearranged understanding after agreed interval of time is FORBIDDEN.

Interference with Conductors/Parts

No person shall touch the insulation which covers or supports a high voltage conductor unless the conductor is dead and earthed.

Fixing of Notices and Screens

Work shall not be carried out on any High Voltage Apparatus which has been made dead and earthed until Caution Notices have been attached at all points where such apparatus can be made live. Danger Notices shall also be attached to the live apparatus.

Caution Notice, Danger Notice, barriers and screens shall be fixed or moved only under the supervision of and authorized person.

Safety locks

Safety locks shall be used to lock off all switches at points where the circuit on which work is to be carried out could be energized.

Safety Keys

Key safes fitted with locks shall be provided at suitable positions for keys which secure switches, barriers, spout shutters, lock-out equipment and other similar devices provided for the protection of men working under an Electrical Permit-to-Work only by a key in the possession of a Senior Authorized Person. The other locks shall be of a type operated by non-interchangeable Keys. Holders of all safe keys are personally responsible for their safe custody. Written receipts must be given by means of an entry made in the station key ledger each time the custody of a key is transferred.

Work on Towers, Poles and high structures.

All persons working on towers, poles and high structures shall wear and make proper use of a suitable safety belt or harness.

No man shall work alone at any tower or high structure. Before any wood pole is climbed it shall be sound and if the condition of it is doubtful shall be climbed only with the permission of the Competent Person in charge. All old weak poles must be guyed or branched before climbing.

Work on Apparatus which can be made live from More than One control system.

a. Before any switching or earthing is carried out or before an Electrical Permit-to-Work or

Sanction-for-Test issued for work on apparatus which can be made live from more than one control system the Control Engineer responsible shall communicate with the control

Engineer(s) of the other system(s) concerned and the switching and earthing shall be agreed between them.

b. The conditions of Rule 8.1 shall apply. Key safes shall be provided and the safety keys places therein.

c. The switching, earthing, deposit of safety keys in key safes and details of any Electrical

Permit-to-Work or Sanction-for-Test issued shall be recorded at all centres concerned.

Minimum Access Distance (MAD)

No part of a work's body or any conductive object held by a work shall be closer to energized high voltage parts than the applicable Minimum Access Distance unless an approved barrier is in place. When work is to be performed within the Minimum Access Distance Including the installation and removal of barriers, one of the following must be employed:

- 1. Adequate barriers.
- 2. Use of live line tools.

3. Clearance.

Conductive objects such as insulator support hardware which extend into Mimimum

Access Distance may be contacted outside the applicable Minimum Access Distance.

However, such objects must have been installed in accordance with approved design standards and be fixed or limited in movement so that the designed Clearances cannot be reduced.

Power equipment or loads shall not be moved closer than 4.6 meters (15 Feet) to energized circuits unless directed by a Safety Watcher. Approach within the Minimum Access Distance can occur only when the circuit is de-energized, properly tagged and grounded, or approved barriers have been installed.

The following Table provides Minimum Access Distance, in meters (inches), for phase-to-phase Voltage commonly used on other system. MAD is based upon maximum transient voltages that can be generated during switching.

| Minimum Access Distance (MAD) | | | |
|--------------------------------|-----------------|--------|--------------|
| Nominal Voltage Phase to Phase | Impulse Voltage | Meters | Inches(Feet) |
| 33 KV | 170 KV | 0.72 | 28 (21/2) |
| 132 KV | 550 KV | 1.25 | 49 (4) |
| 230 KV | 930 KV | 1.83 | 72 (61⁄2) |
| 500 KV/400 KV | 1425 KV | 3.21 | 126 (101/2) |

Enclosures Containing High Voltage Apparatus.

Enclosures, chambers, cubicles or cells containing live High Voltage Apparatus shall normally be kept locked and the keys shall be kept locked in a box or cupboard. They shall be removed only by an Authorize Person, except Authorized Person or person acting under his immediate supervision, shall have access to any enclosure, chamber, cubicle or cell in which a live conductor is exposed.

Towers and Gantries.

Gates and devices to prevent climbing of towers and gantries shall always be kept locked except when they are opened under the instructions of an Authorized Person.

Switching

Operation of Circuit Breakers and Isolators.

No high voltage switching shall be carried out without the sanction of the appropriate Control Engineer, except for cases of emergency For Switching of grid substations, sanction of load dispatcher shall be obtained.

When a control Engineer requires high voltage switching to be carried out he shall first communicate with the Authorized Person concerned. If the switching is to be carried out by another person not under immediate supervision of the Authorized Person, then the Authorized Person shall instruct the person who is to switch to communicate with the control Engineer to receive direct instructions.

Before any switching is carried out on a locally controlled system which may affect other system the Control Engineer authorized the switching shall communicate with the Control Engineer (s) of the other system (s) concerned and the switching shall be recorded at all centres concerned.

Switching to the Control Engineer's instructions, or with his consent shall be carried out without undue delay. All switching, whether to a Control Engineer's instructions or in case of emergency, shall be reported to the Control Engineer as soon as possible after each operation.

When a switchgear shows any sign of malfunction or distress after operating, its condition shall be reported to the Control Engineer and it shall be examined before further operation.

When any Person receives instructions to work on High Voltage. Apparatus but objects to the instructions, he shall report his objections to the Control Engineer who shall then have the matter investigated.

Telephone or Radio Messages

Every telephone or radio message relating to the operation of the high voltage system shall be written down. Every message shall be repeated in full back to the sender to ensure that the message had been accurately received.

Recording of Switching.

A record of high voltage switching shall be made in the station logs. The Control Engineer shall record in his log the time and details of all high voltage switching.

Switching for Test Purposes.

When a section of equipment has been isolated from the main supply system for testing, the Control Engineer may on the form for the Sanction-for-Test give a general sanction for the operation of switches, isolators, earthing switches and earth connections within the isolated, section. And for the application of testing supplies, the person in charge of the testing will then become wholly responsible for complying with these Safety Rules within the isolated section.

No switch or isolator connecting the isolated section to the main supply system shall be operated without the direct section of the Control Engineer except those for the agreed testing supplies.

Grounding (Earthing) Circuit Main Earths.

No high voltage earthing switch shall be operated except to the instructions of the Control Engineer. Only an Authorized Person or competent Person acting under the immediate supervision of Control Engineer shall carry out these operations. Each operation shall be reported to the Control Engineer as soon as possible after completion. Where applicable the location of each connection to earth shall be recorded on the Electrical Permit-to-work or Sanction-for-Test.

Additional Earths

Additional Earth connections may be attached and moved by Competent Person under

Electrical Permit-to-Work

Equipment for Earthing.

High Voltage apparatus is to be discharged and earthed by the use of earthing switches or special apparatus where provided, or by other approved means.

Earthing leads for use at generating stations and substations shall have a cross section of not less than (0.1sq.in) 65mm2 copper equivalents. Earthing leads for use on overhead lines shall have a cross section of not less than (0.04sq.in) 25.8mm2 copper equivalents. The clamps shall be of an approved type and adequate capacity.

Earthing leads shall be examined at least every three months and always immediately prior to use.

Procedure for the use of Earthing Leads

The procedure to be followed when using portable earthing leads shall be as follows:

a. Check that the circuit is not live and where practicable test by means of a voltage indicator of approved type, THE INDICATOR ITSELF BEING TESTED IMMEDIATELY BEFORE AND AFTER VERIFICAITON.

b. Earthing leads shall be connected to the earth system before being connected to the phases. They must be connected to the phases by means of a pole or other approved apparatus and care must be taken to ensure that good contact is made.

c. All phases shall be earthed, even if work is to be carried out on one phase only

d. Earthing leads shall not be applied in any cell or compartment in which there is any exposed metal live at high voltage.

e. When removing earthing leads at any point, they shall all be disconnected from the phase end before being disconnected from the system.

Earthing of Metal-Clad Switchgear

For the purpose of earthing metal-clad switchgear approved appliances only be used. THE INSERTION OF THE HAND OR ANY TOOL IN CONTACT SPOUTS FOR THIS PURPOES IS FORBIDDEN.

Before work is carried out on the withdrawable portion of truck type or metal-clad switchgear, the provisions of Rules 8.1 (a) and (b) shall be first complied with. The apparatus shall then be:

a. Checked by means of an approved voltage indicator, THE INDICATOR ITSELF BEING TESTED IMMEDIATELY BEFORE AND AFTER THE VERIFICATION.

b. Discharged to earth (such earth to remain connected unless the apparatus is bodily removed from its normal live position and is disconnected from all possible sources of supply)

Recording of Earthing

The control Engineer shall record in his log the location and time of application of all circuit main earth connections, and the time of their removal.

Permits-to-work and sanctions-for-test.

Arrangements for issue.

Permits-to-work or sanctions-for-test shall only be issued with the consent of the Control

Engineer, who shall retain a copy of each permit and sanction issued, until a senior authorized person has cancelled it.

Work shall not be carried out by person on any high voltage apparatus where technical knowledge or experience is required to avoid danger until an electrical permit-to-work or sanction-for test has been signed and the card copy handed by a senior authorized person to the person in charge of the work. The person in charge of the work shall then read about its contents to the senior authorized person issuing the permit or sanction, and also sign the card copy, and it's duplicate.

If the apparatus is not situated on the premises of PGCB, the senior authorized person shall hand over a pink copy of the electrical permit-to-work to the official responsible for those premises, and obtain his signature on it.

The person in charge to whom an electrical permit-to-work is issued shall be a competent person and the work shall be carried out under his immediate supervision. If work is to be carried out under the immediate supervision of the senior authorized person himself, he shall issue the permit and hold it as the person in charge. It is not permissible for a senior authorized person to issue an electrical permit-to-work to himself and then leaving the site.

An electrical permit or sanction shall be issued to the person in charge of each working party, unless the superintending engineer has authorized an alternative procedure in writing.

The person in charge to whom a Sanction-for-Test is issued shall be a Senior Authorized

Person or an authorized Person who has been appointed in writing to receive Sanction-for-Test

Precautions during Progress of Work

The apparatus isolated and earthed for work under the terms of an Electrical Permit-to-Work shall remain isolated and earthed until the permit has been cleared, returned to a Senior Authorized person, and cancelled.

The apparatus isolated and earthed for testing under the terms of a Sanction-for-Test comes under the temporary control of the man who receives the Sanction. He may operate it in accordance with these rules. He is responsible for co-ordination all such operation in the isolated equipment and for ensuring safety during the tests.

Procedure for Clearance and Cancellation

After work, for which a permit or sanction has been issued, has been completed or stopped by an Authorized Person, the person in charge the work shall sign the clearance. He shall then immediately return the card to the Authorized Person who shall then obtain the permission of the Control Engineer for cancellation.

Work in Sub-stations and Switching stations.

Safety Clearance to Live Conductors

When work is to be carried out in a sub-station in which there are exposed live high voltage conductors then unless the whole equipment is dead, the section which is made dead for the work to be carried out shall be defined as far as possible by the use of barriers or roping. These shall be arranged so that the minimum clearance from the nearest exposed conductor ground level or platform or access way shall be maintained as stated below

| | Minimum Clearance | | |
|---------------|-------------------|-------|--|
| Rated Voltage | Meters | Feet | |
| 33KV | 2.75 | 9.00 | |
| 132KV | 3.43 | 11.50 | |
| 230KV | 4.22 | 14.00 | |
| 400KV | 5.49 | 18.00 | |

If the work is such that these clearances are not sufficient to avoid Danger, other suitable arrangements shall be made to provide the degree of safety required.

At ground or floor level the section shall be distinguished by red flags fixed on separate supports 0.6m (2) to 0.9 apart. The boundary mark shall not be supported by any, structure carrying electrical apparatus or conductors, and shall not carry notice. Danger Notices shall be placed to indicate adjoining High Voltage Apparatus or section clearly.

Use of Cranes, Ladder and Longer Objects

a. Ladders shall be of an approved type and not longer than that needed for the work.

b. Ladders and other long objects shall not be used without the permission of an Authorized Person. The movement and erection of such ladders and objects shall be carried out only under the direct supervision of an Authorized Person. When moved at ground levels they shall be carried only in a horizontal position and as near the ground as practicable.

c. Portable ladders provided for giving access to fixed ladders shall be locked in position by an Authorized Person while work is being carried out on the structures.

d. When not in use, all portable ladders within substations or switching stations shall be securely locked to a suitable anchorage.

e. When not in use, all portable ladders within substations the route to be followed shall be agreed and defined on site by a Senior Authorized person. The equipment shall be connected to the substation earthing system immediately if it is practicable to do.

f. When cranes or other equipment are taken into or out of a substation, the route to be followed shall be agreed and defined on site by an Authorized Person to an Authorized Person and the equipment shall be erected or moved only within these limits under the supervision of the Authorized Person.

Work on High Voltage Apparatus

No person shall carry out any work on any high voltage Apparatus, unless the following operations are carried out in strict sequence:

a. The apparatus shall be

i) Switched out at all points of supply.

il) Isolated from all points of supply, including voltage and auxiliary transformers and common apparatus may become live.

b. The carrying out of these operations shall be reported to the control Engineer and further permission received for the carrying out of the subsequent operations.

c. The apparatus shall then be

i) Checked by means of an approved voltage indicator to verify that the circuit is not live. THE INDICATOR ITSELEF BEING TESTED BEFORE AND AFTER THE VERIFICATION:

ii) Discharged to earth.

iii) Efficiently connected to earth at all points of isolation from the supply, including points of isolation from common neutral earthing equipment.

d. Caution Notices shall be attached at all points where such apparatus can be made live.

e. Circuit breakers, isolators, spout shutters, control handles and safety devices shall be locked in position by the keys provided for purpose which then be locked in the appropriate key safe.

f. A Permit-to-work shall then be issued.

g. Unless the circuit main earths through which the apparatus is connected to earth are close to and visible from the point of works the apparatus shall be efficiently connected to earth by means of Additional Earths at the points of work. When apparatus has been disconnected from all supplies and bodily removed from its normal live position, its conductors shall be discharged to earth. No fixed earths are necessary.

h. If operations (a) to (e) are carried out at more than one location, the Authorized Person at each location shall lock the safe and retain the key in his possession until he receives instructions from the control Engineer to restore the equipment ready for service. At the location where the Permit-to-work is issued, the senior Authorized Person shall operate the lock reserved for his use and each recipient of a Permit-to-Work shall operate an additional lock and retain the key in his possession until he clears the permit and returns it with the key to Authorized Person. Operations (a) and (b) shall be carried out by an Authorized Person. Operations (c),(d) and (e) shall be carried out by an Authorized Person or a Competent Person acting under his immediate supervision.

Work on Switchboard/Outdoor Station.

The whole switchboard or outdoor station shall be dead. The section in which work is being carried out should be separated by permanent or removable divisions or screens from adjoining section and distinguished by red flags fixed on separate supports 0.6m (2') to 0.9m (3') inside the safe boundary and not more than 6m (20') apart. The permanent or removable divisions or screens shall remain fixed in position during course of the work. Danger Notices shall be placed to indicate adjoining High Voltage Apparatus or sections clearly.

Work on Static Capacitors

Work on high voltage static capacitors shall be carried out in accordance with requirements of Rule 07.01 and the following earthing operations shall be carried out under the direct supervision of an Authorized Person in the following sequence:

a. (i) Apply approved Earth to the capacitor frames.

(ii) Apply approved post or Rack Earths to the common connections of each group of capacitors.

b. A Permit to Work / Test shall then be issued for the group or groups upon which work or testing is to be carried out. Approved additional earths shall then be applied to the capacitor units at the point of work these earths may be applied or remove only under the direct supervision of an Authorized Person.

c. Capacitor units shall be short circuited and remain short circuited on removal from the circuit or in cases where earthing is impracticable.

Remotely/Automatically Controlled Equipment.

Before work is carried out on remotely or automatically controlled equipment such as circuit breakers isolators, tap changing gear, or air compressors, the automatic or remote control features shall first be rendered in-operative. No work shall be carried out on the controlling equipment, wiring or relays except by an Authorized Person or a competent Person acting under the direct instruction of an Authorized Person. **Optical Fibers**

When working with Fiber Optics, the use of personal protective equipment is required to prevent injury. Eye protection shall be worn when splicing glass fiber. Care should be taken during the cleaving process to protect the eyes and the body from broken glass pieces. Looking into the end of an optical fiber may damage eye as there may be laser light present which is invisible before touching or coming within the Minimum Access Distance (MAD) of an optical fiber ground wire (OPGW), it must be grounded at that location by either a portable ground or a permanent ground connection.

Work on Metal-Clad Switching Spouts.

Bus bar spouts of Multi-panel switchboards when work to be carried out on bus bar spouts the following operations shall be carried out in strict sequence:

(a) The section of the bus bars on which work is to be carried out shall be isolated from all points of supply from which it can be made live.

(b) The isolating arrangements shall be locked so that they cannot be operated and shutters of live spouts locked shut.

(c) When practicable, the bus bars shall be checked by means of an voltage indicator itself being tested immediately before and after the indicator shall be done on the panel to be earthed with circuit main earths.

(d) Circuit Main Earths of approved type shall be applied at a panel other than that at which work is to be done, on the isolated section of bus bars. The insertion of the hand or any tool into contact spouts for this purpose is forbidden.

(e) Caution Notices shall be attached at all points where the bus bars can be made live.

(f) Circuit breakers, isolators, spout shutters, control handles and safety devices shall be locked in position by the keys provided for the purpose which shall than be locked in the appropriate key safe.

(g) If operations (a) to (e) are carried out at more than one location the Authorized Person at each location shall lock the safe and retain the key in his possession until he receives instructions from the Control Engineer to restore the equipment ready for service. At the location where the Permit-to-Work is issued the Authorized Person shall operate the lock reserved for his use and each recipient of a Permit-to-Work shall operate an additional lock and retain the key in his possession until he clears the Permit and returns it with the key to an Authorized Person.

(h) Danger Notices shall be attached (where applicable) on or adjacent to the live apparatus at the limits of the zone in which work may be carried out.

(i) A Permit-to-Work shall be issued.

(j) Work on the spouts shall then be done under the personal supervision of Authorized Person who shall prove each spout dead by means of an approved voltage indicator before it is worked on, the indicator itself being tested before and after the verification.

Feeder Spouts, Voltage Transformer Spouts and Single Panel Bus Bar Spouts.

When work is to be carried out on feeder and voltage transformer spouts or on the spouts of a single and separate panel, the following operations shall be carried out in strict sequence:

(a) The spouts on which work is to be carried out shall be isolated from all points of supply from which they can be made live.

(b) The isolating arrangements shall be locked so that they cannot be operated and the shutters of live spouts shall be locked shut.

(c) Where practicable the spout contacts shall be checked by means of an approved voltage indicator to verify that they are not live, the indicator itself being tested before and after the verification.

(d) The circuit shall be earthed with approved earthing equipment at the point of work and where practicable at all points of isolation from the supply. For the purposes of earthing metal-clad switchgear approved appliances only shall be used. The insertion of the hand or any tool into contact spouts for this purpose is forbidden.

(e) Caution Notices shall be attached at all points where the circuit can be made live.

(f) Circuit breakers, isolators, spout shutters, control handles and safety devices shall be locked in position by the keys provided for the purpose which shall then be locked in the appropriate key safe.

(g) If operations (a) to (e) are carried out at more than one location the Authorized Person at each location shall lock the safe and retain the key in his possession until he receives instructions from the Control Engineer to restore the equipment ready for service. At the location where the Permit-to-Work is issued, the Authorized Person shall operate the lock reserved for his use and each recipient of a Permit-to-Work shall operate an additional lock and retain the key in his possession until he clears the Permit and returns it with the key to a Authorized Person.

(h) A Permit-to-Work shall be issued.

(i) Work on the spouts shall then be done under the Personal supervision of an Authorized Person, who shall remove the earths at the point of work and prove each spout dead by means of an approved voltage indicator, before it is worked on the indicator itself being tested before and after the verification. If the only earths that can be applied to the circuit are those applied in the spouts on which work is to be done and are Circuit Main Earths, then while this work is in progress no other work shall be carried out on the circuit connected to those spouts. In all other cases the requirements of Rule 07.01 shall apply.

(j) Where the spouts are connected to an overhead circuit on which there is any likelihood of back feed from other sources or dangerous induced voltage, the back feeding source must be switched off and additional earths shall be efficiently connected at the nearest point to the point of work.

Work on High Voltage Cables and Conduits

High Voltage Cables and Conduits.

(a) No person after receiving a Permit-to-work shall work on any high voltage cable or conduit containing a high voltage cable, unless personally instructed at the point of work by the Authorized Person.

(b) When any high voltage cable is to be cut the Authorized person, after satisfying himself that the cable has been made dead and identified, shall spike the cable in and approved manner at the point where the cut is to be made.

(c) When any high voltage joint or chamber is to opened in circumstances where it is not desirable to spike the cable entering the joint or chamber, the Authorized person shall prove by use of the appropriate cable route records, supplemented if necessary by an approved cable electrical testing set, that the joint or chamber is associated with the particular cable which has been made dead, and on which it is safe to work. The tests shall be carried out in the presence of the person receiving the Permit to work and shall be witnessed by him.

(e) When work is to be carried out on cable circuits in proximity to other live circuits and on cable circuits with fully insulated metallic sheaths, special precautions should be taken to avoid danger from induced voltages.

Single or Multiple Circuit Overhead Lines with all Conductors Dead.

Before any person is allowed to carry out any work on any single or multiple circuit overhead line with all conductors dead, the following operations shall be carried out in strict sequence:

(a) The line or lines shall be:

(i) Switched out at all points of supply including consumers end;

(ii) Isolated from all points of supply, including voltage and auxiliary transformers and common neutral earthing equipment from which the apparatus may become live.

(b) The carrying out of the above-mentioned operations shall be reported to the control

Engineer and further permission received for the carrying out of the subsequent operations.

(c) The conductors shall then be:

(i) Discharged to earth.

(ii) Efficiently connected to earth at all points of isolation from the supply excluding low and medium voltage connections but including points of isolation from common neutral earthing equipment where applicable, or between such points and the points of work.

(iii) Operation (a) and (b) shall be carried out by any Authorized person. Operation (c),

(d) and (e) shall be carried out by an Authorized person or a Competent person acting under his immediate supervision.

Double Circuit Overhead Lines with one Circuit Live

Where work similar to that covered by General Rules has to be carried out on double circuit overhead lines with one of the circuits live the provisions of General Rules shall apply, and the following additional precautions shall be taken.

(a) The Earthing party under the supervision of the competent person at the point of work shall climb the tower on the dead side and shall efficiently connect to earth each individual conductor on that side. They shall then affix red pennants to the cross arms supporting the live conductor at the junction of these cross arms with the tower body The conductors shall remain in position, throughout the progress of the work and the earth shall be removed by the Earthing party only after all other members of the working party have descended the tower on completion of the work. While affixing or removing the earths and red pennants, the Earthing party shall be under observation by another person at ground level.

(b) Work on a tee-off tower shall only be carried out in the presence of an Authorized person and special care shall be taken at terminal and large angle towers.

Triple Circuit Lines or Towers with one or more other Circuits Live.

Work on any one circuit of triple circuit lines or towers shall not be carried out with either or both the remaining circuits live except under the following conditions:

(a) The work shall be carried out as provided by Rules 09.02 and 09.06 except that where crossarms support two circuits separated by screens or barriers, red pennants shall be affixed so as to denote the live circuit or circuits.

(b) Separate means of access shall be provided to each individual circuit.

(c) Either the conductors on each circuit shall be adequately screened from the two other circuits or the clearances from the nearest point of work to the remaining live circuits shall be not less than those specified in Rule 09.06

(d) Caution notices shall be attached at all points where such line or lines can be made live.

(e) Circuit breakers, isolators, spout shutters, control handles and safety devices shall be locked in position by the keys provided for the purpose which shall then be locked in the appropriate key safe.

(f) Unless the Permit-to-work is to be issued and cancelled at a particular station, then at each station, an Authorized person shall personally check the circuit colours at the point of isolation and report to the Control Engineer. He shall also lock the key safe at that station and retain the key in his possession until he receive instructions from the Control Engineer to restore the equipment ready for service. An Authorized person may then issue the Permit-to-work. In this case no key shall be issued to the recipient of the Permit-to-work When the Permit-to-Work is to be issued and cancelled at a particular station, then at that station, the Authorized Person shall personally check the circuit colours and shall operate the lock reserved for his use and each recipient of a Permit-to-Work shall operate an additional lock and retain the key in his possession until he clears the permit and returns it with the key to the Authorized Person.

(g) The conductors shall be efficiently connected to earth by the Earthing party at the point (E) of work or at the adjacent tower on each side of the point(s) of work but in no case shall the earths be more than two spans apart. In addition, if conductors are to be broken they shall be connected to earth at each side of and on the same tower, as the point of work, where the break is to be made. These earths shall be applied before the break is made and shall remain in position until the conductors are reconnected or until work is complete.

(h) When work is to be carried out on lines of all insulated construction and an earthing point is not provided at the point of work. Additional Earths shall be connected at the point of work to an efficient portable earth back driven into the ground. The line shall also be earthed at the nearest line earthing point on either side of the point of work.

Quadruple circuit Lines with one or more other Circuits Live

Work shall not be carried out on the circuits on one side of a tower unless both these circuits have been switched out, isolated and earthed, as provide by Rules 09.02 and 09.03.

Towers Carrying Live Conductors

Painting and other work above the anti-climbing devices on the lower portions of towers carrying live conductors shall only be permitted under the following conditions:

(i) The work shall be carried out under the terms of a Permit to Work.

(ii) Before anyone is allowed to start work the person in charge at each tower shall define the area to be worked in by removable barriers, roping, red flags or pennants arranged to prevent any person working on the tower nearer than the following distances from any live conductors:

| Rated Voltage | Minimum Clearance | | |
|---------------|-------------------|-------|--|
| | Meters | Feet | |
| 33KV | 2.75 | 9.00 | |
| 132KV | 3.43 | 11.50 | |
| 230KV | 4.22 | 14.00 | |
| 400KV | 5.49 | 18.00 | |

While doing so the person in-charge shall be under observation by another person at ground level.



132 (230)KV Tower Clearance

(III) No man shall work in such a manner that his arms or any to extend beyond the limitation fixed under subparagraph (ii) of this Rule.

Adverse Weather Conditions

(a) In the event of the near approach of lightning storm all work on overhead lines shall cease immediately, and the Control Engineer be informed.

(b) If overhead lines are to be patrolled during the hours of darkness, suitable lighting equipment should be provided.

Testing of High voltage Apparatus.

When any High Voltage Apparatus is to be subjected to voltage before being connected to the high voltage system the Authorized person responsible for applying the test voltage shall ensure that such apparatus is adequately guarded to prevent Danger and that Danger Notices are attached to in conspicuous positions during the period the apparatus may be subjected to voltage. All cables shall be discharged before and after the application of test voltage

Temporary conductors used for testing purposes shall be of an adequate size and easily visible.

Test connections shall not be applied in a cell compartment in which there is any exposed metal live at high voltage. (This rule does not exclude the use of approved voltage indicators or approved devices for phasing out circuits)

Insulators on Live Lines-Testing/Washing

Testing of Insulators on live lines shall only be permitted under the following conditions:

(a) Special care shall be taken at tension, double circuit transposition, tee off and terminal towers in view of the close proximity of live cross-over connections.

(b) The work shall be carried out under a Sanction-for Test and under suitable weather conditions. Testing shall not be carried out where the humidity is above 70% and shall be discontinued it a thunderstorm approaches.

(c) All men carrying out such work shall have the Managers written authority and be directly supervised at each tower by an Authorized Person.

(d) Not more than three men shall climb the tower. One of others shall be responsible for seeing that the others maintain the necessary clearance from live conductors. The second man shall apply the testing apparatus. The third man shall take observations either at conductor level or ground level.

(e) No tool other than approved testing apparatus shall be taken up the tower.

(f) The person in charge shall inform the Control Engineer when commencing and finishing the actual work. A line which trips out while such work is known to be in progress shall not be reclosed until the control Engineer has been in communication with the person-in-charge.

(g) If any circuit breaker controlling the line is fitted for auto reclosing equipment, such equipment shall be rendered inoperative before the Sanction for Test is issued and the fact that this has been done shall be recorded on the Sanction.

(h) If during the progress of the work the line is found to be dead the person in charge shall immediately communicate with the control Engineer.

Where special apparatus is provided, washing of live insulators may be carried out provided that the following requirements are complied with:

(a) The work shall be carried out under the supervision of an Authorized person who shall have the General Manager's written authority.

(b) The water used shall normally have a specific resistance of not less than 2,000 ohms/cm. cube on 132 KV and 5,000 ohms/cm. cube for 275 KV system. Where the washing system is common to both voltages, water of the higher specific resistance shall be used.

(c) The jets used shall be such that the water breaks into a spray before reaching the insulator.

(d) The nozzle of the hose shall be connected to earth by an earthing lead not less than

0.1 sq. in. (65mm2) copper equivalents in cross section and the operator shall wear rubber gloves.

(e) The operator shall be not less than 6m (20 ft.) away from the insulator being washed and care shall be taken in observing this to see that no other live insulator or live conductor at a lesser distance inadvertently sprayed.

(f) Water washing shall be discontinued in the event of a local lightning risk.

The inspection of equipment of live lines shall only be permitted under the following conditions:

(a) The inspection shall be carried out under a Permit to Work and from within the body of the tower.

(b) No tool shall be taken up the tower.

Preparation for Work on High Voltage Apparatus Containing /Operated by Compressed Air

In addition to the general requirements of Rule 08.01 the following special precautions shall be taken before any work other than operating adjustments, on High Voltage Apparatus operated by or containing compressed air may be carried out:

(a) The valves controlling the supply of air to the equipment shall be closed and the air released from the associated receivers and pipe work which shall be left open to atmosphere.

(b) The valves shall be locked in position by safety locks and the keys shall be placed in the appropriate key safe.

(c) Caution Notices shall be attached to the valves.

(d) A Mechanical Permit to work shall be issued to the person to whom the Electrical Permit to work has previously been issued.

Operating adjustments or inspection of High Voltage Apparatus which do not involve dismantling of any part of the compressed air system may be carried out without a Mechanical Permit to work provided that the requirements of 07.01 are complied with. All such operating adjustments shall be carried out under direct supervision of the Competent Person to whom Permit-to-Work has been issued.

Work In High Voltage Equipment Containing Sulfur Hexafluoride (SF6) Gas

(a) For any equipment containing sulfur hexafluoride (SF6) gas the PGCB code of practice must be available at the point of work stating the method of dealing with the gas and associated compounds. The apparatus shall bear an approved notice stating that it contains sulfur hexafluoride.

(b) In addition to the requirements of Additional Rules the following special precautions shall be taken when any work involves access to any part of the equipment which is or has been in contact with the gas or associated compounds:

(i) The apparatus shall be isolated from all sources of the supply of gas, purged in accordance with the PGCB code of practice and the associated receiver(s) and pipework jet open to atmosphere.

(ii) The valves shall be locked by safety locks and the keys shall be placed in the appropriate key safe.

(iii) Caution Notices shall be attached to the valves.

(c) Approved protective clothing, respirators, eye shields and sate handling equipment shall be provided and used where danger may arise from the gas or associated compounds in accordance with the PGCB code practice.

Safety Rules for Work on Medium and Low Voltage Apparatus, Conductors and Equipment General Precautions

The consequences of shock or serious burn from short circuit associated with Medium or Low Voltage systems may be serious, or in some circumstances, fatal. Wherever practicable, therefore, work on Medium and Low Voltage Apparatus, conductors and equipment shall be done while they are dead. When verbal instructions are not considered sufficient a Minimum Access Distance (MAD) shall be issued.

Work on Dead Apparatus, Conductors and Equipment When work is to be done on dead Medium Voltage Apparatus, conductors or equipment controlled by circuit breaker or switch, the circuit breaker or switch shall be locked off, where practicable and a Caution Notice affixed. The keys shall be kept in a safe place, preferable in the possession of the person in charge of the work and the circuit shall be proved dead by an approved indicator before work is commenced.

When work is to be done on dead Medium Voltage Apparatus, conductors or equipment, supplied from fuses in a fuse distribution board, the fuses shall be removed and a Caution Notice affixed to the distribution board with a notice specifying the circuit upon which work is in progress. The fuses shall be kept in a safe place, preferable in the possession of the person in charge or the work and the circuit shall be proved dead by an approved indicator before work is commenced.

Before work is commenced on bare low or medium voltage overhead lines which have been made dead, the lines, including he neutral line, shall be short circuited and where practicable earthed

Line Crossings

Any overhead line over which another line is to be run shall be made dead or an adequate temporary cradle guard provided during the running out and binding in or conductors on the new work

Work on Live Apparatus, conductors and Equipment

Work on live Medium or Low Voltage Apparatus, conductors or equipment shall be undertaken only by a competent person.

Work on Overhead lines

Before any wood pole is climbed it shall be sounded and no pole, the condition of which is doubtful, shall be climbed without the permission of the Competent Person in charge. No person shall climb any pole or tower unless he is wearing and makes proper use of an efficient safety belt and is under observation by a second person who is in attendance, preferable at the base of the Pole on which work is being done.

Safety Rules for Live Line Working

Live line work shall be under the direct and continuous supervision of an Authorized

Person who has received specialized training in the work to be undertaken and is appointed in writing to be responsible for such work.

Live line work shall be undertaken only by persons who have received appropriate training and are appointed, in writing, to be authorized persons for live line work.

Live line work shall not be undertaken until the method of working has been planned and written down step by step and explained to all persons to be engaged on the work.

Live line work shall only be permitted on circuits which have been approved as suitable for this type of work.

All tools and equipment used for live line work shall be approved, and shall be maintained and used in approved manner.

The Authorized Person in charge of live line work shall satisfy himself, before work commences, that each member of the team who is to carry out live line work is properly authorized and fully understands the method to be used and the nature and extent of the work to be carried out.

Before the live line work, commences, the Senior Authorized Person in charge of live line work shall satisfy himself that atmospheric conditions are such that the work can be performed safely.

The Authorized Person holding the Live Working Certificate shall examine the conditions of all tools and equipment prior to use. He shall ensure that such tools and equipment are marked to indicate the appropriate limit of the safe handling position. If any defect is found or suspected in a live line tools or pieced of equipment it shall not be used.

Auto-reclose equipment or circuit breakers controlling the circuit concerned shall be rendered, and shall remain inoperative while the HV Live Line Working Certificate is in force.

Caution Notices shall be affixed to the auto reclose equipment. The Control Engineer shall not reclose the circuit, in the event of it tripping until he has obtained toe agreement of the Authorized Person in charge of the live line work.

A channel of communication shall be established between the live line working team and the appropriate Control Engineer before the commencement shall be maintained throughout the period during which live line work is being carried out.

Before work commences, the Authorized Person who holds an authorization for live line work shall with the consent of the Control Engineer, issue to himself, or the another Authorized Person similarly appointed, an HV Live Line Working Certificate.

The Authorized Person in charged shall ensure that all persons while engaged in the live line work wear and made proper use of approved protective clothing, safety belts or harnesses and any other necessary safety equipment.

An approved leakage detector shall be used throughout the duration of the live line work.

Live line work shall cease if the approved leakage detector gives and alarm. Work shall not be resumed until conditions giving rise to the alarm have been cleared.

When displacing live conductors, or near circuits on which live line work is to be carried out precautions shall be taken to avoid danger arising from deduced clearances.

Where mechanical loading conditions are to be varied during the course of live line work conductors, insulators, fittings and steelwork affected shall be inspected before work commences.

No vehicle or equipment or any person shall be followed in the near vicinity while work in progress without the sanction of the Authorized person in charge of the live line work.

No high voltage conductor or connection shall be broken during the course of live line work unless a parallel path of equivalent current carrying capacity has been safely and efficiently connected.

Where the work for which the HV live line working certificate was issued has not been completed on the day of issue of the certificate, all men shall be withdrawn, and then the certificate shall be cancelled with the consent of the Control Engineer.

If live line work has to be suspended, due to adverse atmospheric conditions or for any other reason, the Authorized Person holding the HV live line Working Certificate shall immediately inform the control Engineer and shall agree with him whether the HV live line working certificate is to be cancelled.

If live line work has been suspended for any reason, then before work is recommenced the Authorized person holding the HV line working certificate shall inform the Control Engineer and shall satisfy himself that atmospheric conditions area such that the work can be performed safely and that all tools and equipment are in a safe condition.

On completion of live line work covered by the live line working Certificate, all men shall be withdrawn and then the certificate cancelled with the consent of the Control Engineer.

Fire Protection Equipment and its Auto Control

General

(a) Contact with some chemicals used in fire protection equipment may be dangerous and in such cases notices to that effect shall be displayed adjacent to the equipment

(b) Portable fire fighting equipment shall not be used on electrical apparatus unless such apparatus has been disconnected from the supply.

(c) Portable CO_2 and any chemical extinguishers may be used in the vicinity of live electrical apparatus provided that in the handling of the extinguishers, safety clearances are maintained. After the discharge of portable CO_2 extinguishers in a confined space, the operator shall leave the space until the precautions set out in (d) have been taken.

(d) After any fire or after the discharge Of CO_2 extinguishers in an enclosed space, the space shall be thoroughly ventilated before entry or suitable breathing apparatus shall be worn if entry is necessary before the gases have been cleared.

Automatic Control

(a) Before work or inspections are carried out in any enclosure protected by automatic CO_2 or other chemical extinguishing equipment the automatic control shall be rendered inoperative and the equipment left on hand control and a notice to this effect shall be attached.

(b) The automatic controls shall be restored immediately after the persons engaged on the work or inspections have from the protected enclosure.

(c) Precautions taken to render the automatic control inoperative shall be noted on any

Permit-to-Work issued work in the protected enclosure.

CAUTION NOTICES/TAGS

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