



LEMBAGA LETRIK NEGARA  
TANAH MELAYU



DERAF  
**PANDUAN  
KESELAMATAN**  
(MEKANIKAL)



JANUARI 1986

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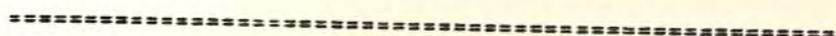
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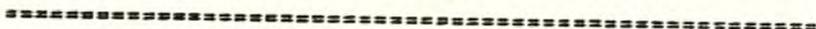


Safety Rules No. ....

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## SECTION 1

### GENERAL PROVISIONS

#### 1.1 STATUTORY REQUIREMENTS

The following constitutes certain legal provisions which must be complied with:

- (i) Electricity Act 1949.
- (ii) Electricity (Board Supplies) Rules 1949 made under Section 89 at the Electricity Act.
- (iii) Electrical Inspectorate Regulations 1984 made under Section 38 of the Electrical Inspectorate Act 1983.
- (iv) Factories and Machinery Act 1967.
- (v) Factories and Machinery (Safety, Health and Welfare) Regulations 1970.
- (vi) Factories and Machinery (Administration) Regulations 1970.
- (vii) Factories and Machinery (Certificates of Competency-Examinations) Regulations 1970.
- (viii) Factories and Machinery (Persons-In-Charge) Regulations 1970.
- (ix) Factories and Machinery (Fencing of Machinery And Safety) Regulations 1970.
- (x) Factories and Machinery (Notification, Certificate of Fitness and Inspection) Regulations 1970.
- (xi) Factories and Machinery (Electric Passenger and Goods Lift) Regulations 1970.
- (xii) Factories and Machinerics (Building Operations and Works of Engineering Constructions) Regulaation 1981.
- (xiii) Poisons Ordinance 1952.

All National Electricity Board Engineers, Technical Assistants and ather supervisor personnels are expected to be thoroughly familiar with such of the provisions of the above mentioned Acts, Rules and Regulations as are related to their particular work. These documents are to be made readily accessible at all stations.

1.2            OBJECTIVE OF SAFETY REGULATIONS

The National Electricity Board has made the following safety regulations for the protection of the Board's Employees, Consumers, Contractors and Others, to govern the working and control of electricity supply throughout the Board's Installations and to ensure the safety of all who may work on the National Electricity Board's installations.

These rules are in addition to and not in substitution of any of the legal provisions of the above statutory requirements in Section 1.1 or the Board's own Technical Instructions, Engineering Instructions and System Operation Instructions.

1.3            DUTIES

It is the duty of all Persons who may be concerned with the operation of, and work on, the Board's installations to make themselves thoroughly conversant with the Statutory Requirements and Safety Regulations governing any work they may have to undertake on the system and apparatus. Ignorance of the Statutory Requirements and the Safety Regulations as well as the Board's Technical Instructions, Engineering Instructions and System Operation Instructions will not be accepted as an excuse for neglect of duty. The person-in-charge of a working party should ensure that at all times the members of his party thoroughly understand the work they have to do and the safety precautions required.

1.4            ISSUE OF SAFETY REGULATIONS

A copy of the Safety Regulations should be given to such employees of the Board as may be concerned with the operation of, or work on, the Board's installation. A person in receipt of the Safety Regulations should sign a receipt for his copy which should be kept in good condition.

1.5            PERSONAL SAFETY EQUIPMENT

Safety equipment which has been provided by the Board for the protection and use of persons required to work on the Board's installation must be properly used on all appropriate occasions. Each item of safety equipment must be examined by the user to check that it is in good condition before and after use. Equipment found not in good condition must be marked "DEFECTIVE" and returned to stores.

1.6            REPORTING OF DANGEROUS SITUATIONS

When any person sees any dangerous situation he should report such situation to the appropriate authority.

1.7            DANGEROUS OCCURANCES AND ACCIDENTS

All dangerous occurrences and accidents should be reported in accordance with the Board's standing instructions and statutory requirements.

1.8            PROCEDURE FOR ISSUE OF CERTIFICATES OF AUTHORISATION AND CERTIFICATE OF COMPETENCY

The procedure for issue of Certificates of Authorisation and Certificates of Competency will be in accordance with the Board's standing instructions.

1.9            VARIATION OF REGULATIONS

In exceptional circumstances these safety regulations may be varied to such an extent as may be authorised in writing by the head of department.

## SECTION 2

### DEFINITIONS

#### 2.1 AUTHORISED PERSON

A person over 21 years of age appointed in writing by the Chief Engineer (Generation Operations) to carry out specific work on the Board's systems, equipment or plant.

The certificate of appointment should state the location and equipment plant or section of the system to which it applies.

The Authorised Person is empowered to isolate plant to make it safe to work on and to issue and cancel Permits-To-Work Certificate (Mechanical) within the terms of his appointment.

#### 2.2 CAUTION NOTICE

A notice in approved form attached to the control equipment of an equipment conveying a warning against interference with such equipment.

#### 2.3 COMPETENT PERSON

A person over 21 years of age who holds a valid Certificate of Competency issued by the Station Superintendent. An Authorised Person is deemed to be a Competent Person.

#### 2.4 DANGER

A risk of bodily injury and/or loss of life or health .

#### 2.5 DANGER NOTICE

A notice in approved form attached to equipment or sections calling attention to the Danger of approach to or interference with such equipment or sections.

#### 2.6 INSTALLATION

Any plant or equipment designed for the supply, or use, or both, as the case may be, of energy, including prime movers with all necessary plant, buildings and land in connection therewith, pipelines, supply lines and consuming equipment if any.

2.7            KEY SAFE (Lock-Out-Boxes)

An approved device for the secure retention of all keys used to lock means of isolation, earthing or other safety devices necessary for the issue of a Permit-to-Work Certificate (Mechanical). It may consist of a box fitted with a number of locks of a type operated by non-interchangeable keys. In addition, one lock of each safe should be of a type that can be operated only by a key in the possession of an Authorised Person.

2.8            PERMIT-TO-WORK CERTIFICATE (MECHANICAL)

A declaration in the form as shown in Appendix 1 to these regulations, signed and given by an Authorised Person to a Competent Person in charge of work for the sole purpose of making known to him exactly what equipment is isolated from all danger and on which it is safe to work. A Permit-to-Work Certificate (Mechanical) must be issued to a Competent Person in charge of each Working Party.

2.9            PERMIT-TO-WORK CERTIFICATE (MECHANICAL) FOR CONTRACTORS

A declaration in the form as shown in Appendix 2 to these regulations, signed and given by an Authorised Person to the Contractor's Person in charge of the working party.

2.10           SHIFT CHARGE ENGINEER

The shift engineer in charge, or other person appointed by the National Electricity Board for regulating the generation of electrical energy and for the operation of machinery/equipment at the generating station. The Shift Charge Engineers should be an Authorised Person.

2.11           WORKING PARTY

A Competent Person and those working under his immediate supervision.

## SECTION 3.0

### SAFETY RULES FOR WORK ON MECHANICAL PLANT

#### 3.1 GENERAL SAFETY PRECAUTIONS

- 3.1.1 Before work is commenced on any of the Board's plant, physical isolation and locking off of the plant from ALL sources of Danger shall be adopted as the prime safety precaution.
- 3.1.2 Where work is to be carried out on plant that is electrically driven, the switches or isolators controlling the supply to all the motors shall be locked in the open position, and fuses or links withdrawn where practicable and the key locked in a Key Safe.
- 3.1.3 Danger Notices shall be attached to all the points of isolation (Mechanical and Electrical).
- 3.1.4 Where personnel safety measures such as the use of belts, harnesses, helmets, goggles, protective shoes and special clothing are required, All such equipment and their use shall be mandatory.
- 3.1.5 Where portable ladders, cranes, scaffolding or conveyer belts are to be used, all such equipment and associated ropes and block and tackles used should be inspected for adequacy of design capacity and ensured to be in a good state of repair.
- 3.1.6 Where ladders, as indicated in 3.1.5 above, are to be used in the presence of electrical equipment, the ladders should be of the insulated variety to enhance electrical safety. Such ladders should be inspected to ensure that the insulation is not damaged immediately prior to any work being undertaken.
- 3.1.7 No plant should be operated with any of its trip interlocks disabled.

#### 3.2 SAFETY OF PERSONNEL

- 3.2.1 Falling
  - (a) Access openings and holes in the ground or floors should not be left unfenced.
  - (b) Barriers around any openings should be securely lashed to make them safe.

- (c) Safety belts should be worn when working at a level 3 metres above ground on a platform unless proper scaffolding with closed floorings, handrails and toe boards along the open sides have been installed. The user should ensure that safety belts must be in sound condition and properly fastened to a safe and secure connecting point.
- (d) Cat-walks or crawling boards should be made use of when working on asbestos roof and fragile materials.
- (e) When replacing ducts and cover plates it should be made certain that they are firmly in their correct position.
- (f) Oil, grease or any other spillage should be removed as soon as possible.
- (g) Passageways, stairways and working areas should be kept tidy. Tools and equipment should not be left lying about in areas where workers may trip over them. All guards, should be replaced. Scrap and rubbish should be removed to a place for disposal.
- (h) The right ladder or scaffolding should be used for the job. Make-shift methods to reach a height have caused many accidents. Boxes or drums should not be used to reach heights.
- (i) Ladders should be examined immediately before use to satisfy that it is in good condition and should be erected at a slope of 1 to 4. The ladder must be secured by lashing it or by having a man to 'foot' it.
- (j) Large or heavy objects should not be carried up a ladder. A rope should be used to haul them.

### 3.2.2 Lighting

- (a) It should be ensured that lighting is adequate for the job when working at night.
- (b) It should be ensured that leads and cables for lighting are placed where they will not pose danger or obstruction.
- (c) All portable temporary lighting used should be supplied from Earthed Leakage Circuit Breaker's supply.

### 3.2.3 Electricity

- (a) Lamps or other instruments not of an approved type should not be used. Make shift testers and long bare metal probes are dangerous.

- (b) Extra care should be taken when working in damp places, or where there is a lot of earthed metal work around.
- (c) Any electrical connection should not be interfered with or touched before checking.
- (d) A check should be made before use to ensure that electrical plugs, sockets and glands are intact and that the cable is not worn or frayed.
- (e) Any faulty electrical equipment which may constitute a **Danger** should be reported immediately.
- (f) The location of the nearest isolator switch should be determined before starting work.
- (g) No work should be done on live equipment without authorisation.
- (h) It should be made sure that all electrical equipment used are effectively earthed and regularly serviced.
- (i) Before commencing work, it should be made sure that the right electrical equipment or plant is being worked upon and that it has been properly isolated.

#### 3.2.4 Good House Keeping

- (a) On completing a job it should be ensured that the work place is made clean and tidy. All tools and equipment should be returned to their original storage places.
- (b) Spilled oil or grease must always be cleaned up immediately. It is particularly dangerous on stairs, steps, hand-rails and passage-ways.
- (c) Gang-ways, passage-ways and stairs should be always kept clear from all obstructions.
- (d) Oily rags or cotton waste are fire hazards. They should always be put in a closed non combustable container, separate from other rubbish.

#### 3.2.5 Personnel Protective Equipment

- (a) Suitable protective equipment must be used as required: helmets for the head, goggles for the eyes, masks for the face and lungs, gloves for the hands, safety shoes for the feet, ear plugs/mufflers for the ears etc.
- (b) Eyes should be protected by wearing goggles or safety glasses when cutting pipes, grinding, chiselling, drilling, turning non-ferrous metals or cast iron works are being carried out.

- (c) Suitable hand gloves should be worn when handling hot, sharp, rough or corrosive materials.
- (d) Safety helmets should be worn where there is a hazard of falling objects.
- (e) Safety vests must be worn when working along a public road.
- (f) Breathing apparatus must be used when tracing toxic gas leakages.
- (g) Life jackets must be worn when working in a place where there is a likelihood of falling into deep water.
- (h) The appropriate Personnel Protective equipment should be worn when handling chemicals.

### 3.2.6 Safety And The Supervisor

Supervisors/Foremen are responsible for taking all reasonable action to safe-guard personnel and equipment under their control, and in order to do this they must ensure that each person under their control is aware of the safety requirements for a particular job.

The following principles should be observed by Supervisors-/Foremen:

- (a) Know the provisions of the Safety Regulations.
- (b) Instruct the worker clearly and concisely on the work procedures and the safety precautions to be taken.
- (c) Ensure that all employees under their control understand what safety procedures are to be applied and that they are aware of reasons for them.
- (d) Use only the safest method for doing the work.
- (e) Ensure that the correct tools and equipment are issued and used by the workers.
- (f) Provide appropriate protective equipment of approved type and insist upon its use by the workers.
- (g) Maintain good housekeeping at all times.
- (h) Report immediately any hazard discovered.
- (i) Promptly report accidents to his Supervisor and take positive action to prevent a recurrence.

### 3.2.7 Safety And The Worker

- (a) All workmen must adhere to the safety principles and instructions set out in the Safety Regulations.
- (b) A workman should report immediately to his Supervisor /Foreman any hazard he discovers in the course of his work.
- (c) Every workman must make use of all safeguards, safety devices and appliances provided for the protection of personnel and equipment.
- (d) Every workman must supply his Supervisor/Foreman full and accurate details of any accidents experienced or witnessed.
- (e) No workman shall without reasonable cause do anything likely to endanger himself or fellow workmen.

### 3.2.8 Demolition Of Structures

The following are the safety rules for minor demolition operations:

- (a) The public and unauthorized personnel should be kept at a safe distance away from the structure by use of barricades and signs, or protective temporary walls, as the case may be. A watchman may be assigned when necessary.
- (b) Utility services (gas, steam, electricity) outside the building should be disconnected. Water lines should be maintained as long as possible, or a temporary water source installed for fire protection and for wetting down the site to reduce dust.
- (c) Before start of demolition, all stored materials and all glass doors and windows throughout the structure should be removed.
- (d) Structure being supported by part of the building to be demolished should be temporarily supported before demolition work commences.
- (e) When demolishing walls, scaffolds supported independently of the walls should be used.
- (f) Debris should be removed promptly.
- (g) Any area where material is being dumped should be barricaded and screens placed where necessary to protect workmen from flying pieces.
- (h) Workmen shall not work below others.

### 3.2.9 Excavation And Shoring

- (a) Pre-excavation conditions (superimposed loads, soil structure, hydrostatic pressure and the like) should be studied, in order to evaluate changes that might occur, or situations that might develop so as to plan the job ahead, based on these findings.
- (b) Shoring, built in accordance with standard engineering practice or procedure, should be provided on excavations where there exists a possibility of cave-in.
- (c) The bottom depth and contents of buried tanks and piping should be indicated on the location markings. If the contents are flammable or toxic, proper protective equipment should be readily available in case of rupture.
- (d) Excavations should be barricaded to prevent people from falling into them. When an excavation must remain open for the duration of the construction work, barricades, fences, and warning signs are necessary. In some cases, watchmen and flagmen are needed. The work area should be guarded by flares, lanterns or flashing lights at night.
- (e) Men who work in ditches are in Danger of being struck by objects knocked into the ditch. Tools and materials lying near ditches should be removed or moved back several metres.
- (f) Unless men working below ground level are protected by a roof, materials or tools should not be passed over their heads.

### 3.2.10 Machine Excavation

- (a) No shovel, dragline or other digging machines should be allowed to excavate close to underground facilities that must be left in place. Establish proximity limit for machine operations and complete the excavation by hand digging.
- (b) When hand excavation is being done, workmen should be warned about driving picks, pavement breakers or other powered tools through the envelope of buried facilities. Attaching the tool air hose to a driven ground will give the workmen protection in the event of sudden contact with an underground electric line. Either the air hose should be of the conductive type or the power equipment adequately provided with grounding device.

### 3.2.11 Open Excavation

- (a) Materials excavated by machine should be thrown at least one (1) metre from the edge of the excavation but not into aisles or work area.
- (b) Pick-and-shovel men working in excavations should be kept far enough apart to prevent injury to one another.
- (c) Excavated materials should be placed at least one (1) metre from the walls of the excavation unless toe boards have been installed to prevent fallback.

### 3.2.12 Trench Excavation

- (a) A trench one (1) metre or more deep should be provided with ladders to facilitate safe entrance and exit. The ladders shall extend from the bottom of the trench to at least one (1) metre above the surface of the ground.
- (b) In hand-excavated trenches, the ends of braces to stringers should be secured to prevent the braces from being knocked out of place.

### 3.2.13 Masonry

- (a) If concrete is being chipped in an area where combustible gas is present, that part of the slab being chipped should be kept under constant stream of water or slab itself kept under water.
- (b) When workmen are repairing furnaces or underground flues, care should be taken to protect them from objects which other workmen may drop overhead. Men working above should be careful in handling materials. When men are working below ground, all openings should be properly guarded to prevent persons or materials from falling into them. Guardrails which for any reason have been removed should be replaced.
- (d) Do not back-fill against newly constructed concrete walls.
- (e) Loads such as or stays should not be put through brickwork until it has set firmly, and then only in places where it will safely withstand the stress.

## 3.3 PERMIT-TO-WORK CERTIFICATE (MECHANICAL)

3.3.1 A Permit-to-Work Certificate (Mechanical) shall be obtained before any work of the following or similar nature is carried out:-

- (a) Work on boiler and its auxiliary plant.

- (b) Work on steam turbine generator and its auxiliary plant.
- (c) Work on pressure vessels and pipework.
- (d) Work on fuel equipment.
- (e) Work in combustion chambers and gas passes of pulverised fuel, gas and oil fired boilers.
- (f) Work in confined spaces.
- (g) Work on a hydrogen cooled machine involving opening up of any part of machine casing which normally contains hydrogen..
- (h) Work on or near overhead crane tracks or other equipment.
- (i) Work on hydro-electric plant and circulating water systems.
- (j) Work on apparatus containing or operated by compressed air or gas.
- (k) Work on diesel generating and auxiliary plant.
- (l) Work on gas turbine generating and auxiliary plant.
- (m) Work on chemical services plant (e.g. Water Treatment Plant, Chlorination Plant, Dosing Plant etc.)
- (n) Any other work for which the Shift Charge Engineer consider a Permit-To-Work Certificate (Mechanical) is necessary

3.3.2 The Competent Person in charge of a Working Party shall apply for a Permit-To-Work Certificate (Mechanical) from the Authorised Person.

3.3.3 The Authorised Person, before issuing a Permit-to-Work Certificate (Mechanical) must satisfy himself that the plant has been correctly isolated and that the requirements stated in 3.1.1, 3.1.2 and 3.1.3 have been complied with. It would be desirable for a joint inspection between the Authorised Person and the Competent Person effecting repair.

3.3.4(a) The Permit-To-Work Certificate (Mechanical) shall be issued by the Authorised Person to the Competent Person in charge of the Working Party. The work shall be carried out under the supervision of the recipient.

- (b) The Competent Person shall sign the original and duplicate of the Permit-To-Work Certificate (Mechanical). The original shall be retained in his possession at all times whilst work is in progress. The duplicate shall be kept in the Shift Charge Engineer's office or other appointed place.
- (c) The issuer of the Permit-To-Work Certificate (Mechanical) must ensure that the contents of the Permit-To-Work Certificate (Mechanical) are clearly understood and agreed by the recipient.
- (d) Where work is to be carried out by more than one Working Party, a Permit-To-Work Certificate (Mechanical) shall be issued to the Competent Person in charge of each Working Party.
- (e) If the Competent Person to whom a Permit-To-Work Certificate (Mechanical) has been issued has to be relieved before the work is completed, the relief (a Competent Person) must be approved by the Authorised Person and must sign under the signature of the original Competent Person who will hand over the Permit-To-Work Certificate (Mechanical) to him. The relief must retain the Permit-To-Work Certificate (Mechanical) during the progress of the work, and upon completion of work, the last Competent Person to be in charge of the work must "CLEAR" the Permit-To-Work Certificate (Mechanical) and hand it back to the Authorised Person.

3.3.5 When the work covered by the Permit-To-Work Certificate (Mechanical) is completed or stopped, the Permit-To-Work Certificate (Mechanical) must be "CLEARED" by the Competent Person (i.e he must sign the Clearance Certificate on the back of the Permit-To-Work Certificate (Mechanical) and its duplicate, stating that he has warned all his men that the equipment is no longer safe to work on), and it must be handed back to the Authorised Person who must "CANCEL" it.

3.3.6 "CANCELLATION" of a Permit-To-Work Certificate (Mechanical) is to be carried out by the Authorised Person writing "CANCELLED" across the face of the Certificate and initialling it after it has been "CLEARED."

3.3.7 No plant shall be normalised and safety precautions withdrawn until ALL Permit-To-Work Certificates (Mechanical and Electrical) on that plant have been "CANCELLED".

### 3.4 WORK ON MECHANICAL PLANT

#### 3.4.1 Tools And Equipment

##### 3.4.1.1 General Rules

- (a) Select the right tools required for the job and use it properly.
- (b) Regularly inspect tools, and use only those that are in good condition. Never use tools with loosely fitted handles.
- (c) Tools should be stored properly.
- (d) Never place or leave tools where they might fall on persons or properties, trip or otherwise cause injuries to personnel. Tools must be secured when working at heights.
- (e) Exercise care when handling or transporting tools, particularly pointed or sharp-edged ones, in order to prevent damage to them or to other properties, as well as to prevent injuries to persons.
- (f) Use protective equipment as required.
- (g) Never use worn, blunt or damaged tool bits.
- (h) Always use the suitable and correct standard tools.
- (i) Never interfere with or distract another person who is operating a tool.
- (j) -All defective tools and equipment should be removed from service for repairs. Suitable signs/tags should be posted and not removed until repairs have been completed.

##### 3.4.1.2 Hand Tools

- (a) Keep keen-edged blades sharp; store them safely when not in use.
- (b) Use wrenches of the right size for the job. Face the movable jaws of an adjustable wrench in the direction of the pull.
- (c) Never use a hand tool on or very close to any moving part of a machine. Stop the machine first, and remove all the tools before re-starting.
- (d) Never use a file without a handle.

- (e) Hammers or chisel with well worn mushroomed head should not be used.

#### 3.4.1.3 Portable Power Tools

##### (A) ELECTRIC

- (a) Before using a portable electric tool check to see that it is properly earthed, unless it is an approved type which does not require earthing.
- (b) Do not use electric tools with damaged casing.
- (c) All cables, plugs or connectors should be sound and properly wired up.
- (d) Use tools only on the correct power supply as instructed on the maker's name plate.
- (e) Make sure that the power cable is long enough to reach your working place without straining it.
- (f) Keep long power cables off the floor, they may get damaged or trip somebody.
- (g) Never stand on a damp or wet surface when using electrical equipment.
- (h) Disconnect tools from the power supply when not in use.
- (i) All dangerous moving parts of the tool should be adequately enclosed.
- (j) Do not oil the tool when it is in operation.
- (k) Do not attempt to stop any moving parts of the tool with your hands.
- (l) Do not leave a power tool unattended until it has stopped.
- (m) If the tool bit sticks, do not try to forcibly pull it out; loosen it out by steady rocking movement of the tool.
- (n) When laying the electric tool down, it should always be placed in a position such that it can do no harm in case the tool is accidentally started.

##### (B) PNEUMATIC

- (a) Disconnect tools from the power supply when not in use.
- (b) All dangerous moving parts of the tool should be adequately enclosed.

- (c) Do not oil the tool when it is in operation.
- (d) Do not attempt to stop any moving parts of the tool with your hands.
- (e) Do not leave a power tool unattended until it has stopped.
- (f) If the tool bit sticks, do not try to forcibly pull it out; loosen it out by steady rocking movement of the tool.
- (g) When laying the tool down, it should always be placed in a position such that it can do no harm in case the tool is accidentally started.
- (h) Make sure that the air hose is properly connected to the tool before opening the pressure valve. Connectors should be properly secured when air hoses of more than one length are used.
- (i) Grip the handle firmly with both hands when operating the tool. Never lean your body against it. When using a heavy pneumatic tool (such as jack hammer, clay digger, etc.) in a horizontal position, the tool should be supported by vertically suspended ropes.
- (j) If the tool is accidentally detached from the air hose under pressure, turn off the air by closing the base control valve; never by kinking the hose.
- (k) Compressed air when misused can be extremely dangerous. Under no circumstances should a worker aim an air hose at anyone.

(C) HYDRAULIC

- (a) Disconnect tools from the power supply when not in use.
- (b) All dangerous moving parts of the tool should be adequately enclosed.
- (c) Do not oil the tool when it is in operation.
- (d) Do not attempt to stop any moving parts of the tool with your hands.
- (e) Do not leave a power tool unattended until it has stopped.
- (f) If the tool bit sticks, do not try to forcibly pull it out; loosen it out by steady rocking movement of the tool.

- (g) When laying the tool down, it should always be placed in a position such that it can do no harm in case the tool is accidentally started.
- (h) Be sure all hydraulic hoses, fittings, etc. are of the proper pressure rating, and that their connections are fully tightened.
- (i) Do not drop heavy objects on the hydraulic hose.
- (j) Avoid sharp kinks in hose. Never apply pressure when hose is in sharp curves.
- (k) Keep your hydraulic tools away from excessive heat which tends to soften packing and cause leakage.
- (l) All hydraulic couplers should be properly tightened. Loose coupler connections will cause complete or partial leakage of oil flow from the pump to the cylinder.
- (m) Do not over-tighten connections. Connections should only be snug and leak free. Over-tightening can cause premature thread failure and may cause high pressure fittings or casting to fail.
- (n) Be sure all hydraulic hoses and fittings are connected to the proper inlet and outlet ports of the pumps and cylinders.
- (o) Never attempt to use the tool in such a way that its rated capacity is exceeded. Overloading causes cracked cylinders, blown cups and bent plungers.
- (p) Always screw dust caps on when coupler halves are disconnected. Use every precaution to guard unit against ingress of dirt because dirt and foreign matter may cause pump failure.

#### 3.4.1.4 Machine Tools

- (a) Disconnect tools from the power supply when not in use.
- (b) All dangerous moving parts of the tool should be adequately enclosed.
- (c) Do not oil the tool when it is in operation.
- (d) Do not attempt to stop any moving parts of the tool with your hands.
- (e) Do not leave a power tool unattended until it has stopped.

- (f) If the tool bit sticks, do not try to forcibly pull it out; loosen it out by steady rocking movement of the tool.
- (g) Do not use a machine unless you are authorised to operate it. The emergency stop control must be located before operating the machine.
- (h) Loose clothing, gloves and flapping sleeves should not be worn near moving machinery.
- (i) Chips and swarfs arising from machining, etc must always be removed with a brush or stick, never with hands or rags. This should be done only when the machine is stationary.
- (j) Always see that guards are in position before operating the machine. Guards should not be removed when the machines are running.
- (k) Before using a grinding wheel, you must make sure that guards and tool rests are in the correct position. For all grinding machine operations, goggles must be worn to protect the eyes from flying particles.

### 3.4.2 Welding And Welding Equipment

#### 3.4.2.1 General

- (a) Always be aware of the risk before welding. Make sure that adequate fire extinguishers are readily available.
- (b) Welders and their assistants must wear welding goggles or use appropriate protective screen when welding is being carried out.
- (c) Welders and assistants are responsible for the safe use of the welding equipment. Care must be taken in laying out the equipment before welding to ensure that there is no damage to regulators, nozzles, hoses etc.
- (d) Bottled gases must be turned off at the cylinder when not in use.
- (e) Do not use oil or grease where it will come into contact with oxygen for risk of explosion.
- (f) Portable screen must be erected wherever possible to prevent flashing and flying particles. Danger Notices must be displayed to warn passers-by.
- (g) When carrying out electric welding, ensure that the return lead makes good contact with the work being welded.

- (h) Any defect in the equipment must be reported to the supervisor.
- (i) Never wear wet clothing, gloves or shoes during electric welding operation.
- (j) Ensure that there is adequate ventilation when welding in confined areas.
- (k) Never strip to the waist during welding work, even if it is warm.
- (l) Do not wear synthetic fibre shirts as weld splatter is sufficient to set these alight.
- (m) Never hold the electrode holder under your arm during off-times in view of risk of electric shock.
- (n) Avoid welding near flammable materials.
- (o) Never weld enclosed vessels, drums or tanks which have contained flammable materials unless they have been purged by steaming or boiling, or filled with inert gas, and tested and certified safe to work on.
- (p) Do not weld inside enclosed vessels unless all safety precautions have been taken.

#### 3.4.2.2 Compressed Gas Cylinders

- (a) Treat every cylinder as 'full' and handle it with care.
- (b) Always use a carrier and secure the cylinders into it.
- (c) Always secure acetylene cylinders in an upright position both in use and in storage.
- (d) Store all cylinders such that they cannot fall or roll.
- (e) Keep cylinders away from sun, artificial heat, flammable materials, corrosive chemicals and fumes.
- (f) Avoid damage to valves and fittings ; do not use them as hooks for lifting or carrying purposes.
- (g) Keep valves and fittings of oxygen cylinders free from oil and grease.
- (h) Do not use cylinders as rollers for shifting equipment.
- (i) Always lift cylinders from truck - do not drop or slide them.
- (j) In the event of fire, all gas cylinder valves should be shut off.

- (k) The appropriate regulations in Section 3.4.9 are also to be followed.

#### 3.4.2.3 Electric Arc Welding

- (a) Make sure that helmets and goggles are fitted with the correct filter glass.
- (b) Wear adequate protective clothing including leather gloves and clear goggles for heavy chipping.
- (c) Ensure that cables and connections are in good condition and firmly attached.
- (d) Make certain that the welding equipment, bench or work-piece is properly earthed.
- (e) Check that the electrode holder is fully insulated and always place it on an earthed surface when not in use.
- (f) Stand on an insulated mat even when the ground is dry.
- (g) Keep trailing welding cables clear of roads and walkways. Secure overhead fixtures where possible.

#### 3.4.3. Pressure Vessels And Associate Pipework

- 3.4.3.1 All safety valves and pressure gauges shall be checked, tested and recalibrated at the time of the Statutory Inspection and results recorded.
- 3.4.3.2 All water level indicators shall be checked and tested weekly. High and low water alarms shall be tested weekly by raising and lowering the water level. The results of these tests shall be recorded.
- 3.4.3.3 Should it be necessary to shut off or gag any water alarm, a Danger Notice warning operators about same shall be attached to the boiler operating panel and a note carried forward on the boiler log sheet.
- 3.4.3.4 No maintenance work other than floating of safety valves, or testing of water level indicators or alarms, or tightening of water wall or super-heater header caps or the use of the Furmanite process for sealing leaks, shall be carried out in or on the above plant or equipment until a Permit-to-Work Certificate (Mechanical) has been issued by an Authorised Person. The use of the Furmanite process for sealing leaks shall be carried out by a person appointed in writing by the Station Superintendent. No maintenance work shall be carried out without informing the Shift Charge Engineer on duty.

- 3.4.3.5 The Permit-to-Work Certificate (Mechanical) shall not be issued until the equipment has been isolated from all possible sources of supply, including blowdown, and brought to atmospheric pressure and if necessary the equipment drained.
- 3.4.3.6 Wherever possible a double shut-off shall be carried out. A non-return valve shall not be considered as a shut-off valve unless it is capable of being locked shut.
- 3.4.3.7 The controlling valves shall be locked shut and Danger Notices posted where necessary and the keys placed in appropriate Key Safe.
- 3.4.4 Oil, Gas And Pulverised Fuel Fired Furnaces And Ancillary Equipment
- 3.4.4.1 All equipment shall be maintained to prevent leakage and kept in a clean condition.
- 3.4.4.2 All explosion doors shall be kept free from obstruction and in good working order.
- 3.4.4.3 Suitable fire extinguishing equipment shall be kept adjacent to all oil firing plant.
- 3.4.4.4 No person shall enter a vessel which has recently been emptied of oil or of any other flammable substance until an Authorised Person is satisfied that all dangerous vapours have been expelled.
- 3.4.4.5 Smoking and exposed flames are prohibited in the vicinity of open vessels containing or which have contained oil or any other flammable substance.
- 3.4.4.6 Work on vessels involving the application of heat is forbidden until all practicable steps have been taken to prevent fire or explosion either by removal of the flammable substance and any fumes or by rendering them non-explosive and non-flammable. A Permit-To-Work Certificate (Mechanical) is to be issued only after such steps have been taken.
- 3.4.4.7 No internal work shall be carried out in the combustion chamber or boiler passes until the firing equipment has been isolated and locked off from all possible sources of supply. Oil and gas fired combustion chambers shall be ventilated and tested for freedom from dangerous fumes. A Permit-To-Work Certificate (Mechanical) is to be issued only after above steps have been taken.
- 3.4.4.8 When a plant is shut down precautions shall be taken to prevent leakage of fuel into the combustion chamber.

- 3.4.4.9 Before any attempt is made to light up a boiler, the appropriate fans shall be used to clear the combustion chamber, boiler passes and flues of flammable gas and dust.
- 3.4.4.10 As a precaution against possible explosion no accumulation of coal dust shall be permitted in the vicinity of the plant.
- 3.4.4.11 No person shall enter a pulverised fuel bunker until the bunker has been emptied of fuel, ventilated, cleared of dangerous gas and fumes and the associated milling plant isolated. Breathing apparatus, safety belt and life-lines shall be maintained in good order and kept available for immediate use.
- 3.4.4.12 No internal maintenance work on any item of pulverised fuel equipment on a steaming boiler shall commence until the equipment has been completely cleared of pulverised fuel and isolated by efficient dampers or blanks from the furnace, flue gas and hot air systems.
- 3.4.4.13 Before admitting pulverised fuel to the furnace the operators shall make certain that the torches or auxiliary oil burners are properly ignited and, should these fail before ignition of pulverised fuel takes place, the fuel supply shall be stopped immediately and all fuel cleared from the furnace and boiler passes before any attempt is made to relight.
- 3.4.4.14 Ash or grit removal shall not commence without the knowledge of the Shift Charge Engineer.
- 3.4.5 Access To Bunkers And Similar Situations
- 3.4.5.1 - Entry to bunkers for the purpose of manual trimming of coal or ash is forbidden.
- 3.4.5.2 Entry for the purpose of maintenance or final cleaning out shall be carried out only after a Permit-to-Work Certificate (Mechanical) has been issued.
- 3.4.5.3 For such approved entry the following provisions shall apply unless the bunker is empty of coal or ash:-
- (a) The person entering the bunker shall wear a safety belt, the line or lines of which shall be properly secured and kept taut during the whole of the time he is in the bunker by one or more other person(s) who shall remain outside the bunker.
  - (b) He and every other person working with him shall be fully conversant with the manner in which the work is to be carried out and with the manner in which the safety belt and lines should be used so as to secure his safety.

- 3.4.5.4 Entry to pulverised fuel bunkers shall only be after adequate precautions have been taken to prevent approach to coal, coke and ash piles where there is risk of collapse.
- 3.4.5.5. No naked lights or smoking shall be permitted where explosive mixtures may be present.
- 3.4.6 Coal, Coke And Ash Handling

### 3.4.7 Hydrogen Cooled Generator -

3.4.7.1 No person shall smoke or use any exposed flame or welding equipment at any time within the hydrogen control cabinet or cubicle.

3.4.7.2 No person shall smoke in any confined space near hydrogen cooled plant and equipment.

3.4.7.3 Before commencing work which involves the opening up of any part of a casing which normally contain hydrogen, the hydrogen supply shall be disconnected from the hydrogen system and the casing shall be cleared of hydrogen and completely scavenged by CO<sub>2</sub> or other inert gas which shall in turn be replaced by air. A Permit-to-Work Certificate (Mechanical) which shall certify that the casing is free of all hydrogen and scavenging gas shall then be issued.

3.4.7.4 Tests should be carried out to establish absence of hydrogen and scavenging gas in the casing before a Permit-To-Work Certificate (Mechanical) as described in 3.4.7.3 is issued.

3.4.7.5 When external work on a hydrogen cooled machine, such as the external maintenance of hydrogen seals, has to be carried out, the casing shall be cleared of hydrogen and replaced by CO<sub>2</sub> or other inert gas, provided the following conditions are observed:-

(a) No part of the casing is dismantled, and

(b) The pressure in the system is maintained above atmospheric pressure at all times.

3.4.7.6 Before work is commenced on any other part of the equipment which contain hydrogen, that part shall be isolated from all sources of hydrogen, and the valves locked. Enclosures containing hydrogen gas shall, wherever practicable, be opened to atmosphere and thoroughly ventilated. A Permit-to-Work Certificate (Mechanical) which states the precautions taken to clear that part of the plant of hydrogen, shall then be issued.

### 3.4.8 Internal Combustion Engines And Gas Turbines

3.4.8.1 All fuel equipment shall be maintained to prevent leakage and kept in a clean condition. Fuel inlet lines should be shut off before any maintenance on the engine is commence. Suitable fire extinguishing equipment shall be kept adjacent to all fuel handling plant.

3.4.8.2 Before work is commenced on any engine:

- (a) The starting equipment shall be locked off, isolators of any associated generator and auxiliaries shall be opened and locked off, the keys locked in a Key Safe and Danger Notices attached.
- (b) Where batteries are used for starting, they should be disconnected at the battery terminal.
- (c) Where compressed air is used for starting, the air supply to the engine should be isolated and locked.
- (d) All cooling water input to the Engine shall be isolated and locked off.
- (e) Anti condensation heaters in generators may be left on if work is only confined to the engine and Danger Notices to this effect should be displayed.

3.4.9 Compressed Air And Gases

3.4.9.1 General

- (a) Always close a hose by the valve. Never kink the hose.
- (b) Do not leave hoses lying around for others to trip over.
- (c) Do not use a cylinder of compressed gas without the pressure reducing regulator attached to the cylinder valve, except when cylinders are attached to a manifold, in which case, a regulator must be attached to the manifold header.
- (d) Do not use a wrench on valves equipped with hand wheels nor hammer the valve wheel in attempting to open or close the valve.
- (e) Never permit the gas to enter the regulator suddenly. Open the cylinder valve slowly.

3.4.9.2 Compressed Air

- (a) Do not use compressed air for any other purpose than that for which it is intended.
- (b) Never direct compressed air at yourself to blow dust off clothes or hair.
- (c) Do not clean down machines and benches with compressed air. Use a brush or special vacuum cleaner.
- (d) Horseplay with compressed air is FORBIDDEN. This can cause agonising injury or death.

- (e) Make sure that your compressed air tool, hose and fittings are in good working conditions. If not, report the fault to your supervisor.
- (f) When connecting a tool to the air line keep a firm hold on the tool in case it whips.
- (g) Before changing tools make sure that the supply line is closed or has an automatic shut-off valve.

#### 3.4.9.3 Combustible Gases

- (a) Keep sparks and flame away from cylinders.
- (b) Connections to pipings, regulators, and other appliances should always be kept tight to prevent leakage. Where hose is used, it should be kept in good condition.
- (c) Never use an open flame to detect combustible gas leaks. Instead, use soapy water.
- (d) When cylinders are not in use, keep valves tightly closed.
- (e) Before regulator is removed from a cylinder, close the cylinder valve and release all gas from regulator.
- (f) Never interchange combustible gas regulators, hoses or other appliances with similar equipment intended for use with other gases.
- (g) Store all cylinders containing combustible gases in a well-ventilated place and in an upright position.

#### 3.4.9.4 Preparation For Work On Equipment Containing Or Operated By Compressed Air Or Gas

The following precautions should be taken before any work, other than operating adjustments may be carried out on equipment operated by or containing compressed air or gas:-

- (a) The valves controlling the supply of air or gas to the equipment should be closed, and the compressed air or gas removed from the associated receivers and pipework, which should be left open to atmosphere.
- (b) The valves should be locked in position by safety locks and the keys should be placed in the appropriate Key Safe.
- (c) Danger Notices should be attached to the valves.

- (d) A Permit-to-Work Certificate (Mechanical) should then be issued.

### 3.4.10 Lifting and Handling

#### 3.4.10.1 General

- (a) Only duly authorised employees should operate heavy and articulated equipment. Lifting equipment should only be operated by designated persons.
- (b) Operators should be responsible for the cleanliness of the heavy equipment assigned to them, and to make reports of any defect or unusual condition therein.
- (c) At no time should the operator allow anybody to be directly under a boom or a suspended load.
- (d) The operator should not allow any unauthorized employee to operate the equipment assigned to him nor allow such person to ride on the equipment.
- (e) No operator should operate any equipment unless he is in sound mental and physical state.
- (f) Operators should receive directional signals only from one duly authorized employee designated for the purpose. Standardised system of signal should be used for all lifting activities (See Appendix 3 for illustration of signals).
- (g) No operator should travel his equipment with a suspended load.
- (h) All booms should be lowered after each work shift except when otherwise authorized by the supervisor in-charge.
- (i) The operator should determine safe clearance on overhead obstructions and building openings, and should only proceed when satisfied that clearances meet the requirement.
- (j) Operators should conduct regular inspections of all hoists/winches with special attention to load hooks, ropes, brakes, and limit switches.
- (k) The safe load capacity of each hoist/winch should be displayed in conspicuous figures on the hoist body of the machine.
- (l) Flanges on hoist drums with single-layer spiral grooves should be free of projections that could damage a cable.

- (m) Hoist supports should have an adequate safety factor for the maximum loads to be imposed.
- (n) Safety latches are recommended for load hooks.
- (o) Material hoists operating on rails, tracks or trolleys, should have positive stops or limiting devices either on the equipment, rails, tracks or trolleys to prevent overrunning safe limits and should be equipped with overspeed devices.
- (p) A load should be picked up only when it is directly under the hoist/winch cables to avoid exceeding allowable stresses for the mechanism and to prevent swing.
- (q) All cranes and lifting tackles used should be adequately maintained, operated and regularly inspected in accordance with the relevant provisions of the Factories Act.
- (r) No person should climb on any crane rail, telfer or other lifting machine without the knowledge of the driver operating the crane or lifting machine.
- (s) None of the moving parts of a hoist or lifting machine should be dismantled unless all parts of the hoist or lifting machine are so secured or placed as to remain stable.
- (t) Do not attempt to board or alight from a crane while it is in motion.
- (u) Be sure that the weight to be lifted is known and is less than the safe working load stamped on the tackle.

#### 3.4.10.2 Manual Lifting and Handling

- (a) Gloves should be worn when handling glass, rough, sharp or hot materials to protect against cuts, scratches, punctures and burns.
- (b) Safety boots or shoes should be worn to protect toes from falling loads.
- (c) Safe team lifting requires co-ordination. Only one man should give instructions.

- (d) See that there are no obstructions in the direction you will be going. Loads in trucks and barrows should be secured, well distributed and should not obstruct vision.
- (e) Ensure that men do not lift beyond their strength. Size up the load and, if necessary, make a trial lift of a few centimeters. Do not attempt to lift alone any load that is too heavy, too large or awkward.
- (f) Where possible use the appropriate mechanical handling equipment.
- (g) Do not use kinked slings, wire ropes and those showing signs of wear and fraying.
- h. Before taking hold of an article, examine it and remove or avoid rugged or sharp edges, protruding nails, splinters, grease, oil or corrosive materials.

#### 3.4.10.3 Cranes

##### (A) MOBILE CRANES

- (a) Open hooks should not be used to support human loads, loads that pass over workmen or loads where there is danger of relieving the tension on the hook due to the load or hook catching or fouling.
- (b) Each controller and operating lever should be marked with the motion it controls and its direction.
- (c) Operating a crane on soft or sloping ground or close to the sides of trenches or excavations is dangerous. The crane should always be level before it is put into operation. Outriggers can be relied upon to give stability only when used on solid ground. Heavy timber mats should be used whenever there is doubt as to the stability of the soil on which a crane is to be operated.
- (d) The use of any makeshift methods to increase the capacity of a crane, such as timber with blocking or adding counterweight, is not permitted.
- (e) Workers should never ride or be allowed to ride a load that is being hoisted, swung or transported.
- (f) Never move the load or the crane unless you are sure that you understand the floor signal.
- (g) Only one man should give lifting instructions. However any emergency stop signal given by anyone should be obeyed.

- (h) When filling the fuel tank of a crane, always provide a metallic contact between the container and the tank.
- (i) Never lift load with a weight greater than the operating capacity for a given boom angle and radius. Keep lift height to a minimum when handling close to maximum load.
- (j) The load should be lowered to the ground before the operator leaves the crane.
- (k) Start and stop the swinging of the boom smoothly. Fast swinging cause loads to extend beyond the boom point, increasing the radius beyond the crane's capacity which might eventually tip the crane over.
- (l) The crane should be kept stationary when lifting loads close to maximum operating capacity.
- (m) Be sure that there is adequate clearance before attempting to move the machine under bridges, power lines, or other low overhead objects. When travelling the mobile crane along highways or streets, the boom should rest on its rack.
- (n) The crane should never be positioned nor left unattended near embankments, deep excavations, banks, ridges, etc.
- (o) The swing brake should be properly set when travelling the crane.
- (p) Before the operator leaves the crane, the engine clutch should be disengaged and the boom hoist pawl engaged.
- (q) Before operation, be sure that the carrier service brakes and outriggers are properly set.

**(B) OVERHEAD TRAVELLING CRANES**

- (a) Each crane should have its safe load capacity indicated on both sides in conspicuous figures, readable from the floor or ground. If a crane has two hoist blocks, each block should have its safe load capacity indicated on both its sides. The crane should not be loaded beyond its safe load capacity, except for testing.
- (b) Nobody, including those who work near cranes or assist in hooking on or arranging loads, should stay directly under loads. Operators should see to it that this is strictly followed.

- (c) All crane machinery, apparatus, and appliances, including ropes, chains, and slings should be inspected regularly by designated persons assigned to this task; and the date, findings, and action taken should be recorded.
- (d) A crane operator should never attempt to make repairs himself but should report to his supervisor any condition that might make the crane unsafe to operate.
- (e) When not in use, the crane should be parked with the load hook (and the slings if this remain on the hook fully) raised. The operator should throw all controls into "off" position and open the main switch.
- (f) A light should be visible from the floor to indicate when the main switch is on.
- (g) When repairs to one crane are necessary, every precaution should be taken to prevent other cranes from colliding with it. Safety stops should be installed.
- (h) Do not allow the load to swing against the rigger or other workers. Make certain that they are in the clear.
- (i) When raising or lowering the load, see that it safely clears adjacent stockpiles or machinery.
- (j) No person should work on or near the wheel track of an overhead travelling crane in any place where he would be liable to be struck by the crane unless effective measures have been taken by warning the driver of the crane or otherwise to ensure that the crane does not approach within 6 meters of that place and a Permit-To-Work Certificate (Mechanical) has been issued before work commences.

#### 3.4.10.4 Other Lifting Machines

- (a) Each control button of an electric lifting machine should be clearly marked.
- (b) Supports for the hoist should be strong enough to carry the load imposed on them.
- (c) Chain Blocks
  - (i) Chain blocks must be kept in good condition by regular inspections. Special attention must be given to see that hooks and chains are always in good condition. Never try to shorten a chain with a bolt or nail, it may break or slip, causing an accident.

- (ii) Never attempt to use a chain block for a load greater than the capacity of the block.
- (iii) Chain blocks should not be left supporting their load capacity or near load capacity for a long period of time. Let down or support the load to relieve strain on the block.
- (d) Lifting with jacks
  - (i) Make sure the footing is substantial; use boards or blocks at right angle to the lift.
  - (ii) Center the jack properly for the lift; if there is danger of the head slipping, use a board or the wedge on top of the jack to keep it in position.
  - (iii) Place the jack so there will be an unobstructed swing of the handle.
  - (iv) Do not lean over a jack handle or handle socket under load; the handle might fly up and strike you.
  - (v) Never leave a jack standing under load with the handle in the socket.
  - (vi) Never rely on jacks alone to support any load you have to work under. Use plenty of substantial blocking - have an ample factor of safety.
- (g) Fork Lift
  - (i) Extreme care should be exercised by the operator when approaching areas where his view is obstructed, or where pedestrians or other vehicles may have difficulty in seeing the approaching fork lift.
  - (ii) Inspect all loads to be moved to determine proper load position, to maintain stability, and to avoid overloading. When moving loads, keep fork or load as close as possible to the ground or floor. Never drive with the platform elevated.
  - (iii) The load should be kept below eye level. Where this is impracticable, operator should drive the forklift backward so that he can see where he is going.
  - (iv) Do not drive with greasy hands.
  - (v) Slow down on wet, slippery, and rough surfaces.
  - (vi) Workmen should not be permitted to ride or work on the platform. Where possible, materials should be unloaded mechanically from raised platform.

(vii) Except the operator, nobody is allowed to ride on the fork lift.

(f) Sky-Climber

The operator should see to it that this rule is strictly followed:-

(i) At least two persons who possess good knowledge about the operation of the sky climber should be present. If the sky climber fails, they should be able to bring it down manually.

(ii) Additional safety ropes must be incorporated with the sky climber so that workers with safety belts can hook the life line to the safety ropes.

(iii) Safety cables must always be incorporated to the sky climber in addition to the normal running cables. This will prevent the sky climber from falling if the running cable snaps.

#### 3.4.10.5 Lifts

##### (A) **GENERAL RULES**

(a) Only Personnel qualified and authorized by the Inspector of Machinery should maintain and repair lifts.

(b) Keys for unlocking of Emergency door latches should be kept in the premises by the person responsible for the operation of the lift and in a location readily available to an Authorized Person (For Emergency purposes).

(c) Enclosures should be kept in good condition to prevent injuries to persons entering and leaving the car.

(d) Elevators should be regularly inspected and properly maintained.

(e) The rated safe load of an elevator should be indicated by a conspicuous sign.

(f) Appropriate "No Smoking" sign should be conspicuously installed inside the elevator. Standard sign are as shown in Appendix 4.

(g) Never use elevators in case of fire or in the event of an earthquake.

(h) Goods lifts should be provided with cages and properly guarded, and should not be operated without a signal man.

- (i) Loads should be properly arranged and secured to prevent their falling from goods lifts.
- (j) The following notice should be exhibited in a permanent place adjacent to the entrance of every machine room:-

**BAHAYA  
BILEK JENTERA  
DILARANG MASUK TANPA KEBENARAN.**

**(B) RULES FOR LIFT OPERATORS**

- (a) Know the safe capacity of your elevator; never overload it.
- (b) The operator should promptly report any abnormal/defective condition.
- (c) Crowding, horseplaying and lighted cigar/cigarettes and the like should not be permitted in the car; require passengers to face the entrance but at a safe distance from it.
- (d) Operators should maintain good house-keeping inside the elevators.
- (e) In case of an emergency, remain calm and institute applicable emergency measures.

**(C) RULES WHEN DOING REPAIR WORK.**

- (a) Before doing repair/maintenance work, opened elevator gates should be provided with a barricade so designed as to provide ample working space for repairman at the floor level and at the same time protect employees/public from hazard of falling in.
- (b) Before doing repair/maintenance work, power source should be shut off, locked and cautioned.
- (c) Danger Notices should be clearly displayed at strategic locations around the lift under repair/maintenance.

**3.4.11 Scaffolding And Ladders**

- (a) All scaffolds should be erected, used and maintained according to the relevant clauses specified in the Factories and Machinery (Building Operations and Works of Engineering Construction) Regulations 1981.
- (b) Toe boards and handrails should be fixed to all scaffold platforms of more than 3 metres high.

- (c) Any ladder which is used should be placed at the correct angle, and secured. Ladders erected against scaffolding should project at least one metre above the platform of the scaffold.
- (d) Ladders in use should stand on level and firm footing. Loose packing should not be used to support the base.
- (e) Scaffolding should be constructed of sound materials, securely fastened and supported. Planks for scaffolds should be free of knots and other imperfections and painted red on both ends for identification, and should not be used for any other purpose. As a general rule the distance with single planks should not exceed one (1) metre with planks 32mm in thickness, 1.5 metres with planks 38mm in thickness or 2.6 metres with planks 50mm in thickness.
- (f) Never construct a scaffold with a span longer than 2.6 metre between supports.
- (g) Scaffolding should only be erected and dismantled under close supervision of experienced personnel.
- (h) Scaffolds (tubes, couplers and boards) and ladders should be carefully inspected before use.
- (i) Scaffolds should be provided with a roof made of light lumber, heavy canvas or heavy wire screen, when other men are working overhead.
- (j) Do not allow men to jump on or hang tools on any part of, nor heavy materials to be dropped on, or anything to be thrown from the scaffold.
- (k) Workmen should not work on a scaffold installed outdoors during storm or high wind.
- (l) A safe means of access to the scaffold, either by stair or permanent ladder should be provided. If portable ladder is used, it should be in good condition and its upper end securely fastened to prevent tipping or slipping.
- (m) When hoisting load, do not let it swing against or catch on scaffolds.
- (n) Good housekeeping should be observed on scaffolds at all times.
- (o) Scaffolds should rest on solid foundation to prevent settling, and plumbed and securely fixed at the bottom to prevent shifting.

- (p) Toeboards, of at least 50mm in height, should be installed at the outer edges of the platform to prevent tools and other materials from falling off. In spite of this protection, however, precaution should be taken, especially during the process of raising the platform to a new elevation, to prevent objects from falling on the men below.
- (q) Pipe members should be of steel tubing complying with B.S.1139 'metal scaffolding' or equivalent standard.
- (r) Supporting ropes should be securely fastened to prevent slip-off in the ends of the pipes.

#### 3.4.12 Ladders

- (a) If ladders are used for two-way traffic, provide one for ascending and another one for descending.
- (b) The upper ends of the side rails of ladders should project no more than one-fourth (1/4) of the total length of the ladder above the point where it is resting, and with lower ends set on stable footing.
- (c) In placing a ladder, the distance from foot of ladder to structure against which it is leaning should be approximately one-fourth (1/4) the length of the ladder.
- (d) Avoid working on a high ladder in a strong wind.
- (e) When you use a step ladder, make sure its legs are fully spread before climbing.
- (f) Always carry a ladder with the anti-slip device (rubber) towards the rear and the front end pointing upward. Be extra careful when approaching doorways and corners. When two (2) men are carrying a long ladder, each man should be close to his end of the ladder.
- (g) Never place ladder in front of door without first locking the door or placing man on guard.
- (h) Keep both hands free for climbing or descending. Do not carry tools in your hands.
- (i) Always face ladder when climbing or descending.
- (j) Only one person should be on a ladder at one time. However, where two (2) employees will work at the same spot on different levels (without using the same rung) they may be allowed to use one ladder provided that the upper end is properly rested and secured on a fixed structure and the lower end is on a stable footing.

- (k) Defective ladders should be repaired or otherwise destroyed.
- (l) Untreated portable ladders should not be left exposed to the elements when not in use, but should be kept in a sheltered place to avoid warps and cracks.
- (m) Prohibition against use of defective ladder; No ladder of the following should be used:-
  - (i) with missing, broken or defective rung.
  - (ii) with broken or split side rails.
  - (iii) of faulty or defective construction.
  - (iv) with any of the rungs depending for its support solely on nails, spikes, or other similar fixing.
- (n) Every ladder should so far as practicable be securely fixed so that it can move neither from its top nor from its bottom points of rest.
- (o) Ladder should not be painted so that defects can be identified easily. Instead lacquer should be used.
- (p) Ladders should extend at least 1 meter above the stepping off point in order to provide an adequate hand hold.
- (q) A register of ladders should be kept at all stations. Ladders should be numbered for identification and inspected at least once every three months and the results recorded in the register.
- (r) Ladders should only be used up to 9 metre. Above this height ladder landing platforms, if necessary enclosed in a ladder access tower, must be provided.

3.5            **CONFINED SPACES SUCH AS VESSELS, CULVERTS, FLUES, SEWERS, TUNNELS AND UNDERGROUND CHAMBERS.**

3.5.1        No person should enter nor work be carried out in any tunnel, pipeline, aqueduct, associated turbine or pump until:-

- (a) The tunnel, pipeline, aqueduct, associated turbine or pump is isolated from all sources of water, drained and vented to atmosphere and supplies of compressed air and chemical injections, are, isolated.

- (b) The supply to motors operating all valves, intake gates, or headstocks are isolated and locked off and all hand operated mechanisms locked. The power supply water to hydraulically operated valves will remain available where necessary to successfully seal off the valves.
  - (c) Danger Notices are attached at points of isolation and shut off.
  - (d) The keys used for locking are placed in a Key Safe.
  - (e) Permission has been obtained from the operations/shift charge engineer associated with the work, who should retain in his possession a copy of each Permit-to-Work Certificate (Mechanical) issued until it has been cancelled.
  - (f) A Permit-to-Work Certificate (Mechanical) is issued to the person in charge of work being carried out.
- 3.5.2 Work or inspection parties shall consist of not less than two persons. Precautions should be taken to prevent unauthorised entry.
- 3.5.3 A person should be stationed at each point of entry to prevent unauthorised entry when and where danger is present i.e. during dewatering and before the tunnel is re-sealed immediately prior to flooding. If however, persons have not been stationed on each point of entry during the whole of the period of access to tunnel or similar equipment, a final inspection should be carried out, with persons stationed at each point of entry to prevent further unauthorised entry.
- 3.5.4 Before the Permit-to-Work Certificate (Mechanical) is cancelled, the person in charge of the work or the inspection party should ensure that all persons have been withdrawn.
- 3.5.5 Reservoir Main Scour or Drain Valves
- (a) When overhauling or inspecting these valves the roller gate should be lowered.
  - (b) When filling the space between the roller gate and the valve, great care should be taken just to break the seal of the gate with the valve open.
- 3.5.6 Where dangerous fuses or substances are liable to be present in a confined space which cannot be effectively isolated and adequately ventilated the following measures should be taken before any person is permitted to enter the space:-

- (a) All practical steps must be taken to prevent the ingress of dangerous fumes or substances.
- (b) Every person who is to enter the confined space should wear an approved breathing apparatus.
- (c) Every person who is to enter the confined space should where practicable, wear a safety harness to which a rescue line is attached.
- (d) An extra person should be kept on duty outside the confined space and this person should keep in touch with those inside the confined space. This person should control the rescue line(s) attached to the safety harness(es) and should be capable of pulling the worker(s) out of the confined space. Where safety harness is not practicable a second set of breathing apparatus should be available for the use of this person.
- (e) A Permit-to-Work Certificate (Mechanical) should then be issued.
- (f) Adequate steps should be taken to ensure that all persons wearing breathing apparatus should be withdrawn from the confined space before the end of the prescribed working duration of the apparatus.

#### 3.5.7

Where a confined space can be adequately ventilated and effective measures taken to prevent the ingress of dangerous fumes or substances this should be done before any person is permitted to enter the space and before exposed flames or smoking are permitted therein. In addition the following should be done:

- (a) Adequate ventilation should be maintained while persons remain in the space.
- (b) If doubt exists as to the adequacy of the ventilation, the atmosphere in the space should be tested for dangerous fumes or substances by an approved detector.
- (c) Danger Notices should be attached at all points of isolation, and the keys used for locking off purposes should be placed in the appropriate Key Safe.
- (d) A Permit-to-Work Certificate (Mechanical) should then be issued.

### 3.5.8 Vessels which have contained Oil, Gas or other Flammable Substances.

Smoking and exposed flames are PROHIBITED in the vicinity of open vessels containing, or which have contained, oil, gas or any flammable substance. Work on the vessels involving the application of heat is FORBIDDEN until an Authorised Person has taken all practicable steps to prevent fire or explosion either by removal of the flammable substance and any fumes, or by rendering them non-explosive and non-flammable.

Before any person is allowed to commence work in a vessel which has contained oil, gas or any other flammable substance; The following should be done:-

- (a) An Authorised Person should satisfy himself that all dangerous vapours and substances have been expelled, that the vessel is adequately ventilated and that adequate ventilation will be maintained whilst work is in progress.
- (b) All possible sources to the tank should be isolated and locked off and the keys used for locking off purposes should be placed in a Key Safe.
- (c) Danger Notices should be attached at all points of isolation.
- (d) A Permit-to-Work Certificate (Mechanical) should then be issued.

## 3.6 HANDLING, STORING AND USING OF CHEMICALS

### 3.6.1 General Precautions And Personal Hygiene

3.6.1.1 All chemicals must be handled in accordance to the instructions written on the containers. Time and opportunities should be given to employees to get familiar with the indicated labels, chemical characteristics and the purposes. Safety precautions such as personal carefulness, are to be observed in handling toxic, corrosive, volatile and flammable chemicals.

3.6.1.2 Wherever and whenever there is danger of contact with chemicals personnel should;

- (a) Be warned of the nature of the potential hazards and the necessary precautions and be instructed in the use of protective clothing and equipment.
- (b) Observe a high standard of hygiene.

- (c) Drinking, eating and smoking are prohibited.
- (d) Avoid wiping nose, eyes or face other than with a clean paper tissue.
- (e) Place all debris and chemical residues in polythene bags for subsequent disposal.
- (f) Wash thoroughly as soon as possible after leaving work area.

3.6.1.3 When handling chemical appropriate safety attire such as chemical goggles, face shields, rubber gloves, rubber boots, chemical resistant clothing should be worn. Handling of chemicals that involve gases or dust, needs sufficient ventilation system, respiratory equipment and chemical resistant clothing.

### 3.6.2 Safety In The Laboratory

#### 3.6.2.1 Safety of the Personnel in Laboratory

- (a) Unauthorized experiments with chemicals or equipment are prohibited.
- (b) Drinking and eating in the laboratory are prohibited.
- (c) Do not use a beaker to drink or for keeping food.
- (d) Never run in the laboratory.
- (f) Maintain constant inspection of gas lines used on burners to prevent leaks.
- (g) Turn off burners and water taps if not in immediate use.
- (h) Wash bottles containing chemicals/solvents should be labelled.
- (i) When working alone in the laboratory ensure that another person should be within call.

#### 3.6.2.2 Housekeeping

Chemical laboratory should be kept clean and in proper order. Passageways leading to building exits must be kept clear from obstructions.

#### 3.6.2.3 Ventilation

The laboratory should be adequately ventilated to ensure and to maintain low concentration of impurities in the laboratory atmosphere. An extraction fan with shutter frame should be installed in every laboratory.

#### 3.6.2.4 Fire Fighting Equipment

Portable fire extinguishers should be available in the laboratory as well as outside the laboratory.

#### 3.6.2.5 First Aid Facilities

The first-aid box must be stocked adequately and be kept inside the laboratory at an easily accessible place.

#### 3.6.2.6 Emergency Showers

Emergency showers should be located within reach of the employees and be operated by spring loaded platform.

#### 3.6.2.7 Fume Cupboards

- (a) A good ventilation system should be installed in the fume cupboard.
- (b) Volatile and flammable chemicals should be handled in the fume cupboard with no naked flame around.
- (c) Experiments that give off fumes and require heating with naked flame should be done in the fume cupboards.

#### 3.6.3 Handling And Storing Of Laboratory Chemicals And Glassware

##### 3.6.3.1 General

- (a) Always read labels and directions on bottles or containers of chemicals before handling.
- (b) Know the properties of chemicals that the personnel are dealing with in order to proceed with necessary caution and care. Classification of hazardous chemicals is given in Appendix 5. (Ajax Chemicals).
- (c) Containers and bottles containing prepared chemicals should be properly labelled. Highly poisonous chemicals should carry the standard poison labels.
- (d) Carry beakers, bottles and flasks with the fingers around the body of the vessel. Do not hold glasses by the neck or lip. A pair of tongs should be used to handle a hot flask.
- (e) Never open bottles or containers of highly volatile and flammable chemicals, liquids or gases, in a room where there are open flames.

- (f) Always place or pour a chemical into a clean container before proceeding with the experiment. Never use contaminated containers.
- (g) Position the bottle with the label facing upwards when pouring the liquid chemical and ensure to pour the last wanted drop out into the container.
- (h) After opening the acid bottle do not lay the stopper down on the table or bench where a next person may rest his hand or arm. Acid bottles must be stoppered tightly and flushed and dried on the outside before replacing them on the reagent shelf.
- (i) Never taste any chemicals. Do not smell a chemical directly. When necessary wave a small amount of vapour with the hand towards the nose at a distance.
- (j) Pour acid into water - NEVER pour water into acid.
- (k) Fill bench reagents in bottles to not more than three-fourth ( $3/4$ ) of their capacity to allow for expansion at room temperature.
- (l) Cover the beaker containing liquids when heating on a hot plate to prevent splatterings. Splatterings from the liquids should be flushed with plenty of water.
- (m) Never pipette the chemicals with the mouth. A pipette filler should be used.

#### 3.6.3.2 Flammable and Combustible Liquids

- (a) Flammable liquids should be identified and ensure the proper labellings are intact.
- (b) Smoking and other spark-producing devices are prohibited in the areas where flammable liquids are stored, handled or used. NO SMOKING sign should be exhibited.
- (c) Mixture of flammable liquids should be avoided because the flash point of the contents is lowered. Never mix acetone with kerosene as it lowers the flash point of the mixture and may cause hazards in future use.
- (d) Flammable liquids which are not miscible with water and are likely to give off toxic vapour should never be poured into the sink.

- (e) Storing flammable liquids in glass containers or open containers is prohibited except in the laboratory for use or in obtaining samples for laboratory use or in testing at operating units. Flammable liquids must be stored in closed metal containers.
- (f) Adequate ventilation system should be installed in flammable liquids storeroom.

### 3.6.3.3 Combustible Gases

- (a) Store all cylinders containing combustible gases in a well-ventilated place and in an upright position. Cylinders should be properly labelled.
- (b) Do not store reserved stock of cylinders containing combustible gases with cylinders containing oxygen. They should be grouped separately.
- (d) Keep naked flame or spark away from cylinders.
- (e) Never interchange combustible gas regulators, hoses, or other appliances with similar equipment intended for use with other gases.
- (f) Cylinders in use must be properly secured to the wall or bench.
- (g) Do not use a cylinder of compressed gas without the pressure reducing regulator attached to the cylinder valve, and use cylinders only when the regulators are attached to the manifold header.
- (h) Always check all connections to piping, regulators and other appliances are kept tight to prevent leakage. Any hose used should be in good condition.
- (i) After attaching the regulator and before opening the cylinder valve ensure that the adjusting screw of the regulator is released.
- (k) Never permit the gas to enter the regulator abruptly. The cylinder valve must be opened slowly.
- (l) Use only soapy water to detect combustible gas leak.
- (m) If the valve is difficult to open, point the valve opening away from you and use greater force. NEVER use a wrench on valves equipped with hand wheels to operate the valves. If further difficulty is encountered in opening the valve, return the cylinder to the supplier for replacement.
- (n) To remove the regulator from a cylinder, ensure to close the cylinder valve first and then release all gas from regulator before removing the regulator.

- (o) Proper trolley should be used for transporting of cylinders.

#### 3.6.3.4 Storage of Laboratory Chemicals

- (a) A cool dry and well ventilated storeroom is the primary requirement to store chemicals. Storage of hazardous chemicals need careful planning. Separate shelves and compartments should be considered depending on the properties of the chemicals and not in any other form of arrays.
- (b) Water-sensitive materials/chemicals should be stored in a dry place. Certain metals such as sodium, and chemicals such as anhydride, concentrated acid and alkali will react with water in one form or another and will emit heat, flammable / explosive gases.
- (c) A cool condition must be maintained in the storeroom as some chemicals are reactive with heat. Oxidising agents when heated would emit sufficient amount of oxygen and others may emit at room temperature.
- (d) Oxidizing agents should be kept separately from flammable liquids or low flash point liquids as they react violently to produce a fierce fire. Peroxides, oxides, permanganates, organic and inorganic nitrates are some examples of oxidizing agents.
- (e) Corrosive and volatile materials which are toxic to personnel should be kept in a well-ventilated room.
- (f) It is important to note the date of receiving chemicals and relevant datas for storage duration. Safety precautions must be taken when handling chemicals which would decompose when kept for a long period of time.
- (g) Volatile chemicals which could react with each other should be kept in separate places and disposed separately to avoid reaction which will cause hazards.

#### 3.6.4 Handling Of Bulk Chemical

##### 3.6.4.1 General

- (a) Work areas, equipment and machinery should be properly cleaned frequently.
- (b) Ensure that labels on containers and bags of chemicals are always intact. Highly poisonous chemicals should carry the standard poison label. See Appendix 4 for standard sign.

- (c) Bulk chemicals such as sodium carbonate, aluminium sulphate, sodium hydroxide, ferrous sulphate, sodium triphosphate and sodium chloride should primarily be stored in a clean, dry and well-ventilated section of the chemical storage area. (See Appendix 6).
- (d) Safety attire such as protective clothing etc. should be provided when preparing bulk chemicals solution.
- (e) Spillage should be avoided and any chemicals spilled on the floor should be removed and not swept.
- (f) Always check the condition of the bags or containers of the chemicals. Chemicals in damaged bags or containers should be used first.

#### 3.6.4.2 Handling of Hydrazine

- (a) It is a colourless liquid and the vapour has an irritating smell. Liquid hydrazine has been used as boiler water oxygen scavenger.
- (b) Direct contact with the skin and inhalation of the vapour should be avoided.
- (c) Goggles and rubber gloves should be worn when handling hydrazine.
- (d) Under no condition should hydrazine be handled in open glasses for fear of breakage. It should be transported in screw capped plastic bottles.
- (e) Accidental spillage of hydrazine should be promptly washed off with plenty of water. Do not wipe with rag or paper.
- (f) Hydrazine should be kept away from sunlight.
- (g) A dilute hydrazine solution ( = 35%) must be kept away from hypochlorite, chromate and other oxidizers as it causes hazardous reaction.
- (h) Hydrazine vapours or residues in contact with organic materials can ignite spontaneously. Hydrazine vapours possess 135% of the explosive strength of TNT.

#### 3.6.4.3 Handling of Ammonia

- (a) Ammonia is another chemical that is used daily in the power station. This chemical is a colourless, alkaline liquid. Ammonia vapour which is lighter than air has a distinctive pungent odour. It is also soluble in water.

- (b) Personnel should be provided with ammonia respiratory equipment when handling the chemical.
- (c) Keep away containers of ammonia from high temperature (above ambient temp.). Store in a cool dry place and away from sources of heat to avoid raising the pressure of the gas.

#### 3.6.4.4 Handling of Hydrochloric Acid

- (a) Hydrochloric acid is usually supplied as 28%, 32% or 36% w/w strength solution. It has a strong fume. Avoid inhaling the fumes.
- (b) When handling the acid never allow the acid in contact with skin as it can cause injuries. Proper protective gloves and shield, should be worn.
- (c) The acid container or the carboy should be handled in a proper manner and never be grasped by the neck.
- (d) Hydrochloric acid should be stored in a place where there are no metal equipment. The fumes will corrode the metal in contact.

#### 3.6.4.5 Handling of Sulphuric Acid

- (a) Sulphuric acid is required to regenerate resin in the water treatment process. The sulphuric acid delivered to the power station is a thick and viscous liquid of 98% strength.
- (b) The acid is highly corrosive to metal and can cause charring of organic matters (paper, skin, wood).
- (c) The acid reacts with water violently. Always add acid to water to avoid boiling and spattering of the mixture.
- (d) Any spilled acid should be washed with plenty of water, then followed by neutralization with soda ash before discharging, do not neutralize the spilled acid directly.
- (e) Personnel who handle acid should be provided with personal protective clothing, to prevent the acid solution from contacting the skin.
- (f) Acid splashed onto the skin or eyes should be washed immediately with plenty of water. Never try to neutralize the splashed acid directly.
- (g) Emergency showers should be installed at the location of handling the acid.

- (h) Concentrated sulphuric acid gives out heat when it comes into contact with moisture. Routinely check that the ventilation pipeline of the sulphuric acid storage tank is free from blockage and the drying agent is in good condition.
- (i) Sulphuric acid storage tanks should be placed in a well ventilated space to avoid violent reactions of acid fume should there be a leakage in the acid storage system. Acid fumes are toxic and may produce many harmful effects on man.
- (j) No smoking is allowed in the acid storage area to avoid hydrogen explosion as a result of acid fumes coming into contact with metal.

#### 3.6.4.6 Handling of Caustic Soda (sodium hydroxide)

- (a) Two forms of caustic soda are used for the water treatment process. One is in the form of 50% liquor. The other is in the form of pallets known as pearls. It is a highly corrosive material and will attack organic matter.
- (b) Solid caustic soda is hygroscopic. Its storage requires water tight containers and a cool dry place.
- (c) The pearl form is dust free compared to the hazardous flake form of caustic soda. When handling the flake form, precaution should be taken as the flakes tend to breakdown to troublesome dust and become air borne.
- (d) Always add solid caustic soda to a full amount of water when mixing caustic soda with water. Never add water to caustic soda as boiling and spattering of the mixture may result and create various hazards.
- (e) Personnel who frequently handle caustic soda should wear proper safety attire to safeguard against skin contact with caustic soda dust.
- (f) Solidified caustic soda needs to be broken into pieces and should be contained in or covered with a soft material to prevent chips from flying.
- (g) Never wipe spilled caustic soda liquor. Spilled caustic soda should be washed away with water. Do not sweep spilled solid caustic to prevent caustic dust flying.
- (h) Never neutralize spilled liquid caustic soda with sulphuric acid directly. Flush with plenty of water.

- (i) When caustic soda gets into the eyes or on the skin, immediately flush the eyes or skin with plenty of clean water. Only water should be put into the eyes except upon order of a physician.
- (j) Any leakage found in the alkali system should never be collected in an aluminium or zinc container as it reacts and emits hydrogen gas.
- (k) Check that the ventilation pipe line of the liquid caustic soda storage tank is clear from blockage.

#### 3.6.4.7 Handling of Bleaching Powder

- (a) It is corrosive chemical and can damage the tissue, eye and skin.
- (c) Any splashed chemical onto the skin or eyes, should be flushed with water for at least 10 minutes before getting medical attention.
- (d) Do not breathe the dust.

#### 3.6.5 Handling Of Chlorine

##### 3.6.5.1 General

- (a) Chlorine gas is heavier than air and has a pungent smell. It is an acute irritant to the mucous membranes of the eye, nose and respiratory passage.  
  
Exposure to 1 ppm of chlorine should not exceed 8 hours. Never be exposed to chlorine more than 10 ppm in concentration as it can cause serious injuries.
- (b) Chlorine is supplied to Power Stations in 916 kg. drums carrying two discharge valves. A chlorine drum should not be exposed to an excessively high ambient temperature. It is to be stored in a dry place to prevent base corrosion and kept away from heat sources.
- (c) Chlorine drums should be placed on rollers. Do not pile drums on top of one another.
- (d) A drum should not be exhausted below 1 bar.
- (e) The drum storage house and chlorination plant room should be adequately ventilated. It is always preferable to have forced ventilation and extraction at floor level and discharging above roof level. The operating switch should not be inside the drum house. Fan capacity should be a minimum of 12 changes of air/hour. Defects in the ventilation system should be repaired immediately.

- (f) The layout of the drum house should allow the operator to escape outside easily if a serious chlorine leak takes place.
- (g) When changing drums a standard procedure should be followed:-
- (i) Two men should always be present in the drum house.
- (ii) Gas masks should be available when connections are made or broken.
- (iii) The drum house door must be left open and the ventilation fan working.
- (h) All pipelines and connections carrying chlorine should be inspected regularly.

#### 3.6.5.2 Handling Chlorine Leak

- (a) Even the smallest chlorine leak should be treated as an emergency and dealt with promptly.
- (b) Make available respirator or breathing apparatus. When dealing with liquid leak a self contained breathing apparatus should be worn.
- (c) Avoid inhaling the chlorine gas .
- (d) Ensure that the ventilation system is on.
- (e) Use ammonia blow-bottle to detect leak. White fumes of ammonium chloride are formed which are easily observed.
- (f) Be sure to allow only experienced personnel to investigate the leak. Breathing apparatus should be worn.
- (g) Control of Major Liquid Chlorine Spillage.  
The liquid chlorine remains as a pool of liquid (boiling point - 34 Degree C) and vaporises.

The best method of control is to use fire-fighting foam produced from a protein based compound, such as Kerr's Profoam, Augus' Nicerol or Pyrene Standard Protein Compound. Consult chlorine supplier for the appropriate type.

Apply the foam to a depth of 6 ins. over the surface.

### 3.6.6 Chemical Cleaning Of Power Plant Internals

#### 3.6.6.1 General

- (a) The storage, use and handling of the chemicals required for the chemical cleaning process are potentially hazardous to the personnel involved. These hazards are listed together with storage requirements in Appendix 6. Emergency provisions and first aid treatment are given in Appendix 7.
- (b) The person-in-charge should ensure that the safety precautions are observed and that suitable first aid facilities are available.
- (c) Chemicals should be stored in well-ventilated areas free from fire risk. Some chemicals require special storage precautions to be taken, see Appendix 6.
- (d) Manual handling of chemicals should be avoided as far as possible; wherever possible mechanical aids should be used.
- (e) An adequate water supply should be available to deal with leakage or spillage of chemicals.

#### 3.6.6.2 Precautions During the Cleaning Process

- (a) The chemical handling, mixing and temporarily hazardous areas should be cordoned, cleared of extraneous matter, and Danger Notice should be displayed. Persons not concerned with the cleaning exercise should be prohibited from the area.
- (b) Whenever chemical solutions are in the plant, the entire circuit both temporary and permanent should be periodically examined for leaks. Any leakage should be arrested as quickly as possible and the contaminated area thoroughly flushed down.
- (c) If the supervising officer deems the leakage to be dangerous to personnel or plant, the process should be suspended and the affected circuit drained and flushed prior to repair.

#### 3.6.6.3 Approach To The Plant (Excluding Bodily Entry) After Any Stage Of The Cleaning Process

When the plant is to be opened up after the passivation stage or after any acid stage the following precautions should be observed:-

- (a) The chemical cleaning circuits should be drained taking care to minimize spillage, splashing of solutions or accumulation of vapour.

- (b) Avoid acidifying solutions containing nitrite or bromate or mixing strong acids and alkalis, or mixing strong oxidising and reducing agents.
- (c) Vapours admitted from plant openings should be dispersed by using good ventilation.
- (d) When the access points are first opened, personnel should not exposed themselves to risk when making a quick inspection of the plant interior (without bodily entry)

#### 3.6.6.4 Entry Of Personnel Into Plant Which Has Been Chemically Cleaned

The following precautions are necessary if entry is to be made into plant after the passivation stage or after any acid stage during the process:-

- (a) Entry to the plant should be restricted to the minimum number of people necessary.
- (b) During the time that personnel are inside the plant a standby man should be positioned at the point of entry.
- (c) Before entering plant there should be an absolute minimum delay of three hours after opening all entry points. During this period ventilation of the plant should be carried out at a rate of at least ten air changes per hour using a filtered air supply. It is essential that this three hours delay period is observed even if a higher ventilation rate is adopted. Ventilation of the plant at a rate of at least ten air changes per hour should be continued whilst personnel have entered the plant.
- (d) - Before personnel enter plant the temperature should be below 30 Degree C.
- (e) Where practicable, personnel entering the plant should wear an overall, gloves and eye-goggles.
- (f) Removal of debris or chemical residues from the plant should be carried out so as to avoid contamination of external surfaces.

#### 3.6.6.5 Disposal of Chemical Waste.

- (a) For disposal, debris and chemical wastes should be washed into a system where considerable dilution and treatment can be achieved.
- (b) Disposal of all surplus solutions and chemical wastes should be by an approved route. Reference should be made to the Pollution Control Regulations.

3.7 FIRE PREVENTION AND CONTROL

3.7.1 Fire Prevention

3.7.1.1 The best time to stop a fire is before it starts. Electrical equipment, machinery and processing equipment, housekeeping conditions and other sources of fire should be checked for fire hazards at regular intervals.

3.7.1.2 Fire fighting equipment should be checked regularly to be sure that they are ready for any emergency. Each designated employee must become proficient in the method of handling fire fighting equipment installed at the area or station where he works.

3.7.1.3 Gasoline, oil, gases and other volatile liquids (low flash point) should be handled with great care. Open flames, lighted cigars, cigarettes, or pipes should be kept away from them.

3.7.1.4 Employees should eliminate or report to their immediate supervisor, fire hazards, particularly in their work area .

3.7.2 Housekeeping

(a) Oil-soaked and paint-saturated rags, papers, waste and other combustible refuse should be deposited in non-combustible, covered receptacles, and removed daily from the work areas for proper disposal.

(b) A procedure on safe collection and disposal of all combustible waste and rubbish should be a part of the fire prevention program.

(c) Accumulation of all types of dust should be cleaned at regular intervals from overhead pipes, beams and machines, particularly from bearing and other heated surfaces.

(d) Roofs should be kept free of sawdust, shavings and other combustible refuse. No such materials should be stored or allowed to accumulate in air shafts, or elevator and stair shafts, tunnels, out-of-the-way corners near electric motors or machinery, against steam pipes, or within 3 metres of any stove, furnace, or boiler.

(e) All passageways leading to portable fire extinguishers, fire hose cabinets and fire exits must be kept free from obstructions at all times. Portable fire extinguishers should not be relocated from their officially designated places without previous clearance from the designated Safety Officer.

### 3.7.3 Rubish Disposal

- (a) Combustible rubbish, weeds and grass should not be allowed to accumulate in substation yards, in or around pole yards, or near buildings, other combustible materials, or storage drums/tanks of flammable liquids.
- (b) Rubbish should be burned only in incinerators or designated areas away from buildings, sheds, lumber piles, fences and grass or other combustible materials.
- (c) Wind and weather conditions should be considered before fires are lighted. Only a controllable amount of materials should be burned at one time and a fire hose or other suitable fire fighting equipment should be on hand. In no case should a fire be started on a windy day where there is any possibility of the fire getting out of control.

### 3.7.4 Electrical Equipment Fires

- (a) Only approved electrical equipment should be used where flammable gases or vapors may be present.
- (b) Portable electrical tools and extension cords should be inspected at frequent intervals and repaired or replaced promptly when found defective. User should also visually check same before use.
- (c) Waterproof cords and sockets should be used in damp places, and explosion-proof fixtures and lamps should be used in the presence of highly flammable gases and vapors.
- (d) Portable lamp bulbs should be protected by heavy lamp guards or by adequately sealed transparent enclosure and kept away from sharp objects and from falling. Bare bulbs should never be used when exposed to flammable dusts or vapors. Lamp bulbs must be considered as potential hazards in areas where flammable dusts or vapors exist; they must be safeguarded accordingly.

### 3.7.5 Smoking

- (a) In areas, where smoking is prohibited, the no-smoking sign should be posted conspicuously.
- (b) Where flammable and combustible liquids, vapors, chemicals, gases and the like are stored or handled, personnel should be prohibited from carrying matches, lighters and other spark-producing devices.

### 3.7.6 Open Flames

- (a) If gasoline, kerosenes, LPG (Liquified Petroleum Gas), acetylene or alcohol torches are used, they should be placed so that the flames are at least 50cm from wood surfaces. They should not be used in proximity with flammable materials.
- (b) When portable furnaces, blow torches and the like are used, there should be an overhead clearance of at least 1.5 metres. Combustible materials should be removed or protected by non-combustible insulating board or sheet metal and preferably by a natural draft hood and flue of non-combustible material.

### 3.7.7 Fire Protection Equipment

#### 3.7.7.1 General

- (a) Contact with some chemicals used in fire protection equipment may be dangerous and in such cases Danger Notices should be displayed adjacent to the equipment.
- (b) Portable fire fighting equipment should not be used on electrical apparatus unless such apparatus has been disconnected from the supply.
- (c) Portable CO<sub>2</sub> and dry 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<sub>2</sub> extinguishers in a confined space, the operator should leave the space until the precautions set out in (d) have been taken.
- (d) After any fire, or after the discharge of CO<sub>2</sub> extinguishers in an enclosed space, the space should be thoroughly ventilated before entry or suitable breathing apparatus should be worn if entry is necessary before the gases have been cleared.

#### 3.7.7.2 Automatic Control

- (a) Before work or inspections are carried out in any enclosure protected by automatic CO<sub>2</sub> or other chemical extinguishing equipment the automatic control should be rendered inoperative and the equipment left on hand control and a notice to this effect shall be attached.
- (b) The automatic control should be restored immediately after the persons engaged on the work or inspections have withdrawn from the protected enclosure.

- (c) Precautions taken to render the automatic control inoperative should be noted on any Permit-to-Work issued for work in the protected enclosure.

### 3.7.8 Portable And Manual Fire Control Equipment

#### 3.7.8.1 Inspection And Maintenance

- (a) Extinguishers should be maintained in a fully charged and operable condition and kept in their designated places at all times, except when being used, tested, repaired or replaced.
- (b) Extinguishers removed from the premises where they are regularly installed for recharging or repair should be temporarily replaced by spare extinguishers of the same type and capacity.
- (c) Extinguishers should be inspected monthly to ensure they are in their designated places, that they have not been tampered with and are fully charged and pressurized, and to detect any physical damage, corrosions or other impairments. Extinguishers or parts thereof which are not in good operating condition should be immediately recharged, repaired or replaced.
- (d) Each extinguisher should have a durable tag securely attached to show the maintenance or recharge date and the initials or signature and name of the person who performs this service.
- (e) Fire fighting equipment should not be tampered with.

#### 3.7.8.2 Installation

- (a) Extinguishers should not be obstructed or obscured from view. In large rooms and in certain locations where visual obstruction cannot be completely avoided, the location and intended use of extinguishers should be indicated conspicuously.
- (b) In situations where extinguishers must be temporarily provided, unless they are of the wheel type, they should be installed on standard portable stands or set on shelves.
- (c) Extinguishers should be installed with the operating instructions facing outward. The location of such extinguishers should be marked conspicuously.

### 3.7.9 Care Of Fire Hose

- 3.7.9.1 Fire hose should always be in good order and cared for properly. It should not be used except for the purpose it is intended.

- 3.7.9.2 Fire hoses provided for yard hydrants should be kept in well-ventilated hose house with sufficient space to hold the hose and equipment. Hot locations should be avoided, if possible. The hose should be so stored that it may be unrolled easily when required.
- 3.7.9.3 Care must be taken so that gasoline, grease, harmful chemicals and acids do not come in contact with hose. Where such exposure is likely to occur, a hose resistant to these agents should be employed. If a hose does come in contact with any of the above materials, it should be washed with soap and thoroughly rinsed with water. After use, hose must be drained, cleaned and dried before it is placed in storage.
- 3.7.9.4 Do not store hose until thoroughly dry. Drying must be done carefully by hanging the hose or placing it on a rack.
- 3.7.9.5 Hose should not be dried in the sun on concrete roadways or sidewalks. Just as soon as the hose is thoroughly dry, it should be removed from exposure to the weather. Over-exposure, especially in or by the sun can be damaging. Hose should not be left in hot drying towers or cabinets after drying has been completed.
- 3.7.9.6 If the hose appears to be defective, it should be tested hydrostatically and replaced if necessary. If the hose has had prolonged or severe use at a fire, it should be inspected and tested.
- 3.7.9.7 Nozzles
- (a) All nozzles should be checked periodically and immediately after use.
  - (b) If there is an obstruction that cannot be removed by fully opening the nozzle, the nozzle should be taken from the hose line and the obstruction removed through the coupling end, since any further attempt to force it out through the tip may damage the nozzle.
  - (c) Care should be taken to avoid dents or nicks in nozzle tips, as this can seriously affect the reach of the stream. Nozzles should not be dropped or thrown aside.
  - (d) When using a nozzle, care should be taken not to twist or bend the handle of the shut off valve.
  - (e) During inspection, check that nozzle valves work freely. Otherwise, they should be immediately taken out of service, temporarily replaced and repaired.

### 3.7.9.8 Couplings

- (a) Couplings should be kept in good operating condition, and after each time the hose is used, the coupling threads should be examined. Any length of hose with defective or damaged couplings should be removed from service and repaired. Couplings should be adjusted so that they would function easily by hand.
- (b) Couplings should not be greased or oiled if found to be stuck. Ordinarily, they can be freed satisfactorily by immersion in warm soapy water.
- (c) When disconnecting the line after use, care should be taken not to drop couplings on pavement or other hard surface.
- (d) Inspection should be made to see that hose is firmly attached to the coupling so that the coupling and the hose do not come apart.

### 3.7.9.9 Gaskets

- (a) When couplings are inspected, the gasket in the swivel should be checked. Rubber gaskets deteriorate with age and will break away from the washer or gasket seat.
- (b) Care should be taken that the gasket does not protrude into the waterways, particularly at the nozzle coupling, as this can cause a ragged stream, thus reducing the effective reach of the nozzle.

### 3.7.10 Procedures For Control Of Fire At Power Station

3.7.10.1 Any person, upon discovery of any fire should inform the Electrical Control Room, and the Shift Charge Engineer on duty giving details and the location of the fire.

3.7.10.2 The Control Assistant on receiving the information of any fire should immediately sound the fire alarm. He should also ring for the Fire Brigade for assistance if a big fire is reported. The Shift Charge Engineer should confirm this is carried out.

#### 3.7.10.3

- (a) On hearing the fire alarm raised, all office, workshop, stores and maintenance staff should evacuate the premises immediately and proceed to the nearest designated safety areas.
- (b) All operational staff on duty should remain at their normal place of work and await instructions from the FIRE FIGHTING Officer unless the fire is in their immediate vicinity and except those who are members of the fire fighting team.

- (c) The fire fighting team should first be directed by the Fire Fighting Officer to proceed to the fire site with the necessary equipment and commence fighting the fire.
  - (d) The Shift Charge Engineer should not hesitate in deciding to take off the plant as appropriate before evacuation of the operation personnel.
- 3.7.10.4 If the Fire Brigade arrives on the scene, the Fire Fighting Officer and his team will give every assistance to the Fire Brigade. The Shift Charge Engineer present is to liase to this effect.
  - 3.7.10.5 The Shift Charge Engineer is to report (or directing the Control Assistant if he's too busy to do so) to the Station Superintendent and his deputies in event of any fire outbreak.
  - 3.7.10.6 The Fire Fighting Officer should be the Workshop foreman and in his absence the Shift Charge Engineer is to carry on and be in direct incharge of the fire fighting team.

APPENDIX 1

PERMIT-TO-WORK CERTIFICATE {MECHANICAL}  
{FRONT}

RECEIPT, CANCELLATION AND CLEARANCE CERTIFICATE  
{BACK}

# LEMBAGA LETRIK NEGARA TANAH MELAYU

STATION 115 SERIAL No. 11-3/11

## PERMIT TO WORK CERTIFICATE (MECHANICAL)

I hereby declare that it is safe to work on the following apparatus and that the prescribed safety measures have been carried out.

(a) Here state EXACTLY the only apparatus on which it is safe work.

7/ No 3 " regulator valve "

(b) Here state EXACTLY at which point or points isolating steam, water compressed air, or fuel oil valves have been shut and locked off and what motor controllers have been locked off and isolated from their motor.

7/ No 3 under oil  
hasp of gear off and locked  
A.O.P. of oil control  
A.C. B of (generator) on  
pump off and locked

ALL OTHER PARTS ARE DANGEROUS

(c) Here describe the nature of the work to done.

to check the valve  
and regulator valve

Issued by S. J. Foo a person duly authorised in accordance with the National Electricity Board Safety Regulations.

Date 13/6/21  
Time 8-9/21

Signature [Signature]

\* Name of Authorised Person signing the Certificate to be written here in block letters.

ORIGINAL

**RECEIPT**

NOTE 1—This Certificate after being signed by the Authorised Person is to be handed to the Competent Person in charge of the work and retained by him or his "relief" until the work is completed or stopped by the Authorised Person.

A "relief" may only take charge with the approval of the Authorised Person who must take reasonable steps to ensure that the "relief" understands clearly the precise extent of the work permitted by this Certificate.

All Competent Persons to whom this Certificate is issued must sign the declaration below on the original and the copy.

I hereby declare that I understand that the apparatus specified on this Permit is safe to work upon here and that this Permit applies to this apparatus only.

	<u>Signature</u>	<u>Time</u>	<u>Date</u>
First Competent Person	..... <i>[Signature]</i>	..... <i>7:45 AM</i>	..... <i>7/27/75</i>
Second " "	.....	.....	.....
Third " "	.....	.....	.....

NOTE 2—The apparatus mentioned hereon must not be recommissioned until the declaration below has been signed on the original and the copy by the Competent Person last in charge of the work and the Certificate has been returned to the Authorised Person who will cancel the original and copy before recommissioning the apparatus.

**CLEARANCE CERTIFICATE**

I hereby declare that all men under my charge have been withdrawn and warned that it is no longer safe to work on the apparatus specified in this Certificate and all gear and tools are clear, and that all guards have been replaced, and loose material removed.

Signature .....  
(Competent Person)

Date .....

Time .....

**CANCELLATION**

NOTE 3—When the above declaration has been signed and the Certificate returned to the Authorised Person the Authorised Person must sign the declaration below and also write "CANCELLED" across the face of the original and all copies and thus cancel the permit.

I hereby certify that this Permit to Work Certificate and all copies are hereby cancelled.

Signature .....

Date .....

Time .....

The cancelled original must be forwarded to the Officer-in-Charge of the Station.

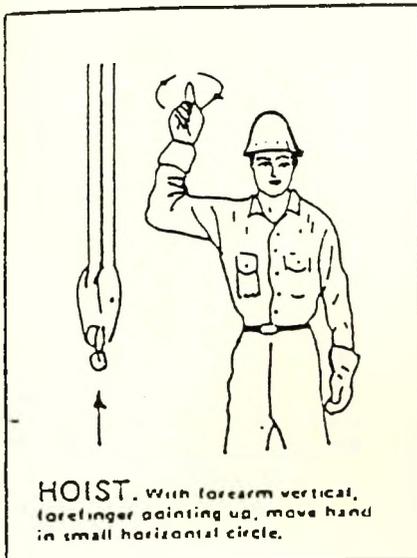
B.T.—24-10-1975.

APPENDIX 2

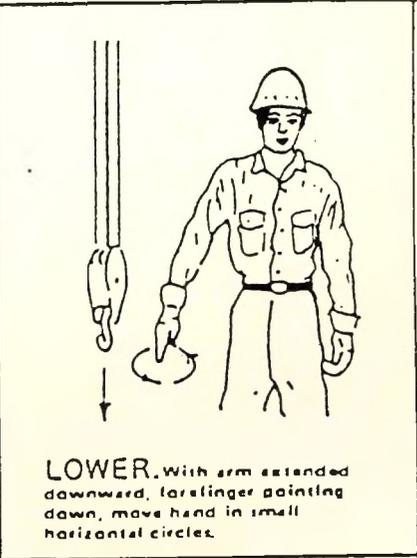
PERMIT-TO-WORK CERTIFICATE {MECHANICAL}  
FOR  
CONTRACTORS

## APPENDIX 3

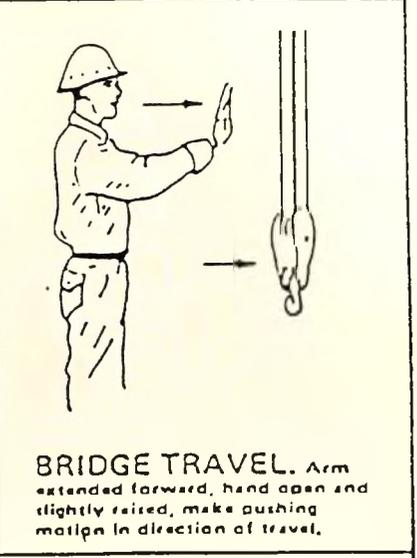
- 1) STANDARD HAND SIGNALS FOR CONTROLLING OPERATION  
OF  
OVERHEAD AND GANTRY CRANES
  
- 2) STANDARD HAND SIGNALS SUITABLE FOR CRAWLERS,  
LOCOMOTIVES AND TRUCK BOOM CRANES



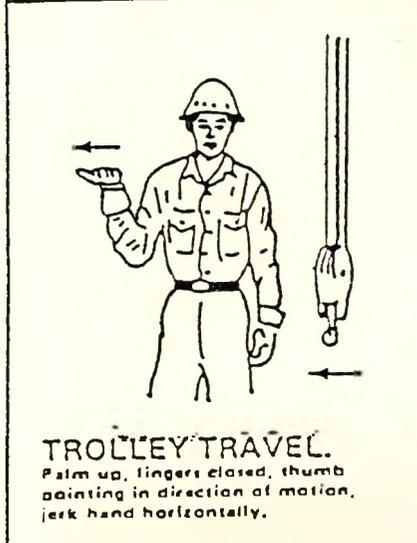
**HOIST.** With forearm vertical, forefinger pointing up, move hand in small horizontal circle.



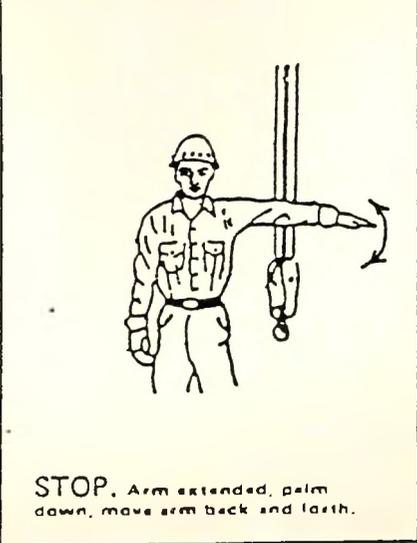
**LOWER.** With arm extended downward, forefinger pointing down, move hand in small horizontal circles.



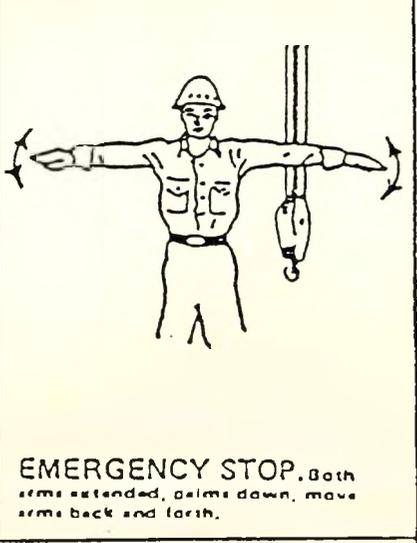
**BRIDGE TRAVEL.** Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.



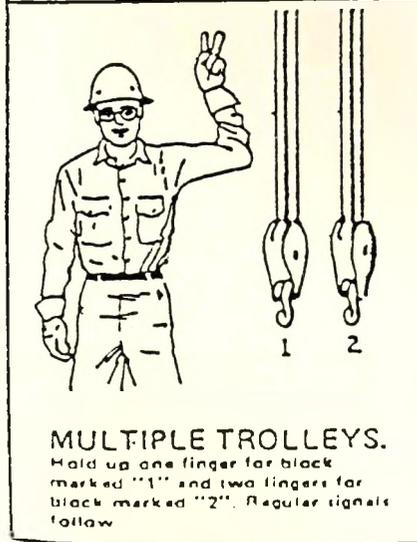
**TROLLEY TRAVEL.** Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.



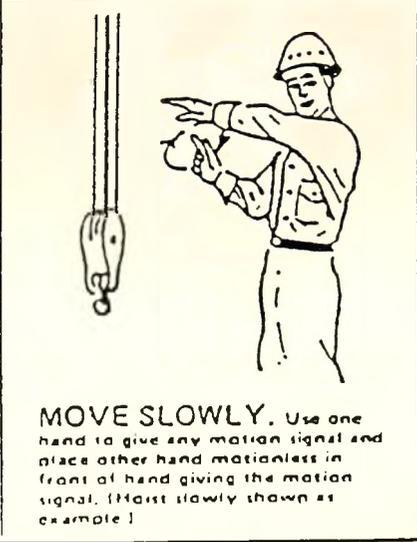
**STOP.** Arm extended, palm down, move arm back and forth.



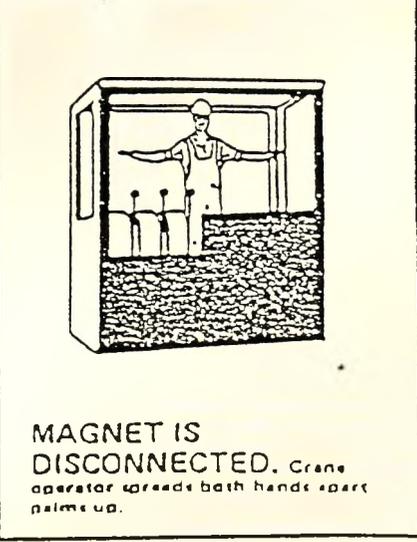
**EMERGENCY STOP.** Both arms extended, palms down, move arms back and forth.



**MULTIPLE TROLLEYS.** Hold up one finger for black marked "1" and two fingers for black marked "2". Regular signals follow.



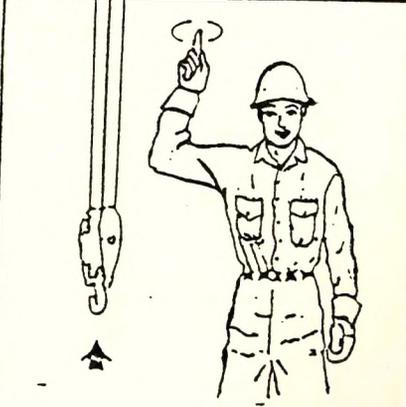
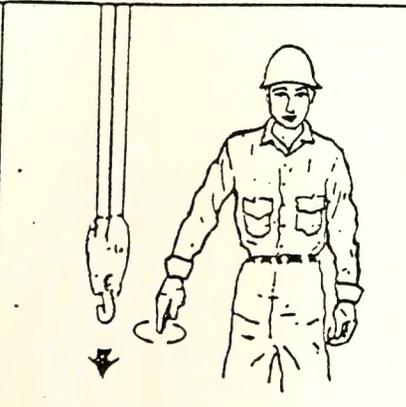
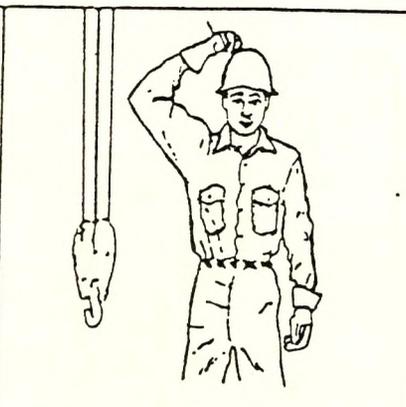
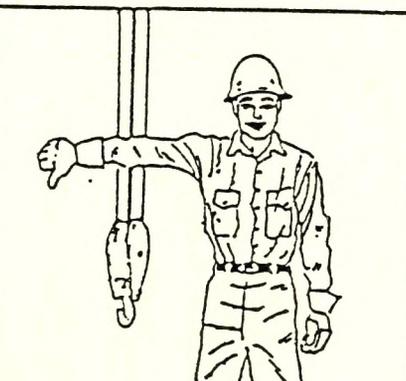
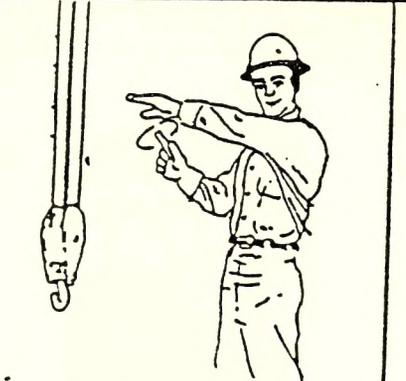
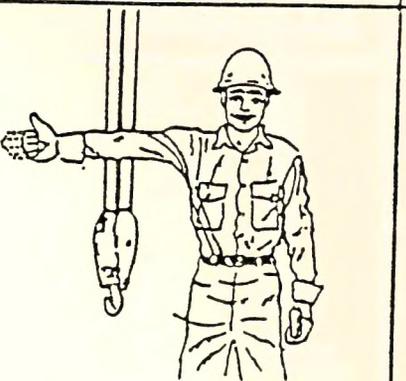
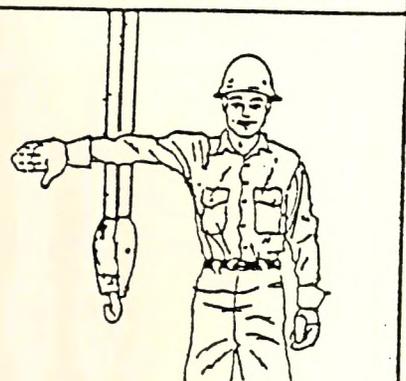
**MOVE SLOWLY.** Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example.)



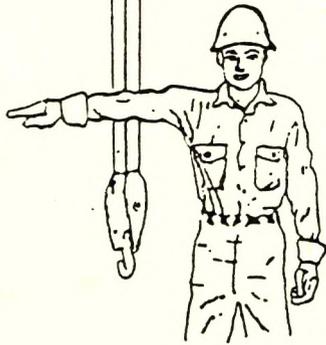
**MAGNET IS DISCONNECTED.** Crane operator spreads both hands apart, palms up.

Standard hand signals for controlling operation of overhead and gantry cranes.

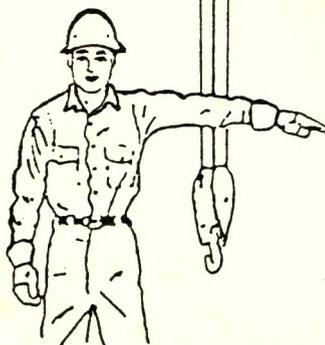
# Hoisting Apparatus and Conveyors

 <p><b>HOIST.</b> With forearm vertical, forefinger pointing up, move hand in small horizontal circle.</p>	 <p><b>LOWER.</b> With arm extended downward, forefinger pointing down, move hand in small horizontal circles.</p>	 <p><b>USE MAIN HOIST.</b> Fist on head; then use regular signals.</p>
 <p><b>USE WHIP LINE.</b> (Auxiliary Hoist) Tap elbow with one hand; then use regular signals.</p>	 <p><b>RAISE BOOM.</b> Arm extended, fingers closed, thumb pointing upward.</p>	 <p><b>LOWER BOOM.</b> Arm extended, fingers closed, thumb pointing downward.</p>
 <p><b>MOVE SLOWLY.</b> Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example)</p>	 <p><b>RAISE THE BOOM AND LOWER THE LOAD.</b> With arm extended thumb pointing up, flex fingers in and out as long as load movement is desired.</p>	 <p><b>LOWER THE BOOM AND RAISE THE LOAD.</b> With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.</p>

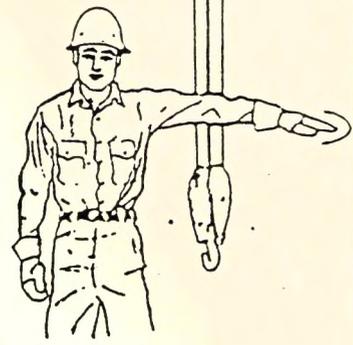
—Standard hand signals suitable for crawler, locomotive, and truck boom cranes. One-hand signal for extending or retracting telescopic boom (not shown above). Extend boom—one fist in front of chest with thumb topping chest. Retract boom—one fist in front of chest, thumb pointing outward and heel of fist



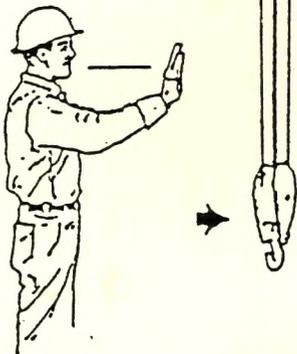
**SWING.** Arm extended point with fingers in direction of swing of boom.



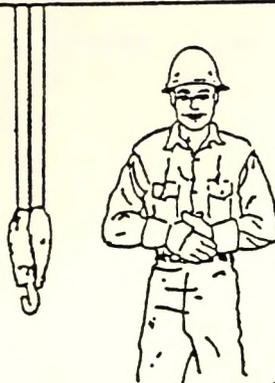
**STOP.** Arm extended, palm down, hold position rigidly.



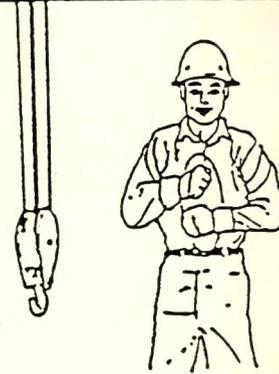
**EMERGENCY STOP.** Arm extended, palm down, move hand rapidly right and left.



**TRAVEL.** Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.



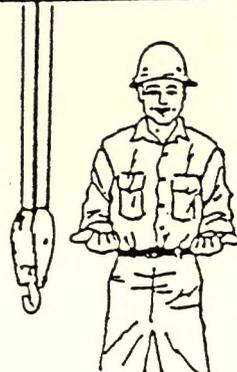
**DOG EVERYTHING.** Clasp hands in front of body.



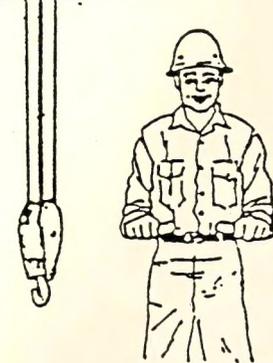
**TRAVEL.** (Both Tracks) Use both fists, in front of body, making a circular motion, about each other, indicating direction of travel; forward or backward. (For crawler cranes only)



**TRAVEL.** (One Track) Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body. (For crawler cranes only)



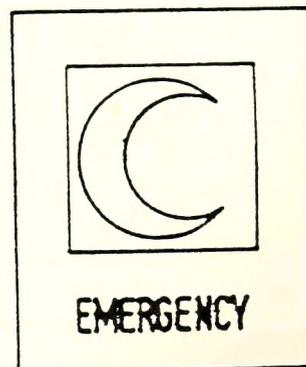
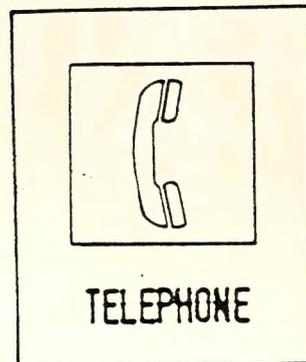
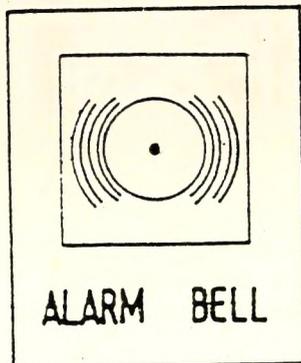
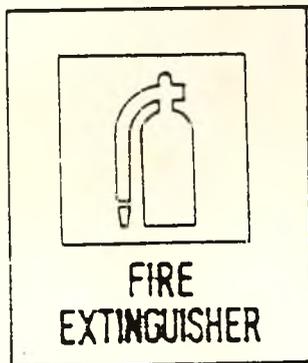
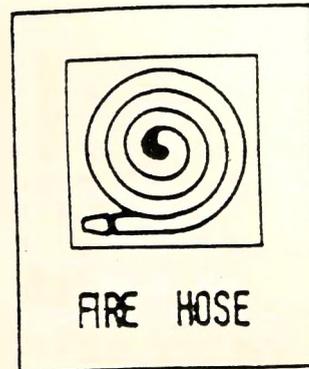
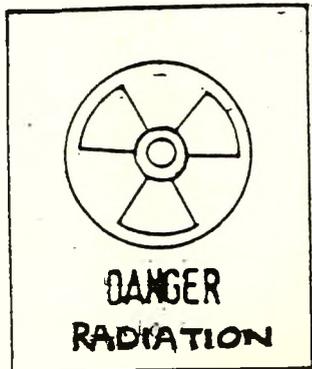
**EXTEND BOOM.** (Telescoping booms) Both fists in front of body with thumbs pointing outward.

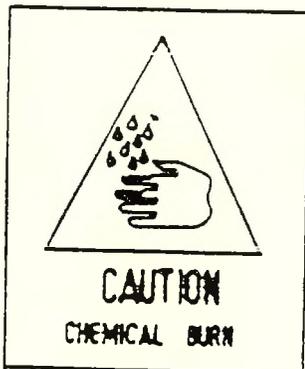
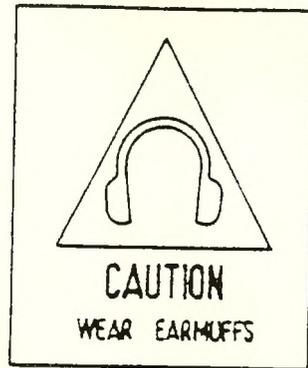
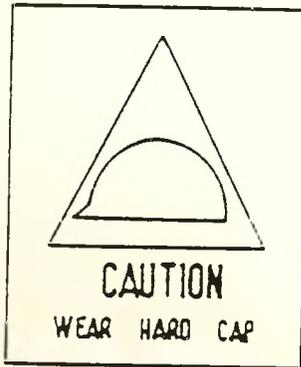
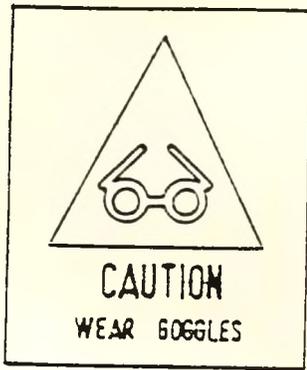
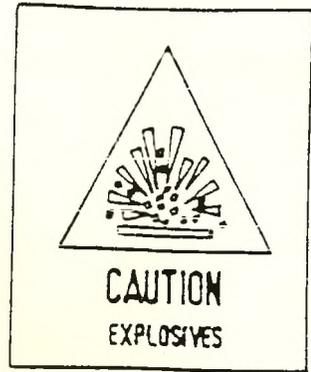
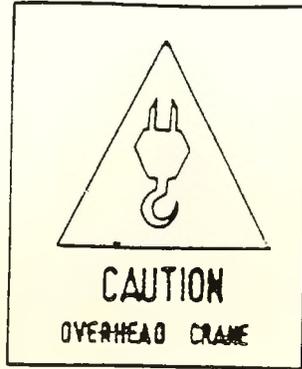
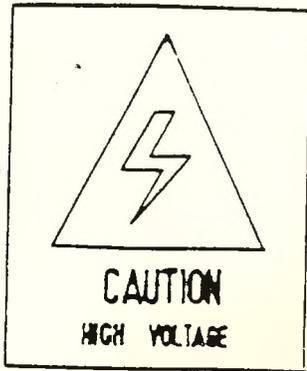


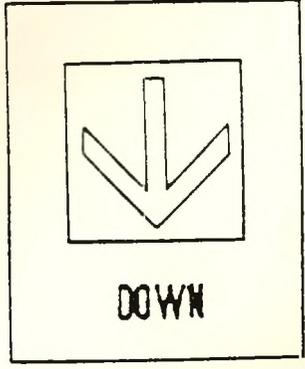
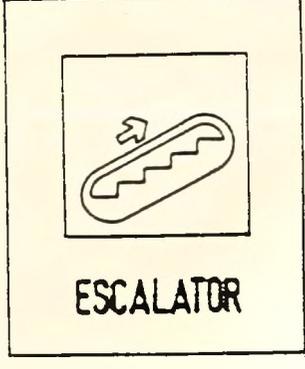
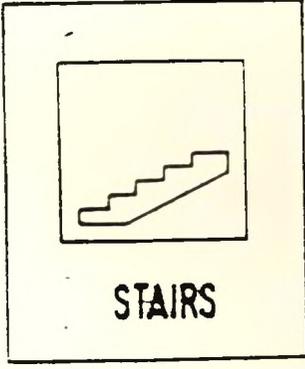
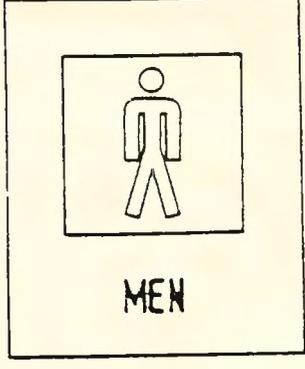
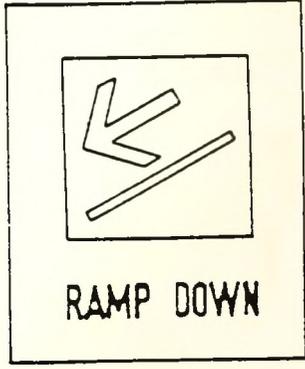
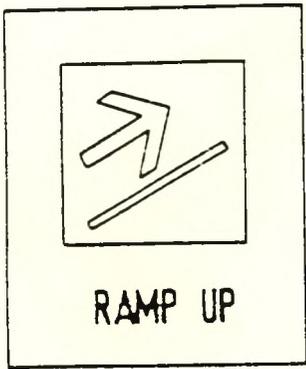
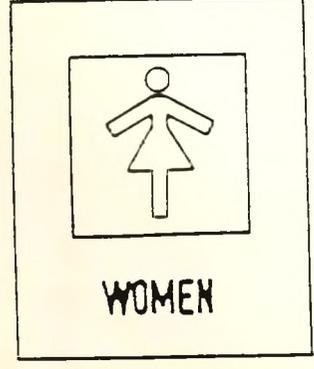
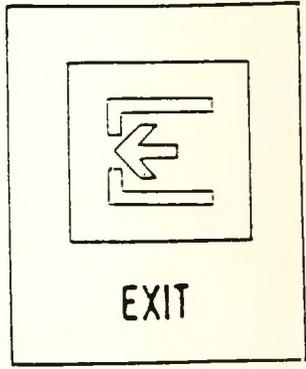
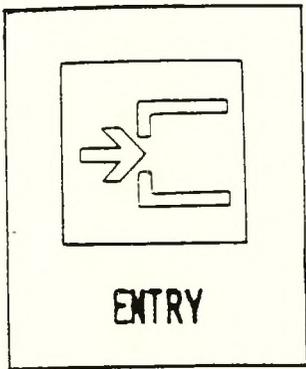
**RETRACT BOOM.** (Telescoping booms) Both fists in front of body with thumbs pointing toward each other.

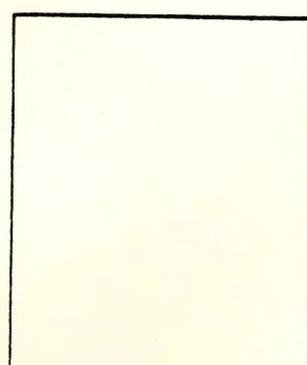
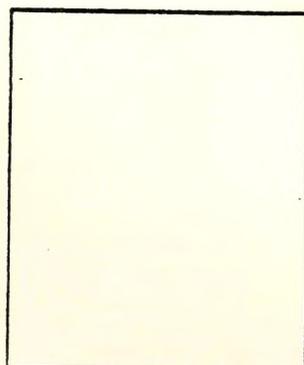
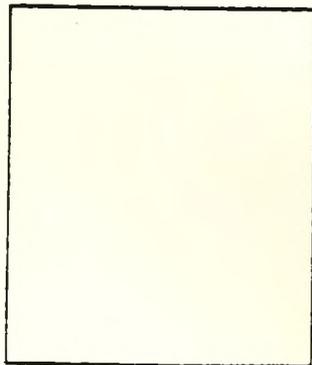
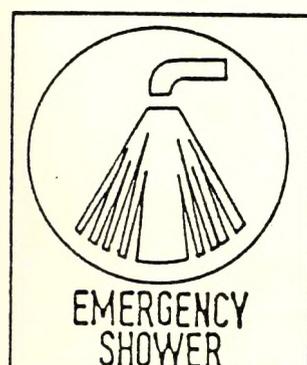
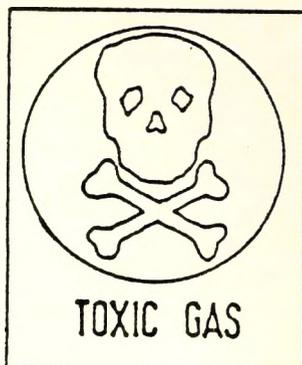
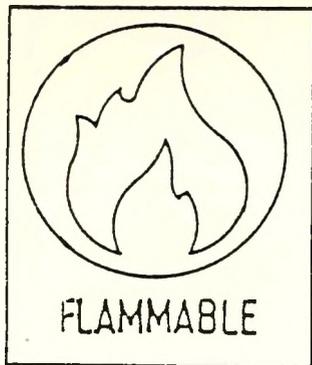
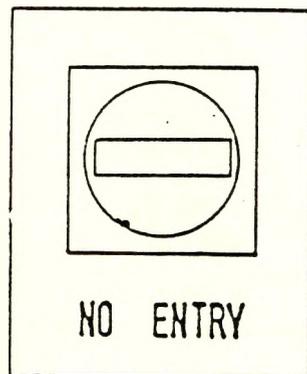
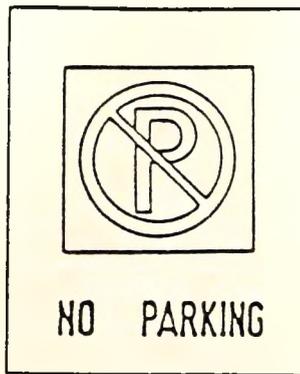
APPENDIX 4

STANDARD SIGN









APPENDIX 5

CLASSIFICATION OF HAZARDOUS CHEMICALS  
{AJAX CHEMICALS}

APPENDIX 5

CLASSIFICATION OF HAZARDOUS CHEMICALS (AJAX CHEMICALS)

CLASS	TYPE	EXAMPLES
1.	EXPLOSIVES	Benzoylperoxide, Diazodinitrophenol, Dipicrylamine, Hydrazine Nitrate, Lead Azide, Mercury Fulminate, Nitro Urea, Picric Acid, Sodium Picramate, Trinitrobenzene, Trinitrotoluene.
2.	FLAMMABLE GAS	Acetylene, Butane, Carbon Monoxide Cyanogen, Deuterium, Dimethylamine, Ethylamine, Ethylene Oxide, Ethyl Methyl, Ether, Hydrogen, Propane, Vinyl Chloride.
2.2	POISON GAS	Boron Trichloride, Bromomethane, Carbon monoxide, Carbonyl Chloride, Chlorine, Cyanogen Chloride, Fluorine, Hydrogen Bromide Anhyd., Hydrogen Fluoride Anhyd., Nitric Oxide, Nitrogen Dioxide, Sulphur Dioxide.
2.3	NON-FLAMMABLE GAS	Argon, Carbon Dioxide & Nitros Oxide Mixtures Carbon Dioxide & Oxygen mixtures, Dichlorodifluoromethane, Dichloromonofluoro Methane, Dichlorotetrafluoroethane, Helium, Nitrogen, Nitrous Oxide, Oxygen.
3.1	FLAMMABLE LIQUID (Flash point below 18 Deg. C)	Acetaldehyde, Acrylonitrile, Acetone, Allyl Chloride, Carbon Disulphide, Cyclohexane, Diethylamine, Diethyl Ether, Hexane, Iso-propylamine, Tetrahydrofuran.
3.2	FLAMMABLE LIQUID (Flash point - 18 Deg.C to 23 Deg.C)	Acetonitrile, Amyl alcohols, Benzene, Butandione, Dimethylamine, 4-Dioxane, Heptane, Methanol, Propanol, Toulene.
3.3	FLAMMABLE LIQUID (Flash point 23 Deg.C to 51 Deg.C)	Acetic acid, Acetyl chloride, Butanol Chlorobenzene, Cyclohexanone, Diethylbenzene, Formaldehyde, Furfuraldehyde, Nitromethane Pinene, Styrene.
4.1	FLAMMABLE SOLIDS	Aluminium Iso-propoxide, 2, 4-Dinitrophenol, Hydrosul, Magnesium Ribbon, Metaldehyde, Naphthalene, Phosphorus pentasulphide, Posporus red, Picric Aid, Sulphur, Titanium, Trinitrotoluol.

CLASS	TYPE	EXAMPLES
4.2	SPONTANEOUSLY COMBUSTIBLE MATERIALS	Calcium dithionite, activated Charcoal, Diethylaluminium Chloride, Diethyl-Magnesium Chloride, Grignard Solution, Magnesium Diamide, Phosphorus White & Yellow, Potassium & Sodium-Dithionite, Zirconium.
4.3	WATER REACTIVE ( Materials Emitting Flamable Gas)	Aluminium Carbide, Aluminium Lithium Hydride Barium Metal, Calcium Carbide, Calcium Hydride, Lithium Metal, Magnesium Phosphide, Potassium Metal, Sodium Amide, Titanium Hydride, Zinc Powder.
5.1	OXIDIZING AGENTS	All Nitrates, Ammonium Dichromate, Barium Peroxide, Calcium Hypochlorite, Chromium Trioxide, Hydrogen Peroxide, Lead Dioxide, Magnesium Bromate, Zinc Peroxide, Perchloric Acid, Sodium Chlorite, Sodium Persulphate.
5.2	ORGANIC PEROXIDES	All Organic Peroxides.
6.1	POISONS	Aniline, Antimony Potassium Tartrate, Arsenic Compounds, Barium Compounds, Carbon Tetrachloride, Cyanide Compounds, 1, 2 - Dichlorobenzene, Ethyl Bromoacetate, Mercury Compounds, Nitrophenols, Sodium Azide, Toluidines.
6.2	IRRITANTS	Organic Isocyanates Isothiocyanates, Bromobenz Cyanide, Chloroacetaphenone, Tear Gas, Xylyl Bromide.
7.	CORROSIVES	Acetic Anhydride; Acetic, Hydrochloric; Nitric and Sulphuric Acid; Aluminium Bromide, Benzyl Chloride; Boramine; Diaminoethane; Ferric Chloride; Hydrofluoric Acid; Iodine Trichloride, Potassium & Sodium Hydroxide, Stannic Chloride Anhyd, Trimethyl Chlorosilane.

APPENDIX 6

SUMMARY OF MAIN CHEMICAL HAZARDS  
AND  
SPECIAL STORAGE REQUIREMENTS

APPENDIX 6

SUMMARY OF MAIN CHEMICAL HAZARDS AND  
SPECIAL STORAGE REQUIREMENTS

Chemical	TLV (Note 1)	Main Hazards	Special Storage Requirements
Acetic acid	10 p.p.m.	Corrosive, irritant, can cause severe burns.	Store away from chromic and nitric acids.
Chromic Acid	0.05mg/m (as Cr)	Can cause severe burns. Can cause violent explosion in contact with reducing agents.	Store away from oxidizing and any fire risk.
Citric acid	-	Power and solution can cause eye injury	Store away from oxidizing agents.
Formic acid	5 p.p.m.	Corrosive. Can cause severe burns.	Store in a well-ventilated area.
Hydrochloric acid	5 p.p.m.	Corrosive and irritant.	Store in a well-ventilated area.
Hydrofluoric acid.	3 p.p.m.	Toxic and corrosive. Can cause severe burns.	Store in a well-ventilated area.
Nitric acid	2 p.p.m.	Oxidizing and corrosive. Can cause severe burns.	Store away from acetic acid, ammonia and combustible materials.
Sulphamic acid	-	Emits toxic fumes when heated. Irritant.	Store away from heat.
Sulphuric acid	1 p.p.m.	Extremely irritant and corrosive. Causes severe burns.	Store away from alkali.
Ammonium bifluoride	-	Corrosive. Reacts with mineral acids to produce HF gas. Highly irritating to skin, eye and nose.	Avoid contact with acids and fire risk.
Sodium fluoride	2.5mg/m (as F)	Highly toxic	

Chemical	TLV (Note 1)	Main Hazards	Special Storage Requirements
Sodium hydroxide (caustic soda)	2 mg/m (Note P)	Highly corrosive. Severe irritant. Dust or mist can cause irritation to upper respiratory tract.	Store away from acids.
Potassium hydroxide (caustic soda)	2 mg/m (Note 2)	Highly corrosive. Severe irritant. Inhalation of dust or mist causes intense irritation.	Store away from acids.
Dipotassium hydrogen Phosphate	-	Produces toxic. irritant fumes when heated	
Disodium hydrogen Phosphate	-	Produces toxic, irritant fumes when heated	
Sodium carbonate (soda ash)	-	Skin irritant. Dust or mist irritating to upper respiratory.	Store away from acids.
Tripotassium Phosphate	-	Skin irritant. If heated emits highly toxic fumes.	
Trisodium Phosphate	-	Skin irritant. If heated emits highly toxic fumes.	
Ammonia irritant.	25 p.p.m.	Corrosive. Severe and/or bromate.	Store away from acids
Hydrazine	0.1 p.p.m.	Strongly caustic. Irritant. May cause damage to liver and kidneys.	Store separately.
Hydrogen peroxide	1 p.p.m.	Oxidizing and corrosive. Can cause severe damage to eyes and skin. May explode in contact with dust.	Store separately and away from all combustible materials.

Chemical	TLV (Note 1)	Main Hazards	Special Storage Requirements
Potassium or sodium bromate	0.05mg/m (as Br)	Oxidizing agent. Eye/skin irritant. With acid solutions toxic gases are produced. Possible explosion hazard with ammonia and contact with organic materials.	Store away from acids, combustible materials and ammonia.
Potassium or sodium chromate	-	Eye/skin irritant. With acid solutions toxic gases can be produced. Possible explosion hazard on contact with organic materials.	Store away from acids and combustible materials.
Potassium or sodium bichromate	-	Eye/skin irritant. With acid solutions toxic gases can be produced. Possible explosion hazard on contact with organic materials.	Store away from acids and combustible materials.
Potassium or sodium nitrite	-	Eye/skin irritant. With acid solutions nitrous fumes are produced. Possible explosion hazard on contact with organic materials.	Store away from acids and combustible materials.
Potassium or sodium permanganate	-	Eye/skin irritant. with acid solutions toxic gas may be produced. Possible explosion hazard on contact with organic materials.	Store away from acids and combustible.
Inhibitors (Armohib 28, Salvene, Rodine, Stannine 2-mercaptobenzo-thazole etc.)	-	Can cause skin and eye irritation (some severe). Some combustible/toxic/corrosive.	

Chemical	TLV (Note 1)	Main Hazards	Special Storage Requirements
Wetting agents (Lissapole, Teepol, etc.)	-	May cause eye and skin irritation.	

Notes:

1. Confirm by reference to the most recent Health and Safety Document, EH 15.
2. Maximum values.

APPENDIX 7

FIRST-AID TREATMENT  
FOR  
CHEMICAL ACCIDENT

## APPENDIX 7

### EMERGENCY PROVISIONS AND FIRST AID TREATMENT

#### Emergency Provisions

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Flushing and washing water supplies	(a) Ample supplies of tepid flushing and washing water shall be provided at all possible points of discharge.  (b) Adequate provision shall be made for emergency treatment of the eyes, comprising eyewash bottles, located conveniently to places where discharge, spillage or escape of chemicals can occur.
First-aid room	A suitable first-aid treatment room with outside telephone facilities shall be provided within a reasonable distance of the place where chemicals are being used.
Store room	A suitable room shall be provided for housing the protective clothing and apparatus required for emergency use.

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#### First-aid Treatment

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Injury	Chemicals	Treatment
Splashes of the eyes	All chemicals	(a) Immediately flood the eye with water. To be effective the eye must be opened. After a quick preliminary swill to wash away fluid around the eye, the eyelids should be pushed apart using the thumb and index finger of the left hand. The casualty will probably not be able to open the eye himself because of painful spasms.  If an eyewash bottle is used, the jet should not be directed at the front of the eye but should be directed in from the side, so that flow is over the surface of the eye.  (b) Irrigation should be continued for 7-10 minutes, after which the casualty should be taken to the first-aid room.

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(c) Irrigation should be continued in the first-room. Remember, vision is saved by thorough irrigation. No other treatment can prevent damage if this is omitted.

(d) After thorough irrigation the eye should be covered with a pad; the patient should be referred for medical opinion.

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Irritation of the skin	All Chemicals	If signs of skin irritation occur, the person should be removed from contact and referred for medical opinion.
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In the event of splashing of the skin with chemicals the affected area should be washed thoroughly avoiding spreading contamination to the face and eyes.

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Gassing	All Chemical	Remove person to fresh air, remove contaminated clothing, cover with blanket and keep person still and under observatiion. Refer for medical opinion.
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	Ammonia or Nitrogen	Additional to above, if breathing is distressed give oxygen. If breathing fails, give artificial respiration, summon doctor to Site.
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Bromine from sodium bromate.  
Nitrogen dioxide from sodium nitrite

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APPENDIX 8 #

TREATMENT OF ELECTRICAL SHOCK

## APPENDIX 8

### TREATMENT OF ELECTRIC SHOCK

The following method should be learnt From a qualified instructor and practised regularly.

#### Immediate and Speedy Action is Necessary

##### Free from contact

Switch off current immediately or send someone to do so. Do not attempt to remove a person from contact with high voltage unless suitable articles insulated for the system voltage are used for this purpose. When attempting to free a person from contact with low or medium voltage use rubber gloves, boots, or mat, or insulated stick, but if these are not available use a loop of rope, cap or coat to drag the person free. Whatever is used should be dry and non-conducting.

##### After Release

Do not waste time moving him. Lay the patient down on something dry, if possible and if no sign of breathing can be observed, IMMEDIATELY proceed to promote artificial respiration and send someone else for a doctor and ambulance. Do not give up efforts to restore natural breathing until told to do so by a Doctor. Keep the patient warm.

##### Artificial Respiration: Mouth-to-Mouth Method

(i) Remove any foreign material - false teeth, vomit, etc. which may cause blockage of the air passages (See Figure 1).

(ii) To open the air passage tilt the patient's head backwards as far as possible. Use one hand to push the patient's head backwards and the other to pull the jaw forwards. At the same time slightly opening the patient's mouth. (See Figure 2).

(iii) Take a deep breath, place your mouth over the patient's mouth and blow. Seal the patient's nose either by pressing your cheek against it or by grasping it with the fingers. (See figure 3).

(iv) Give 6 to 8 quick blows and then continue to inflate chest about 10 times per minute. Which the chest during inflation it should rise. No movement indicates a blocked airway. If so, check mouth and throat are clear and tilt the head further backwards.

#### Artificial Respiration: Holger Neilsen Method

(i) Lay the patient face down - hands under chin. The face should not be turned to either side. If the hands are injured prop the chin up from beneath with a firm pad. (see Figure 4).

(ii) See that the air passages are clear of foreign matter.

(iii) Kneel on one knee at the patient's head with the other foot near his elbow.

(iv) Place your hands on the patient's shoulder blades and rock forward with your elbows straight until your arms are vertical, pressing downwards but not too heavily. This movement should take two seconds. (See Figures 4 and 5).

(v) Grasp the patient's arms just above the elbows and rock yourself backwards lifting the elbows above the patient's head (two seconds). (See Figures 6 & 7).

(vi) Lower arms and transfer your hands to his shoulder blades. (See Figure 4).

(vii) Repeat total movement at the rate of ten times per minute.

#### Artificial Respiration: Silvester Method

(i) Remove any foreign matter blocking the airway.

(ii) Place casualty on his back with a pad of some kind under his shoulder so that the head falls back fully extended. (See Figure 8).

(iii) Kneel at his head - grasp the patient's at the wrist - cross then over the lower chest and press to squeeze the air out of the chest (two seconds). (See Figure 8).

(iv) Pull arms upwards and outwards to above the head, stretching the chest (three seconds). (See Figure 9).

(v) Repeat the whole movement approximately ten times per minute.

### Other Injuries

After breathing, priority should be given to controlling bleeding. This is achieved by firm pressure on the wound.

(i) Cover with a clean dressing and bandage firmly in place.

(ii) If bleeding continues add further dressing on top of the first and increase the pressure by bandaging firmly in place.

Burns should be covered with clean, sterile dressing to exclude air. The dressing should be bandaged lightly in position.

Unless it is dangerous to leave the casualty at the site of the accident expert assistance should be sought before other injuries are treated. If it is necessary to move the casualty, do so with the utmost gentleness carefully supporting any injured parts.

### FIRST AID APPLIANCES

The first aid appliances provided shall be used only for the purpose intended. A person shall be appointed to be responsible for ensuring that supplies are always available.

FIGURE 3

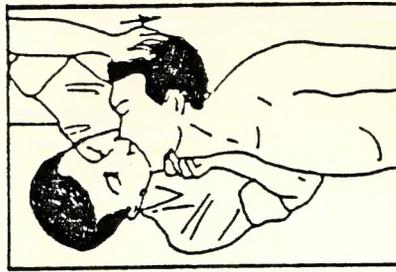


FIGURE 2

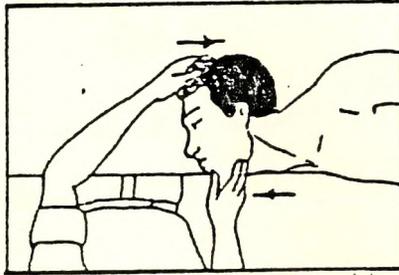
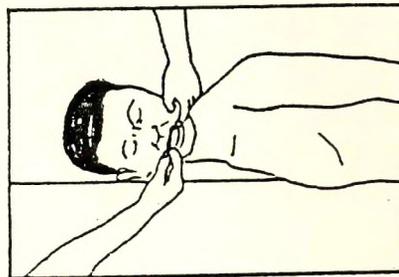


FIGURE 1



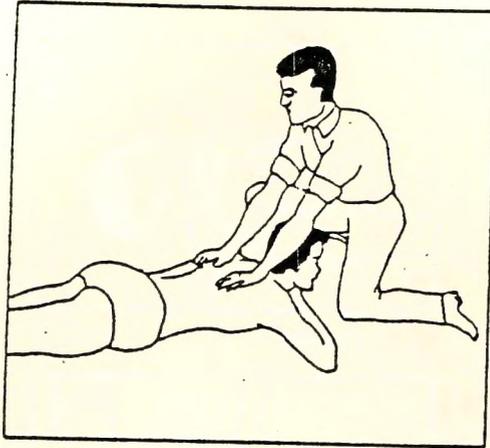


FIGURE 4

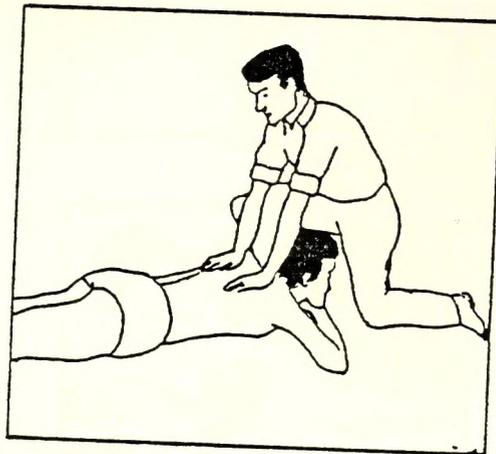


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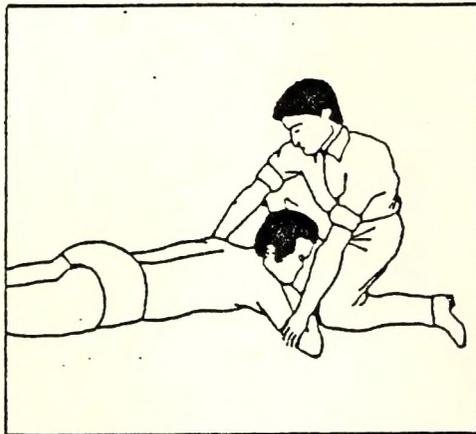
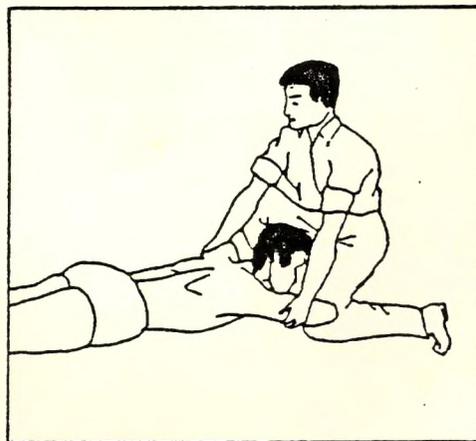


FIGURE 6



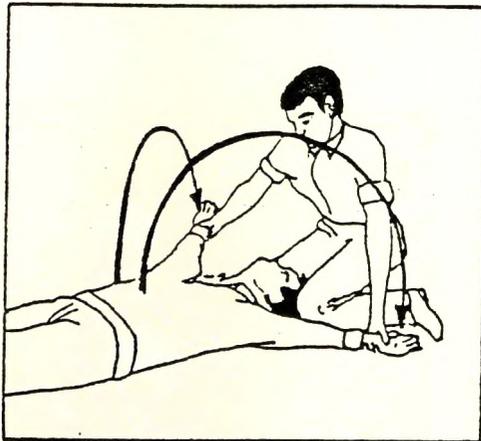


FIGURE 8

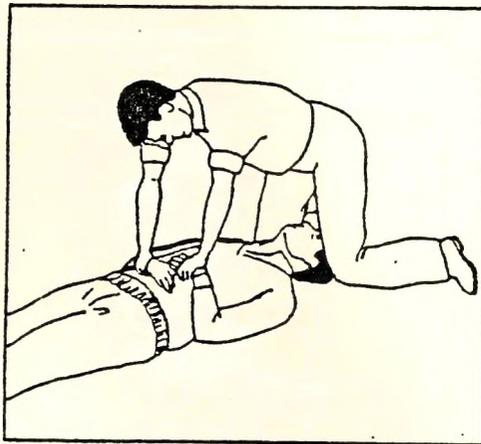


FIGURE 9