PERSONAL PROTECTIVE EQUIPMENT
(PART-I : NON-RESPIRATORY EQUIPMENT)

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PERSONAL PROTECTIVE EQUIPMENT
(PART-I : NON-RESPIRATORY EQUIPMENT)

Prepared by:
COMMITTEE ON “PERSONAL PROTECTIVE EQUIPMENT”

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Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director

Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is over 100 years old. For historical reasons, the industry has adopted different international standards and codes of practice in the various organisations. With a view to standardise the practices in the oil industry (and particularly in areas of safety), the Ministry of Petroleum and Natural Gas constituted in 1986 a Safety Council assisted by the Oil Industry Safety Directorate (OISD) to formulate and implement a series of self-regulatory measures aimed at removing obsolescence, standardising and upgrading existing standards to ensure safer operations. Accordingly, OISD constituted a number of functional committees comprising experts nominated from industry to draw up standards and guidelines on various subjects.

The present standard on Personal Protective Equipment (in two parts) was prepared by the Functional Committee on Personal Protective Equipment based on industry experience and on various national and international standards and codes of practice. It is meant to serve as a users’ guide and is, in no way, a substitute for existing standards and manufacturers’ recommendations. It is hoped that this standard will help industry personnel select the appropriate PPE and use as also maintain them in the right way.

1. Part-I : Non-respiratory PPE
2. Part-II : Respiratory PPE

Suggestions for improving the standard are invited from users after it is put into practice. These may be addressed to:

The Member Co-ordinator
Committee on Personal Protective Equipment
Oil Industry Safety Directorate
8th Floor, OIDB Bhavan, Plot No. 2, Sector – 73, Noida – 201301 (U.P.)
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These documents are intended only to supplement and not to replace the prevailing statutory requirements.

Note 1 in superscript indicates the changes / modifications / additions as approved in 20th Safety Council Meeting held in October 2002.
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<thead>
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<td><strong>LEADER</strong></td>
<td></td>
</tr>
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<td>Bongaigaon Refinery &amp; Petrochemicals Ltd., Bongaigaon</td>
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<td>Gas Authority of India Limited, Vijaipur</td>
</tr>
<tr>
<td>Shri S. P. Garg</td>
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</tr>
<tr>
<td>(Since November, 1993)</td>
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</tr>
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</tr>
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<td></td>
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In addition to the above, several other experts from Industry contributed in the preparation, review and finalisation of this document.
# PERSONAL PROTECTIVE EQUIPMENT
## PART - I

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PERSONAL PROTECTIVE EQUIPMENT

PART-I

1.0 INTRODUCTION

The cardinal principle in controlling an unsafe condition is to remove the hazard. This could be achieved through better design, change of process or guarding by mechanical means.

In spite of care taken to design safety into all systems and operations in the oil industry, the risk of failure of engineering controls, materials, equipment and even that of safety devices cannot be fully eliminated. There are also some operations and situations like welding and cutting etc. where engineering controls are not feasible and use of Personal Protective Equipment (PPE) is done regularly. The use of personal protective equipment can, in such situations, do one or more of the following:

- Reduce risk of dangerous occurrences (e.g. safety belts).
- Provide a physical barrier between the user and the hazard (e.g. apron, face shield).
- Render a hostile environment friendly albeit for limited period of time (e.g. breathing apparatus).

It is of course of primary importance that personal protective equipments are carefully selected and maintained. Improper selection, use and maintenance can only endanger the life of the user. The limitations of each equipment should also be clearly understood and personnel should be thoroughly trained in the right use of personal protective equipment.

Keeping this in mind, these standard guidelines are prepared for selection, use and maintenance of PPE. This standard has been divided in two parts for convenience of users i.e.

1. Part-I : Non-respiratory Personal Protective Equipment
2. Part-II : Respiratory Personal Protective Equipment

2.0 SCOPE

This part of the standard is intended to serve largely as a guide for selection of appropriate PPE for different situations. Specifications of various items of PPE are given in national & international standards and their capabilities, maintenance procedures and methods of use should be known from manufacturers also. This standard is not intended to give detailed equipment specifications.

3.0 DEFINITIONS

3.1 Brim - The rim surrounding the shell.
3.2 Chin strap - An adjustable strap that fits under the chin to secure-re the helmet on the head.
3.3 Harness (Helmet) - The complete assembly by means of which the helmet is maintained in position on the head which includes head band, cradle etc.
3.3.1 Headband - Part of harness surrounding the head. The plane of lower margin of headband shall correspond to reference line of the head form.
3.3.2 Anti-concussion tapes - Supporting straps which form the cradle.
3.3.3 Cradle - The fixed or adjustable assembly comprising of anti-concussion tapes & nape strap, where provided.
3.3.4 Nape Strap - An adjustable (with respect to the shell) strap that fits behind the head to secure the helmet & may be an integral part of the headband.
3.4 Neck Curtain - Additional part of the helmet to protect the neck.

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3.5 Peak - The extension of the shell above the eyes.
3.6 Shell - The hard, smoothly finished material that provides the general outer form of the helmet.
3.7 Ventilation - Holes provided in the shell to permit circulation of air inside the helmet.
3.8 Filter - The device through which the wearer of the equipment views the welding or cutting operation & which provides protection to the eyes against glare, injurious radiations, sparks or hot particles of metal or a combination of these hazards.
3.9 Filter – Cover- A transparent cover to protect the surface of the filter.
3.10 Goggles - A device worn over the eyes & held in place by a headband used for protecting the eyes & eye sockets from flying particles & injurious radiations.
3.11 Hand Shield - A device held in the hand and designed to give protection during welding & cutting to the eyes, ears, face, neck & part of the top of the head of the user.
3.12 Helmet - A device supported on the head and designed to give protection during welding and cutting to the eyes, ears, face, neck and part of the top of the head of the user.
3.13 Cuff - Extension of the glove, gauntlet or mitt which covers the wrist or arm.
3.14 Full-arm Gauntlets - A covering for the hand having separate fingers & thumb with cuff length greater than 300 mm but not exceeding 400 mm.
3.15 Gauntlet - A covering for the hand having separate fingers & thumb with cuff length greater than 63.5 mm but not exceeding 300 mm.
3.16 Glove - A covering for the hand having separate fingers & thumb with cuff length not greater than 63.5 mm.
3.17 Gun Pattern- A pattern of the four-fingers & thumb design, having the face of the thumb, the palm and first (index) & fourth (little) fingers made of one piece of material. The back is of one piece up to the cuff & includes the back of the four fingers at least. The fronts of the second and third fingers may be one piece each, attached to the palm at the base of appropriate finger.
3.18 Hand Guards - A piece of protective material of various designs used to protect the hand.
3.19 Mitt - A covering for hand with separate thumb & a common covering for the fingers.
3.20 Clute-Pattern - Gloves of the four fingers and thumb design having a one piece palm including the front of all four fingers and the back of the index finger also. The seam on the back of the hand may be an outseam or an inseam.
3.21 Montpelier Pattern - The Montpelier pattern shall be of the four fingers and thumb design having the front and all four fingers of one piece and the back of the gloves and gauntlet and back of all four fingers of one piece. There shall be one piece fourchettes between the first & second, second & third and third & fourth fingers.
3.22 One Finger- Mitt - A covering for the hand having a separate thumb and index finger and a common covering for the remaining fingers.
3.23 Reinforcement - An extra thickness of material attached to portions of the gloves to meet a particular requirement.
3.24 Bib Type - Apron covering chest, waist & legs down to the knees or sometimes to ankles.
3.25 Waist Type Apron - Apron covering waist and legs down to the knees and below.
3.26 Suit - Covering from head to foot, for complete protection and normally used with respiratory provision.
3.27 Hood - Protects wearer’s head, face, neck and shoulders.
3.28 Thermal Flux - It is the rate of the transfer of heat per unit area per unit time.
3.29 Thermal Resistance - It is an inverse measure of the capability of the clothing to transmit heat.

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3.30 Thermal Protective Index (Flame) - A number equal to the time in seconds before the temperature of the back surface of the protective clothing assembly rises by 25 degree C when exposed to standard heat source burning hexane.

3.31 Thermal Protective Index (Radiation) - A number equal to the time in seconds before the temperature of the back surface of protective clothing assembly rises by 25 degree C when exposed to standard radiation source consisting of radiant panel.

3.32 Reflectivity - When radiation falls on the material, part of it may be absorbed, part transmitted and the rest reflected. The reflectivity is the ratio of the radiation reflected to the total incident radiations.

3.33 Clothing Assembly - Clothing Assembly means composite material made from layers of similar or different materials, including lining which is used for making a single garment.

3.34 Safety Belt - The equipment which provides protection & safety in situations like working at higher elevation, maintenance of buildings, structures or jobs such as window cleaning & chimney cleaning and includes all components & fittings required for its use.

3.35 Safety Harness - The assembly which consists of the waist belt together with shoulder straps.

3.36 Life Line - The line which provides linear communication between the user & rescue party at the remote distance by tension or other means, particularly in enclosed space.

4.0 HEAD PROTECTION

Head houses the command centre of our central nervous system that controls all the movements, senses & basic body functions. An injury to the head can pose a serious threat to the brain.

Head injuries at work in industry may result from:
- falling objects
- persons hitting their heads on fixed objects
- fall of persons
- contact of head with bare live electrical conductors
- splashes of hot, cryogenic or corrosive liquids
- flying hard particles

Injuries such as perforation of the skull, fracture of the skull or of the cervical vertebrae and brain lesions without fracture of the skull can be fatal. Wearing appropriate head protector while at work in industry is, therefore essential. There are also personnel dedicated to firefighting duties where the nature of work requires the use of particular types of protectors.

The purpose of a helmet is to protect the wearer's head against hazards. The protection afforded by an industrial safety helmet or by a fireman's helmet are against the specific hazards which may be encountered at work. They are not suited for use as crash helmets by two wheeler drivers.

In order to reduce the destructive effects of shocks to the head, a safety helmet should:
- limit the pressure imposed on the skull by spreading the load over the maximum possible surface.
- the shell must resist deformation & perforation.
- deflect falling objects by having a suitably smooth and rounded shape.
- dissipate and disperse energy that may be transmitted to it in such a way that the energy passed on to the head and neck is largely reduced.

There may be other requirements such as protection against splashing of hot/corrosive/cryogenic materials & against electric shock. Accessories such as face shields and the helmet can provide additional protection to the wearer.

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Materials used in the manufacture of the helmets and harnesses should retain their protective qualities over a long period of time and under all foreseeable climatic conditions.

4.1 SELECTION OF SAFETY HELMET

While selecting a helmet, its characteristics, the hazards against which protection is required and the conditions under which the helmet will be used, need to be considered. As it is not practical for users to carry out performance tests for selecting a helmet, only those conforming to relevant standards such as IS:2925 or ISO International Standard No.3873 or an equivalent, duly certified by DGMS, should be used. The following aspects should also be considered:

4.1.1 GENERAL CONSIDERATIONS

(a) The outer shell should be strong and resistant to deformation or puncture. In case of plastics, the shell should be at least 2 mm thick.

(b) Helmets made of thermoplastic materials such as polycarbonate, ABS, polyethylene & polycarbonate glass fibre, fitted with a good harness provides the best protection against perforation. Light metal shells do not stand up well to puncture by sharp or angular objects.

(c) Helmets with projections inside should not be used as they may cause serious injuries in the case of sideways blow.

(d) Polyethylene, polypropylene and ABS helmets tend to lose their mechanical strength under the action of weather (heat, cold, strong sunlight). Polycarbonate, polyester or polycarbonate glass fibre helmets are better in areas of strong sunlight as they have greater resistance to aging. In all cases, evidence of discolouration, cracks, shredding of fibres or of cracking, when subjected to twisting, should call for the helmet to be discarded.

(e) The harness, chin strap of nape strap, brim and peak should conform to standards referred in following sections.

4.1.2 PARTICULAR CONSIDERATIONS

(a) If there is a danger of contact with electricity, only helmets made of thermoplastic material should be used. They should not have ventilation holes and no metal parts such as rivets should be apparent on the outside of the shell.

(b) For working overhead, particularly in the case of steel framework erectors, helmets must have chin straps to hold it firmly in place. "Skull-cap" shaped helmets are preferable in such work as the brim or peak may come in contact with joists or girders while maneuvering.

(c) For high temperature areas, use of polyethylene helmets is not recommended; helmets of polycarbonate, polycarbonate- glassfibre, phenol textiles or polyester-glass fibre are preferable instead. The harness should be of woven fabric and ventilation holes may be provided on the shell if there is no risk of electrical contact.

(d) Where there is a danger of crushing, helmets made of glass fibre reinforced polyester or polycarbonate and with a rim of at least 15 mm width should be used.

COMFORT CONSIDERATIONS:

(a) The helmet should be as light as possible.

(b) Woven fabric harnesses are preferred to polyethylene as they are more flexible, permeable to liquid and do not irritate or injure the wearer. A full or half sweatband incorporated on the headband improves absorbency and reduces skin irritation.

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(c) Sufficient ventilation should be available through space between headband & shell & through ventilation holes where permissible.

4.1.3 CLASSIFICATION OF HAZARDS RELATED TO HEAD PROTECTION

Hazards against which Protection Equipment for head to be used are given below in Table 4.1.

<table>
<thead>
<tr>
<th>Hazard Code No.</th>
<th>Typical Industrial Operation</th>
<th>Protection Against hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>Falling Object</td>
<td>Impact</td>
</tr>
<tr>
<td>H-2</td>
<td>Hitting of head on fixed objects</td>
<td>Impact</td>
</tr>
<tr>
<td>H-3</td>
<td>Falling of persons (from height)</td>
<td>Impact</td>
</tr>
<tr>
<td>H-4</td>
<td>Contact with bare live electrical conductor</td>
<td>Electrical shock</td>
</tr>
<tr>
<td>H-5</td>
<td>Splash of hot liquid, work in hot area</td>
<td>Thermal Burns</td>
</tr>
<tr>
<td>H-6</td>
<td>Cryogenic or corrosive liquid</td>
<td>Chemical Burns</td>
</tr>
<tr>
<td>H-7</td>
<td>Flying hot particles like, chipping, welding</td>
<td>Impact/Thermal burns</td>
</tr>
<tr>
<td>H-8</td>
<td>Direct fire hazard</td>
<td></td>
</tr>
</tbody>
</table>

4.1.4 SELECTION OF EQUIPMENT FOR VARIOUS HAZARDS

Different types of head protection equipment should be selected keeping in view the hazards, they can protect against. Guidance may be taken from the Table 4.2.

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### Table - 4.2

<table>
<thead>
<tr>
<th>Brief description of Equipment</th>
<th>Recommended Hazard Code No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester fibre reinforced helmet</td>
<td>H-1/H-2/H-3</td>
<td>15mm runs, 2mm thick shell</td>
</tr>
<tr>
<td>Thermo plastic material helmet</td>
<td>H-4</td>
<td>No metal parts in helmet</td>
</tr>
<tr>
<td>Polycarbonate / polyester fibre glass helmet</td>
<td>H-6</td>
<td>Chemical resistant PVC helmets should be used for acid protection.</td>
</tr>
<tr>
<td>Rigid heat insulation coating with neck curtain</td>
<td>H-8</td>
<td>Additional neck curtain with leather.</td>
</tr>
<tr>
<td>Normal helmets with metal parts of helmet including rivets, if exposed to inside of the helmet, to be insulated.</td>
<td>H-7</td>
<td>Head gear should retain the helmet firmly.</td>
</tr>
</tbody>
</table>

### 4.2 INDUSTRIAL SAFETY HELMET

#### 4.2.1 Construction

![Diagram of a safety helmet](image)

**General Details for safety helmets**

**Fig. 4.1**

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Shell:

The shell of the helmet shall be dome shaped without any metallic component passing through it. The brim and the peak (if provided) shall be integral parts of the shell and without any sharp edges. Ventilation holes (at least 3 on each side) of 6 mm (max) diameter with edges of adjacent holes, not more than 15 mm apart, of total area, not more than 300 sq.mm, shall be provided on the shell sides.

Harness:

(i) Headband of not less than 30 mm width designed for adjustment of size shall be securely attached to the shell and crown straps. A gap of 5 mm (minimum) will be maintained between the shell and headband with the help of spacers for ventilation except at the point of general adjustment.

(ii) Cradle formed out of anti-concussion tapes (at least 19 mm wide) fitted to the headband and secured at least at 4 anchoring points should provide a clearance of 30 mm between the head of the wearer and the inside of the top of helmet crown at the smallest size adjustment of the headband and a depth of fit not less than 80 mm at the maximum size adjustment of the headband.

(iii) Chin Strap or Nape Strap:

Either a chin strap or a nape strap shall be provided on the helmet.

(a) Chin Strap shall be at least 19 mm wide attached to the shell and fitted with a fastening device to adjust and maintain tension.

(b) Nape Strap shall be either an integral part or an attachment to the head-band of adjustable size and have a minimum depth of 115 mm.

(iv) Lamp Bracket or Cable Clip: (where required) shall conform to the requirements of IS : 2925.

4.2.2 Performance Tests

IS : 2925 details six different performance requirements and ten different tests for industrial safety helmets. ISO International Standard No.3873 sets out the essential features required in a safety helmet together with the related testing methods. These tests can be broadly classified as –

(a) Obligatory Tests to cover shock-absorbing capacity, resistance to perforation and resistance to flame.

(b) Additional Optional Tests intended to be applied to safety helmets designed for special groups of users. They include tests for dielectric strength, resistance to lateral deformation & low temperature test.

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Table - 4.3

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>DESCRIPTION OF TEST</th>
<th>CRITERION</th>
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<tr>
<td><strong>OBLIGATORY TESTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absorption of shocks</td>
<td>A hemispherical mass of 5 Kgs is allowed to fall from a height of 1m and the force transmitted by the helmet to fixed false (dummy) head is measured. The test is repeated on a helmet at temperatures of (-) 10 deg.C, (+) 50 deg.C and under wet conditions.</td>
<td>The maximum force measured should not exceed 500 daN.</td>
</tr>
<tr>
<td>Resistance to perforation</td>
<td>The helmet is struck with in a zone of 100 mm in diameter on its upper most point using a conical punch weighing 3 Kgs and a tip angle of 60 degrees. Test to be performed under the conditions which gave the worst results in the shock test.</td>
<td>The tip of the punch must not come into contact with the false (dummy) head.</td>
</tr>
<tr>
<td>Resistance to flame</td>
<td>The helmet is exposed for 10 s to a Bunsen burner flame of 100 mm in diameter using propane.</td>
<td>The outer shell should not continue to burn more than 5 s after it has been withdrawn from the flame.</td>
</tr>
<tr>
<td><strong>OPTIONAL TESTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>The helmet is filled with a solution of NaCl and is itself immersed in a bath of the same solution. Electric leakage under an applied voltage of 1200 V, 50 Hz is measured.</td>
<td>The leakage current should not be greater than 1.2 mA.</td>
</tr>
<tr>
<td>Lateral rigidity</td>
<td>The helmet is placed sideways between two parallel plates and subjected to a compressive pressure of 430 N.</td>
<td>The deformation under load should not exceed 40 mm and the permanent deformation should not be more than 15 mm.</td>
</tr>
<tr>
<td>Low temperature test</td>
<td>The helmet is subjected to the shock and perforation tests at a temperature of minus 20 degree C.</td>
<td>The helmet must fulfil the foregoing requirements for these two tests.</td>
</tr>
</tbody>
</table>
4.3 FIREMAN’S HELMET

4.3.1 Construction

Shell: The shell of the helmet should be hard, smooth, sufficiently rigid and as uniformly thick as possible. The design of the shell shall provide at least 30 mm free space above the head and a wearing height of not less than 80 mm.

Protective Padding: The inside of the shell shall be suitably insulated against heat by providing a protective padding of compressed cork sheathing of atleast 3 mm thickness and covering the whole of the internal surface of the shell to within 30 mm of the lower edge of the headband. The padding should be of uniform construction and thickness without any gap wider than 5 mm and no part of it should be readily detachable.

Harness: Headband of not less than 30 mm width made of thin, flexible fibre, rexine or leather (IS:3840) shall be attached to the shell, well-cushioned from it by means of at least 10 mm thick continuous sponge or any other suitable material fixed all around the head.

Crown Straps: Crown Straps shall form a cradle to support the helmet on the wearer’s head. The straps shall be at least 20 mm wide, made of HDPE or nylon webbing with a breaking load of not less than 450 Kgs.

Chin Straps: Chin Straps of leather or other suitable material (IS: 3840) not less than 20 mm wide with facility to adjust length shall be fixed tightly to the shell fitting.

Neck Curtain: Neck Curtain of leather or other suitable material at least 250 mm deep & extending from ear to ear shall be provided.

![Diagram of Fireman's Helmet](image)

Fig. - 4.2
Dimensions of Brim and Peak

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4.3.2 **Performance Tests**

IS:2745 details nine test methods for fireman’s helmets. These include tests for weight, clearance, shock absorption, flame resistance, electrical resistance, penetration, impact, chin strap etc.

4.3.3 **Selection of Fireman’s Helmet**

a) Only helmets conforming to IS:2745 or equivalent foreign standard should be used during fire fighting operations.

b) Provision shall exist to fit a visor to the helmet when this is required.

c) The helmet should fit comfortably when breathing apparatus is also worn.

4.4 **Welder’s Helmet - Refer item 5.5.2**

4.5 **Head Protection against acid - Refer item 5.5.3**

4.6 **Maintenance**

i) Helmets shall be inspected prior to use. Helmets with cracks shall not be used.

ii) Do not keep helmets in sun for prolonged exposure to ultraviolet rays of sunlight to avoid shortening of life.

iii) Helmets shall not be kept or carried in the shelf near the rear wind shield of vehicle because of exposure to sunlight and in case of accident, may not act as a hazardous missile.

iv) Condition of suspension is most important in absorbing shock of blow. These must be kept in good condition.

v) Once damaged, helmet is to be discarded.

5.0 **EYE AND FACE PROTECTION**

Eye and face protectors shall be used when there is a likelihood of injury to the face or eyes. This includes work where machinery or operations present the hazard of flying objects, glare, splashing liquids, injurious radiation or a combination of these hazards.

Protectors shall meet the following minimum requirements:

— Provide adequate protection against the particular hazards for which they are designed.

— Be reasonably comfortable when worn under the designed conditions.

— Fit snugly and shall not unduly interfere with the movement of the wearer.

— Be durable.

— Be capable of being disinfected.

— Be kept clean and in good condition.

Persons whose vision requires the use of corrective lenses/ spectacles and who are required by this standard to wear eye protection, shall wear goggles or spectacles of one of the following types:

- Spectacles whose protective lenses provide optical correction.

- Goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles.

- Goggles that incorporate corrective lenses mounted behind the protective lenses.

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Contact lenses are not a substitute for safety apparel and eyes/face must be protected by the proper type of goggles or face shield.

Every protector shall be distinctly marked to facilitate identification of the manufacturer.

When limitations and precautions are indicated by the manufacturer, they shall be explained to the user and care taken to see that such limitations are known & precautions are strictly observed.

5.1 ASSESSMENT GUIDELINES

In order to assess the need for eye and face protective equipment, the following steps should be taken:

Survey:

Conduct a walk-through survey of the area in question. The purpose of the survey is to identify sources of hazards to the eyes and face of workers and co-workers. Consideration should be given to the basic hazard categories.

Sources:

During the walk-through survey observe -

(i) Sources of motion i.e. machinery or processes where any movement of tools, machine elements or particles could exist or movement of personnel that could result in collision with stationary objects.

(ii) Sources of high temperatures that could result in facial burns, eye injury or ignition of protective equipment etc.

(iii) Types of chemical exposures.

(iv) Sources of dust.

(v) Sources of optical radiation such as welding, brazing, cutting, furnaces, heat treatment, high intensity lights etc.

(vi) Layout of work place and location of co-workers.

(vii) Any electrical hazards.

Organise Data:

Following the walk-through survey, organise the data and information for use in the assessment of hazards. The objective is to prepare for an analysis of the hazards in the environment to enable proper selection of protective equipment.

Analyse Data:

Having gathered and organised data on a work place, assess the potential for eye and face injury. Each of the basic hazards should be reviewed and the type and level of each of the hazards found in the area determined. The possibility of exposure to several hazards simultaneously should be considered.

Selection:

Specify the allowable eye and face protection suitable for the hazards identified.

Re-assessment of Hazards:

Re-assess the work place hazard situation by identifying and evaluating new equipment and processes, reviewing accident records and determining the suitability of previously selected eye and face protection.

5.2 CLASSIFICATION OF HAZARDS RELATED TO EYE & FACE PROTECTION

Hazards, against which protection equipment for eyes and face should be used, are classified in Table-5.1.

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### Table - 5.1

<table>
<thead>
<tr>
<th>Code</th>
<th>Equipment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>Impact</td>
<td>Chipping, coiling, sealing, grinding of metals, stone dressing, turning of cast iron and non ferrous metals etc.</td>
</tr>
<tr>
<td>H-2</td>
<td>Dust</td>
<td>Sealing, grinding, handling of cement, clay, earth work, sand/shot blasting etc.</td>
</tr>
<tr>
<td>H-3</td>
<td>Splash of liquids</td>
<td>Handling of acids, alkanes, hot and cold hydrocarbons and other chemicals, dechoking etc.</td>
</tr>
<tr>
<td>H-4</td>
<td>Irritating gases, vapours</td>
<td>Blinding &amp; deblinding of flanges, cleaning of tanks, vessels, blow-down pits etc.</td>
</tr>
<tr>
<td>H-5</td>
<td>Reflected light and glare</td>
<td>Testing of lamps, sheet metal and lathe work etc.</td>
</tr>
<tr>
<td>H-6</td>
<td>Injurious radiant energy</td>
<td>Oxy-acetylene welding and cutting, electric arc welding etc.</td>
</tr>
</tbody>
</table>

### Table - 5.2

<table>
<thead>
<tr>
<th>Code No. of equipment</th>
<th>Brief description of equipment</th>
<th>Recommended against hazard (Code No.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-1</td>
<td>Safety spectacles with side shields, safety lenses mounted in spectacle type frame</td>
<td>H-1, H-5 &amp; H-6</td>
<td>Spectacles may be fitted with clear, tinted blue or welding filter glass lenses</td>
</tr>
<tr>
<td>E-2</td>
<td>Cup-type goggles, two separate cupped eye pieces holding safety lenses and connected across the nose and provided with headband or harness</td>
<td>H-1, H-5 &amp; H-6</td>
<td>Goggles may be fitted with clear, tinted blue or welding filter glass lenses</td>
</tr>
<tr>
<td>E-3</td>
<td>Goggles - a) with ventilation b) without - do -</td>
<td>H-3</td>
<td>-</td>
</tr>
<tr>
<td>E-4</td>
<td>Dust goggles</td>
<td>H-2</td>
<td>-</td>
</tr>
<tr>
<td>E-5</td>
<td>One piece eye protectors (Monogoggles)</td>
<td>H-1, H-2, H-3, H-5 &amp; H-6</td>
<td>Should be capable of being used over prescription glasses</td>
</tr>
<tr>
<td>E-6</td>
<td>Face shields</td>
<td>H-1, H-2, H-3 &amp; H-6</td>
<td>-</td>
</tr>
</tbody>
</table>
5.3 SELECTION OF EQUIPMENT FOR DIFFERENT HAZARDS

Different types of eye and face protection equipment should be selected keeping in view the hazards they can protect against. Guidance may be taken from the information given in Table-5.2.

5.4 PROTECTION REQUIREMENTS & EQUIPMENT NECESSARY FOR INJURIOUS RADIANT ENERGY (HAZARD CODE NO. H-6)

For the purpose of this standard, operations in welding and cutting have been classified in the ascending order of the degree of hazard involved. Table 5.3 indicates the protection equipment permissible for each class of hazard.

<table>
<thead>
<tr>
<th>Hazard involved</th>
<th>Permissible Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure to moderate injurious radiation of light and heat &amp; to sparks e.g. in gas welding and cutting</td>
<td>Goggles, hand held shields and helmet mounted shields may be used.</td>
</tr>
<tr>
<td>Exposure to high intensity radiation of light and heat, sparks &amp; particles of hot metal e.g. in electric welding and cutting</td>
<td>Hand shields or helmets.</td>
</tr>
<tr>
<td>Exposure to direct / reflected radiation e.g. in gas shielded metal arc welding and cutting</td>
<td>Helmets but with provision for auxiliary heat absorbing filter lenses (*)</td>
</tr>
</tbody>
</table>

(*) The shade number of the filter lenses used in welding helmets, are determined by the visible density of the glass. The recommended shade numbers are as follows:
- Shade No.3 : For protection against glare or reflected light, spot welding operations or light brazing
- Shade No.4 & 5 : For light acetylene cutting
- Shade No.6 : For general acetylene welding and also for use by welder’s helper
- Shade No.8 : For heavy acetylene weld-ing or cutting, also for very light arc welding
- Shade No.10 : For arc welding upto 250 amperes
- Shade No.12 : For arc welding of more than 250 ampere and for atomic hydrogen welding
- Shade No.14 : For Argon arc welding

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5.5 TYPE OF PROTECTION

5.5.1 Goggles

General requirements:
The goggles shall consist of a frame, lens or lenses and a means of support such as an adjustable headband to retain the goggles in front of the eyes.

The frame shall be opaque and the interior shall have a permanent dull, low reflecting finish. The edge of the frame in contact with the face shall be flared so as to prevent cutting of the face and shall have a surface free from roughness or irregularities which may cause discomfort.

Ventilation:
The interior of the goggles shall be ventilated in a manner to permit circulation of air. The ventilation openings shall be baffled to prevent the passage of intense stray light or any particle into the interior of the goggles.

Workmanship:
The workmanship shall be such that the goggles, when worn in the normal manner, shall not allow direct entry of any particle or radiation to the interior.

Goggles shall be of 1 of the following types:

(a) Based on use
   — Heavy Impact-Cup type goggles (Chipping goggles)
     These goggles provide protection against impact from relatively large flying objects while chipping, cutting, grinding & performing striking operations such as breaking concrete etc.
   — "Acid" Goggles
     These goggles protect against splashes, sprays & mists of injurious liquids such as chemicals, oils etc. They are required to be worn in areas where possibility of splash exists. In addition, they provide protection against dust and light flying objects.
   — Removal of Acid Goggles:
     If acid goggles get sprayed with acid or caustic, you must get under a shower as soon as possible. If it is necessary to remove the goggles to be able to see the way to the shower, special care must be taken to keep acid or caustic out of the eyes. The following procedure must be followed:
     (i) Bend over until looking directly at the ground.
     (ii) Pull goggles down and away from the face by stretching the headband and then slipping them over the top of the head.
     (iii) Place the hand across the fore-head then stand up straight and proceed to the shower.
     Goggles should not be removed before getting under the shower. Use the above method only when your vision is obscured by the splashed material.
   — Burning and gas welding goggles
     For injurious light rays from ACETYLENE BURNING & WELDING, cup type specially shielded goggle with a special lens provides protection for this operation. The shade of lens varies with the operation. FOR REFLECTED ELECTRIC ARC WELDING RAYS, cup type shielded goggle with

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special lens (flash goggles) provides protection against reflected rays from electric arc welding. These goggles will not protect against the direct rays from an electric arc.

**How to use:**

For maximum protection and comfort, goggles must be properly adjusted to fit the face.

Goggles with elastic headbands can be easily adjusted by the user. The head-band should be worn just tightly enough to hold the goggle firmly to the face. The headband should come just above the ears and then slope down on the lower part of the back of the head. Do not place the band over a cap or hat while using the goggles. Adjust the bridge, if necessary.

- **Spectacle type goggles**
  This should be used for Ltd. hazards needing only frontal protection. Jobs such as machining, grinding, routine process operations like opening valve, checking pump etc. fall in this category.

- **Furnace goggles**
  These goggles with cobolt blue lenses and leather shields are designed for looking at the flame inside the furnace.

**Care of goggles:**

- When goggles are not in use, keep them in the proper case. Do not throw them in tool boxes and drawers as they may get damaged or the adjustment thrown out of line.
- Keep your goggles and lenses clean. Do not wear a pair of goggles which have been worn by someone else until they have been sterilised.
- Be sure, the headbands are in good condition and are elastic. Have defective bands replaced.
- The lens must be securely held in the frames. Inspect them for pits & scratches which may cause eye strain.
- Be sure to use the correct goggles for the hazard involved. Consult your supervisor in case of doubt.

(b) **Based on Construction**

- Cup-type goggles consist of two eye-piece with adjustable connection across the nose.
- Box-type goggles provide total enclosure of both the eyes and have separate filter holders or a single lens or filter lens.

Eye cup type goggles shall be provided with rigidly constructed screw-on type, with lens retaining rings of metal or plastic. These shall provide a complete clamping action against the lenses.

Lens thickness shall be 3.0 mm. For lenses that can withstand high velocity impact, 2.0 mm thickness is acceptable.

When properly adjusted for the wearer, the distance from the pupil of the eye to the inner surface of the filter shall be such as to permit an effective angle of vision of not less than 105 degrees for each eye but shall in no case be less than 14.0 mm.

In the eye cup type goggles, the two cups shall be joined by a suitably shaped nose-bridge which is adjustable easily by hand to allow accommodation to various pupillary distances.

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Headbands shall be capable of holding the equipment in correct position when properly adjusted. They shall be capable of adjustment continuously (not step wise) without the aid of special tools. The means of adjustment shall be designed to be non-slip.

5.5.2 Welder’s Helmets/Hand Shields

The helmets and hand shields are basically the same in design, the difference being that the helmet has a headgear by which it is supported on the head while the hand shield has, attached to the bottom, a hand grip by which it is held in the hand.

General Requirements:

The helmet and hand shield shall consist of a body, a filter arrangement, suitable headgear in the case of the helmet and a hand grip in the case of the shield.

The body of the helmet and hand shield shall be of such size and shape as to protect the face, top of the head and the neck to a vertical line on back of the ears. The body shall be opaque and the interior shall have a permanent dull low reflecting finish.

The helmet and hand shield shall have in the front of the body a window with filter which allows the wearer to see the welding or cutting operation and yet prevent harmful radiation and sparks from reaching the face or eyes.

All interior parts shall be free from sharp edges or any irregularities which may be a hazard to the user.

The workmanship shall be such that the helmet and hand shield when used in the normal manner shall not allow direct entry of any particle or radiation to the interior.

Any metal parts, including rivets which extend through the material of the body of the helmet or shield and which may touch the user’s head or face, shall not be exposed on the inside of the helmet or shield. Such metal parts shall be insulated by means other than lacquer or varnish.

The headgear shall retain the helmet comfortably and firmly in place on the wearer’s head but shall permit the helmet body to be tilted back over the head. The headgear shall be adjustable, without the use of tools, so as to permit the setting of the filter in the line of vision of the wearer.

The design of the helmet shall be such that the inner surface of the filter shall not be less than 50 mm from the eyes of the wearer.

Hand shields shall be provided with a hand grip which shall either be fixed inside the shield or be provided with the other means of protection for the hand.

5.5.3 Acid Proof Hoods

These types of personal protective equipment by person exposed to possible splashes from corrosive chemicals.

General Requirements:

This type of hood shall have a window of glass or plastic that is securely joined to the hood to prevent acid or chemicals passing through.

Hoods shall be made of rubber, neoprene, plastic or impregnated fabrics suitable for resistance to different chemicals.

All materials which come in contact with the user’s skin shall be of a kind which is known not to cause skin irritation.

The hood shall be of an easily removable type.

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The workmanship shall be such that the hoods when worn in the normal manner shall not allow direct entry of any particle or splashing of corrosive chemicals. All interior parts shall be free from sharp edges or any irregularities which may be a hazard to the user.

5.5.4 Face Shield
Protective devices generally intended to shield the wearer’s face or portions thereof, in addition to the eyes, from certain hazards. Face shields are secondary protectors and shall be used only with primary protectors. Face shields may have a headgear that supports a window, curved to surround and cover the wearer’s face. Neck & chin protectors are also available. The headgear assembly may be provided with or without a crown protector. Face shield windows may be attached to protective helmets (hard hats) in place of their own headgear. The assembled devices are available in many combinations of the various major component types to provide the use with a wide choice of suitable equipment.

5.6 INSPECTION AND MAINTENANCE
Protective equipment should be inspected frequently to ensure that it is in good condition. Frequency of checking can be decided depending upon the usage.
A responsible officer should be entrusted to make frequent inspections of the protective equipments and to see that all defective devices are either properly repaired or placed out of commission.
All the protective equipments should be numbered serially, category-wise & a record of the inspection should be maintained.
When not in use, protective equipment should be properly stored at some central place. A cabinet containing serially numbered hoods are recommended for the same.
Goggles are likely to get damaged if carried loose in the pocket or with tools. Hence, carrying cases shall be provided for the same.
After the use of protective equipment, it should be cleaned and disinfected before being issued to another person. Equipment used continuously by one person should be cleaned and disinfected at regular intervals. Cleaning and disinfecting can be carried out as per the procedure given in IS: 1179, A-7 ‘Cleaning and Disinfecting.’
Protective equipment should be checked daily for tightness of screws or securing bolts, stitching, elasticity of head bands and proper placement of lenses in the various frames or holders. Fine adjustments should be made by a designated supply room employee, rather than each employee possibly using improper tools.

6.0 EAR PROTECTION
This section covers the allowable noise exposure levels in the working areas and the requirement of protective equipment for ears.

6.1 ALLOWABLE NOISE LEVEL
Two aspects of noise exposure having significance on the damage potential are the length of exposure and the loudness or intensity of exposure. Higher frequencies may play a role in creating more hearing loss than lower frequencies. The following points should be taken into account while considering exposure levels:
When on-the-job exposures level is less than 80 dBA, it need not be considered in any exposure evaluation. The limit for continuous noise without protection is 90 dBA for exposures of 8 hours per day. Exposures to sound pressure levels greater than 115 dBA and of continuous nature are not permitted.

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The impact noise limit is 140 dBA per day for continuous exposure. The permitted sound pressure level versus duration of exposure are given in the table below:

<table>
<thead>
<tr>
<th>Sound pressure level, dBA</th>
<th>80</th>
<th>85</th>
<th>90</th>
<th>95</th>
<th>100</th>
<th>105</th>
<th>110</th>
<th>115</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible duration Hours</td>
<td>32</td>
<td>16</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1/2</td>
<td>1/4</td>
</tr>
</tbody>
</table>

6.2 PROTECTIVE EQUIPMENT

Wearing proper hearing protection reduces the dose of sound level. The selection of the appropriate equipment depends on several factors such as comfort for the user, cost, noise data available for the area of interest & frequency of noise. There are two general types of hearing protective devices available, namely ear plugs and ear muffs.

6.2.1 Ear Plugs

(i) Ear plugs shall be made up of pliable rubber, soft or medium plastic, polyurethane foam (PUF) and impregnated cotton.

(ii) They shall be easily removable/insertion type and should be without sharp edges that may cause injuries to the ear drum or other parts.

(iii) All the materials used which come in contact with the users’ skin shall be of a kind which is known not to cause skin irritation.

(iv) Properly fitted and used ear plugs should reduce noise reaching the ear by 30 dBA in the higher (and more harmful) frequencies. They shall give ample protection against sound levels up to 120 dBA.

(v) Ear plugs shall be designed in such a way that they can be used in combination with ear muffs.

6.2.2 Ear Muffs

(i) Ear muffs should be designed in such a way that it reduces the noise reaching the ear by 45 dBA in the higher (and more harmful) frequencies. It shall give ample protection against sound level up to 135 dBA.

(ii) The muffs shall be made in a universal type or a head, neck or chin type.

(iii) All the materials used which come in contact with the user’s skin shall be of a kind which is known not to cause skin irritation.

(iv) Ear muffs shall be designed in such a way that they can be used in combination with ear plugs.

7.0 HAND AND ARM PROTECTION

Hand and Arm protective equipment is intended to protect hands/arms where there is likelihood of injury as in the case of handling chemicals, solvents and jobs involving heat, radiation, electricity and abrasive materials.

7.1 CLASSIFICATION OF HAZARDS

Classification of hazards related to protection of arms and hands is given in Table 7.1.

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<table>
<thead>
<tr>
<th>Code No. of Hazard</th>
<th>Description of Hazard</th>
<th>Typical Industrial Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>Heat, where no irritant substance is present and the risk of wear is not serious</td>
<td>Furnace work, drop stamping, casting &amp; forging, handling hot tyres and similar operations.</td>
</tr>
<tr>
<td>H-2</td>
<td>Heat, where irritant substance is present and risk of wear is serious</td>
<td>Stoking gas retorts, riveting, holding up, hot chipping.</td>
</tr>
<tr>
<td>H-3</td>
<td>Heat, when fair degree of sensitivity is required and splashes or spatter of molten metal may occur</td>
<td>Welding, case hardening in cyanide bath.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code No. of Hazard</th>
<th>Description of Hazard</th>
<th>Typical Industrial Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-4</td>
<td>Sharp materials or objects</td>
<td>Sharp metal after guillotining, blanking or machining.</td>
</tr>
<tr>
<td>H-5</td>
<td>Glass or timber with splintered edges</td>
<td>Handling cold castings/forgings, precast concrete, bags of cement or bricks.</td>
</tr>
<tr>
<td>H-6</td>
<td>Abrasions</td>
<td>Shot blasting.</td>
</tr>
<tr>
<td>H-7</td>
<td>Gross abrasion</td>
<td>Light handling operations.</td>
</tr>
<tr>
<td>H-8</td>
<td>Light abrasion</td>
<td>Handling or contact with acids, alkalis, dyes and general chemicals but not involving contact with solvents or oils.</td>
</tr>
<tr>
<td>H-9</td>
<td>Chemicals</td>
<td>Handling or contact with solvents, oils or grease.</td>
</tr>
<tr>
<td>H-10</td>
<td>Solvents, oils and grease</td>
<td>Electric current carrying equipment.</td>
</tr>
<tr>
<td>H-11</td>
<td>Electric shock</td>
<td>Work on X-ray, radio isotopes etc.</td>
</tr>
<tr>
<td>H-12</td>
<td>X-ray and other radio active radiations</td>
<td>Plating and subsequent operations</td>
</tr>
<tr>
<td>H-13</td>
<td>Sharp materials or objects in alkaline degreasing bath</td>
<td>—</td>
</tr>
<tr>
<td>H-14</td>
<td>Electrolytic deposition</td>
<td>—</td>
</tr>
<tr>
<td>H-15</td>
<td>Hot alkaline cleaning bath</td>
<td>—</td>
</tr>
<tr>
<td>H-16</td>
<td>Spraying paint or cellulose lacquers</td>
<td>—</td>
</tr>
<tr>
<td>H-17</td>
<td>Special hazards : lead tetra ethyl; mercury, lead and their salts</td>
<td>—</td>
</tr>
</tbody>
</table>

### 7.2 Selection of Protective Equipment

The following Table-72 give an idea of the various protective devices intended for the hazards mentioned earlier:

*“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”*
<table>
<thead>
<tr>
<th>Code No.</th>
<th>Type of Equipment</th>
<th>Recommended for use against hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-1</td>
<td>Chrome leather gloves</td>
<td>H-1, H-8, H-16</td>
</tr>
<tr>
<td>E-2</td>
<td>Chrome leather inseam mitts and one-finger mitts</td>
<td>H-1, H-2, H-3, H-4, H-6, H-7, H-8</td>
</tr>
<tr>
<td>E-3</td>
<td>Chrome leather gauntlet</td>
<td>H-1, H-2, H-3</td>
</tr>
<tr>
<td>E-4</td>
<td>Chrome leather inseam gauntlet with canvas or leather cuts, with or without reinforcement between thumb and forefinger</td>
<td>H-1, H-2, H-4</td>
</tr>
<tr>
<td>E-5</td>
<td>Chrome leather stapled double palm gloves</td>
<td>H-6</td>
</tr>
<tr>
<td>E-6</td>
<td>Chrome leather inseam gauntlet with vein patches and aprons covering palm to first joint of fingers</td>
<td>H-4</td>
</tr>
<tr>
<td>E-7</td>
<td>Chrome leather back and palm inseam gloves</td>
<td>H-6</td>
</tr>
<tr>
<td>E-8</td>
<td>Chrome leather, felt lined (thumb only), mitts with canvas or leather faced palms</td>
<td>H-1, H-2, H-4, H-7, H-8, H-16</td>
</tr>
<tr>
<td>E-9</td>
<td>Lined polyvinyl chloride gloves and gauntlet</td>
<td>H-4, H-6, H-8, H-9, H-10, H-13, H-14, H-15, H-17</td>
</tr>
<tr>
<td>E-10</td>
<td>Unlined polyvinyl chloride gloves and gauntlet</td>
<td>H-9, H-10, H-13, H-14, H-15, H-16</td>
</tr>
<tr>
<td>E-11</td>
<td>Unlined light weight rubber gloves and gauntlet</td>
<td>H-6, H-7, H-8, H-9, H-10, H-14, H-16</td>
</tr>
<tr>
<td>E-12</td>
<td>Unlined medium weight rubber gloves and gauntlet</td>
<td>H-6, H-7, H-8, H-9, H-10, H-14, H-15, H-16</td>
</tr>
<tr>
<td>E-13</td>
<td>Unlined heavy weight rubber gloves and gauntlet</td>
<td>H-4, H-6, H-7, H-9, H-10, H-13, H-14, H-15, H-17</td>
</tr>
<tr>
<td>E-14</td>
<td>Chrome leather hand guards/pads</td>
<td>H-4, H-5, H-6, H-8</td>
</tr>
<tr>
<td>E-15</td>
<td>Cotton drill gloves</td>
<td>H-5, H-6, H-8</td>
</tr>
<tr>
<td>E-16</td>
<td>Cotton drill gloves with chrome leather palms</td>
<td>H-5, H-6, H-8</td>
</tr>
<tr>
<td>E-17</td>
<td>Lined light weight rubber gloves and gauntlet</td>
<td>H-6, H-10, H-16</td>
</tr>
<tr>
<td>E-18</td>
<td>Lined medium weight rubber gloves and gauntlet</td>
<td>H-6, H-9, H-10, H-13, H-14, H-15, H-16</td>
</tr>
<tr>
<td>E-19</td>
<td>Lined heavy weight rubber gloves and gauntlet</td>
<td>H-4, H-6, H-9, H-10, H-13, H-14, H-15</td>
</tr>
<tr>
<td>E-20</td>
<td>Asbestos gloves &amp; gauntlet</td>
<td>H-1, H-2, H-3</td>
</tr>
<tr>
<td>E-21</td>
<td>Asbestos gloves &amp; gauntlet reinforced with leather</td>
<td>H-1, H-2, H-3</td>
</tr>
<tr>
<td>E-22</td>
<td>Aluminised fabric gauntlets</td>
<td>H-1</td>
</tr>
<tr>
<td>E-23</td>
<td>Natural rubber gloves</td>
<td>H-11</td>
</tr>
<tr>
<td>E-24</td>
<td>Lead rubber gauntlets</td>
<td>H-12</td>
</tr>
<tr>
<td>E-25</td>
<td>Lead plastic gauntlets</td>
<td>H-12</td>
</tr>
<tr>
<td>E-26</td>
<td>Lead leather gauntlets</td>
<td>H-12</td>
</tr>
</tbody>
</table>

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### Table – 7.2 Contd.....

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Type of Equipment</th>
<th>Recommended for use against hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-27</td>
<td>Leather elbow pads</td>
<td>H-6, H-7, H-8</td>
</tr>
<tr>
<td>E-28</td>
<td>Rubber elbow pads</td>
<td>H-8</td>
</tr>
<tr>
<td>E-29</td>
<td>Asbestos sleeve</td>
<td>H-1, H-2</td>
</tr>
<tr>
<td>E-30</td>
<td>PVC sleeve</td>
<td>H-9</td>
</tr>
<tr>
<td>E-31</td>
<td>Rubber sleeve</td>
<td>H-9</td>
</tr>
<tr>
<td>E-32</td>
<td>Treated canvas sleeve</td>
<td>H-9</td>
</tr>
</tbody>
</table>

### 7.3 Protection against dermatitis

The choice is not always a simple one when protection against dermatitis-producing agents is required. If the irritant substance is in dry form, plain cotton gloves and other apparel may serve as well as have the added advantage of easy laundering. Disposable paper and plastic garments can also be used.

When the irritating substance is a liquid, the material chosen for the apparel must be impervious to the specific agent; otherwise the substance may penetrate through the material and then be maintained in a high concentration in prolonged contact with the skin. Since there is always the chance of some of the substance getting inside the garment, frequent cleaning is important.

If the apparel chosen is not absolutely impervious to the irritating agent, it will eventually penetrate inside and be trapped next to the skin, causing repeated expo-shure, every time, the garment is worn.

#### 7.3.1 Protective creams

Specially formulated barrier creams and lotions may sometimes offer the only practical protection, for example:

(i) when personal protective equipment is too cumbersome or uncomfortable;

(ii) where manual dexterity is all important;

(iii) where protective apparel might constitute a hazard near moving machinery.

#### 7.3.2 Skin Cleansers:

Germicidal and antiseptic soaps, detergents and cleansing creams are used to remove dirt, grease, oil and chemicals from the skin after exposure.

### 7.4 MAINTENANCE

Continued good performance of protective apparel depends largely on the care it receives. In the first place, proper fitting is important, especially with gloves. Not only does this ensure greater ease in working but the gloves can be put on and taken off without unnecessary damage. The gloves and sleeves should not be left folded in an unnatural way as this places the folded part under stress and weakens it.

Periodic cleaning & maintenance to remove the build-up of solvents, degreasing agents etc. lengthens the life of the protector. Gloves with rough finish require thorough cleaning because the irregular surface forming the finish traps solutions which may cause deterioration. If gloves swell, they should be taken out of use to permit solvents to evaporate and the original shape to be restored.

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Some gloves made of rubber, cotton or leather may be reconditioned to prolong their useful life. Reconditioning may include cleaning, sterilisation & reshaping as well as repair. Defective protectors should be scrapped and replaced at once.

8.0 BODY PROTECTION

Personal protective equipments required to be used for protection of human body in oil and gas industries include items such as aprons, suits and safety belts.

8.1 CLASSIFICATION OF HAZARDS RELATED TO BODY PROTECTION EQUIPMENT IS GIVEN IN TABLE - 8.1.

<table>
<thead>
<tr>
<th>Hazard Code No.</th>
<th>Protection Against Hazard</th>
<th>Typical Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>Flame</td>
<td>Flame proximity and flame entry</td>
</tr>
<tr>
<td>H-2</td>
<td>Flying chips &amp; rough objects</td>
<td>Grinding, welding</td>
</tr>
<tr>
<td>H-3</td>
<td>Strong acids &amp; alkalis</td>
<td>Handling chemicals</td>
</tr>
<tr>
<td>H-4</td>
<td>Organic solvents/oil</td>
<td>Handling petroleum products</td>
</tr>
<tr>
<td>H-5</td>
<td>X-Rays</td>
<td>X-ray techniques</td>
</tr>
<tr>
<td>H-6</td>
<td>Accidental fall</td>
<td>Excavation, tank cleaning</td>
</tr>
<tr>
<td>H-7</td>
<td>Accidental fall</td>
<td>Maintenance work at high elevations such as window cleaning &amp; painting/chimney cleaning &amp; painting.</td>
</tr>
</tbody>
</table>

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8.2 SELECTION OF EQUIPMENT FOR DIFFERENT HAZARDS

While selecting body protection equipment, it should be borne in mind that the material, of which the equipment is made, will give protection only against hazards given in Table-8.2.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Protective Wear</th>
<th>Recommended for use against Hazard Code No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Suits/Apron/Jacket of Aluminised fabric and glass fibre insulated fabric / Water Based Gel Blanket</td>
<td>H-1</td>
</tr>
<tr>
<td>(ii)</td>
<td>Leather suits /apron/ jacket</td>
<td>H-2</td>
</tr>
<tr>
<td>(iii)</td>
<td>Apron/suit/jacket of Rubber, PVC, Plastic coated fabric</td>
<td>H-3, H-4</td>
</tr>
<tr>
<td>(iv)</td>
<td>Lead plastics or lead rubber or lead leather apron / suit/ jacket</td>
<td>H-5</td>
</tr>
<tr>
<td>(v)</td>
<td>Nylon/Polyester belt and harness</td>
<td>H-6, H-7</td>
</tr>
</tbody>
</table>

8.3 Aprons

Aprons may be classified based on coverage they provide and the material of construction.

8.3.1 Based on coverage

(i) Bib Type : Covering chest, waist and legs down to the knees or sometimes to ankles.
(ii) Waist Type : Covering waist & legs down to the knees or below.

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8.3.2 Based on material of construction

(i) PVC Apron: It shall be used in handling acid and alkali. Chemical protection clothing can be manufactured from a special grade heavy duty high visibility yellow PVC. The material shall have excellent chemical resistance, high tensile, tear & elongation strength, abrasion, ozone as well as heat resistance.

The clothing seam shall be welded by high frequency electrical heating.

(ii) Rubberised Apron: It shall be used in handling acid and alkali.

The requirements for the finished fabrics and coating shall conform to IS-4501 for rubberised water proof fabrics. Rubberised fabrics shall have resistance to chemical solutions, solvents, abrasives, gases, punctures, tearing, oxidation and ozone attack.

Stitching: Sewing shall be done with thread conforming to variety No.11 of IS-1720 and lock stitch with not less than 32 stitches per 10 cm. The joints for the strap with the aprons shall be stitched from inside the apron.

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Straps: The same material which has been used for making aprons shall be used for straps also. Strap shall be folded and sewn at both sides.

Buckles: Suitable nickel plated sliding jaw type buckles shall be fitted to the rubber straps.

Dimensions: The length and width of the apron shall not be less than 100cm and 75cm respectively. Eyelets shall be made from aluminium alloy of size No.24 of IS-4084, 1967.

(iii) Chrome Leather Aprons: It shall be used where there are chances of hot metal splash & sparks, flying chips, rough objects and mild impacts.

Chrome leather shall conform to the following requirements:
— It shall be soft, pliable and free from flaws and loose fibres.
— The leather shall not contain any chromate extractable by water or dilute acids.
— The leather should also be treated for mildew resistance.
— It shall be treated in such a manner as shall not obscure defects and such that it is not to be stained with compounds of iron.

8.4 SUITS

Following types of suits are commonly used:
- Boiler Suits
- Fire Fighting Suits
- Chemical Protection Suits

8.4.1 Boiler Suit

It may be in one piece or two pieces. It is used by Maintenance & Inspection Personnel. It is preferably made up of cotton fabric to retain the comforts of air permissibility & moisture transmission. It shall not propagate flame, have afterglow, be self-extinguishing, shall retain basic characteristics of the fabric, shall be durable to natural detergent washings, dry cleanings & be environment friendly. Where persons may be exposed to sparks, flame or heat, fire retardant clothing or suits may be used. For TEL handling, white colour suit shall be used. For details, refer Item 10.4.

8.4.2 Fire Fighting suits

These are of following types:
- Fire Proximity Suit
- Fire Entry Suit

(i) Fire Proximity Suit

It allows the fire fighter to work next to the flames i.e. radiant heat and occasional flame lick for the purpose of rescue work & knockdown fire fighting operations in proximity of flames but not actually in flames. These suits shall conform to UL/EN/ NFPA/BIS specifications.

(ii) Fire Entry Suit

It allows the firemen to work in the flames i.e. complete static immersion but for a very short duration of 20-30 seconds. For typical fire proximity suit/fire entry suit, refer Fig.8.2.
Fig.8.2 : Fire Proximity / Entry Suit

Water based gel blanket

Water based gel blanket consists of woven pure wool, impregnated with sterile water based gel and provides a shield against the flame, heat & smoke. It may be draped around the body of the person trying to escape through fire. Period of its exposure to heat should be limited to that of the specified period.

It may be draped around the body of a burning/burnt person. It reduces the pain & trauma of wounds/burns. It reduces the risk of further infection by physically covering the burns.

It can also be used to extinguish small fire by providing a cover.

The blanket should be kept inside the specified box with proper cover in a cool and hygienically clean place. It should not be handled with infectious hands. It should be used only before its expiry period.

Selection of Material

The material shall be non-flammable, light-weight & flexible having sufficient heat reflecting properties. Such treatment shall be of permanent nature, that is a garment made out of materials so treated shall retain the flame-retardant property throughout its effective life.

The material shall be durable, shall not disintegrate when subjected to intense radiated heat and/or flame and any garment made out of these, particularly, its outer layer, shall retain its strength to remain in position during its normal intended use.

Where it is necessary to use a material impervious to water in the outer layer of clothing assembly, the material shall not deteriorate by repeated contact with water and shall not be affected adversely by fire fighting foam.

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Reflective coating shall be of such quality that it shall not crack or chip during normal usage of the garment.

**Clothing Assembly:**
Fire entry suits shall have high thermal capacity combined with a high thermal resistance. Heat resistant suits shall have a high thermal resistance and where possible, the outer surface shall be of such a nature that it will reflect the maximum possible heat.

The thickness of the clothing assembly shall be such that it would not unduly restrict the mobility of the wearer and in any case, it shall not exceed 15 mm.

All threads used for stitching of garments shall be adequately treated to render it flame retardant to the same degree as other components of the clothing assembly.

The material shall be tested in accordance with the method of test given in Appendix of IS-7612. The garment may be backed by a lining and/or under garments, provided that these are representative of the type of clothing yarn for the proposed application. Clothing assembly shall meet all the requirements given in IS-7612.

**Headwear:**
The helmet shall conform to the requirements of IS:2745-1969. These shall be designed in such a way that visor or face shield does not mist up in use to an extent that it reduces the visibility.

**Handwear:**
The gloves shall be graded as light duty or heavy duty. The design shall be such that the thumb and index finger are protected individually and the remaining three fingers either individually or together. The length of this portion, measured from the wrist joint to the tip of it shall be as given below:

- Small size - 350 mm
- Medium size - 370 mm
- Large size - 400 mm

**Footwear:**
The trouser leg of the protective suit should fit snugly into or around the boot to prevent ingress of flame. For fire entry work, the foot wear shall reach to just below the knee and worn over shoes or boots. Use of stud type fastener shall be avoided.

**8.4.3 Chemical protection suit**
It may be of PVC, Butyl, Viton or a combination of Butyl and Viton etc. For compatibility of protective clothing for various chemicals, refer Annexure-I.

The suit shall be complete in one piece with gas tight zip and all joints shall be seam welded and with a hood visor providing a large field of vision and complete with safety boots & gloves. There should be a provision for wearing respiratory protective device internally. There should be a provision for inflating the head protection cap. For typical chemical protection suit, refer Fig. 8.3.
Fig.8.3 : Chemical Protection Suit

Requirements:

— It shall be able to provide gas tight and chemical resistant cover for full body and equipment protection.
— It shall be able to produce personal air ventilation inside the suit to reduce heat stress.
— It shall be able to build positive pressure inside the suit that prevents the penetration of chemicals when leakages occur.
— As far as possible, it should be light weight.
— It shall be easy in donning for fast response to emergencies and shall provide easy movement in confined places.
— Seam with high tear resistance be adopted to suit material. Double seam be provided on both sides for gas tightness.
— It shall have integral safety boots with toe cap, steel sole and ankle protection.
— Wrist seals shall be provided, supplementary seals optional.
— Zip fastener used shall be gas tight, sturdy, covered with teeth inside, vertically located at front.
— Back Pack Padding shall be provided in the back pack area for protection against impact.

Sizes

Chemical protection suits are available in various sizes like small, medium, large & extra large and also as per the requirement of users.

Workmanship

Workmanship of finished garments shall be of the high quality. The stitches shall be secure, even and unbroken. Wherever possible, seams shall be such that the threads are protected. The thread shall be compatible with the body fabric and shall not impair the effectiveness of the protection afforded by the garment.

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8.5 MAINTENANCE & CARE OF INDUSTRIAL CLOTHING

8.5.1 PVC
- Consult the manufacturer on the care & cleaning precautions necessary for these special garments & follow their recommendations.
- Protect these garments from excessive heat and mechanical damage.
- When harmful material gets on to the garments, wash it off carefully.
- Use warm soapy water for cleaning.
- Never use compounds that may affect the impregnated or coated material.
- Clean the garment thoroughly before storing and avoid unnecessary folding or creasing in storage.

8.5.2 Rubber
- Keep oil, grease and solvents away from rubber boots, aprons, acid hoods and electrical lineman's equipments.
- Protect rubber equipment from excessive heat and mechanical damage.
- When not in use, avoid exposing to direct sunlight.
- Store and use such equipment so that it does not get cut, torn, scratched or worn by abrasive action. Avoid crushing or creasing it.
- Wash and dry thoroughly before storing it. Warm air drying should be used when possible.
- Use talc powder for inside of the gloves to avoid sticking to the hand.
- Avoid undue stretching when in use.

8.5.3 Leather
- Keep water, oil and acids away from leather goods as far as possible.
- If the wearer is not exposed to splashes of molten metal, the clothing may be repaired by patching with pieces of leather or by sewing the tear.

8.5.4 Flame Proof Fabrics
- Flame-proof garments are usually made from cotton impregnated with flame resistant chemical solutions. The recommendations of the manufacturer shall be followed to retain the original flame resistant qualities of the garments.
- As & when necessary, cleaning of garments shall be done if paints, oils or grease of flammable nature get on to the garment.
- After dry-cleaning, garments shall be tested for serviceability in respect of flame resistant properties.
- If repaired or cleaned clothing require chemical treatment, work shall be done as recommended by the manufacturer.
- It should be properly maintained and intelligently used.

8.6 Marking and Instruction
Each apron/suit shall have clear marking at suitable place regarding manufacturer’s name or trade-mark, size, type, year of manufacture and for flame resistant and heat resistant suit, the exposure time limit. Manufacturer’s instructions shall be provided with each set of protective clothing.
The apron/suit shall be marked with the ISI certification mark or as far as possible PPE must have the approval from certifying authority like DGFASLI or DGMS.

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8.7 Packing
Each suit/apron shall be kept in suitably designed bag of water proof material. The bag shall be provided with a flap with quick release fittings.

8.8 Safety Belts
Safety belts are required to protect persons from injury by arresting the fall in the event of user losing his balance or support & falling from the place of work either at an elevation or in closed locations or containers, construction jobs or electrical jobs at elevation.

Safety belts and safety harnesses together with their accessories such as safety lines, life lines, safety clamps, hooks etc. are to be provided for proper protection.

In selecting suitable equipment, that is, belt or harness for a particular duty, care should be taken to ensure that such equipment gives the wearer protection as far as possible, compatible with safety, maximum degree of comfort, freedom of movement and in the event of falling, the greatest possible security against injury either from the impact from the ground or surrounding structures or from the belt itself.

8.8.1 Types and General Design

Waist Safety Belt - Type-1:
This is for general use in industry where the movement is restricted and user is not likely to fall from a height. This type of belt is intended for an anchorage within 1m of the wearer’s place of working and the fall is restricted to 0.6m. This type of safety belt shall consist of a belt with suitable buckle fasteners and provided with one or two D-rings for attachment of safety life line. The recommended maximum length of the safety line with this belt shall be 2m.

Fig.8.4 Safety Belt Type-1

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General Purpose Harness Safety Belt - Type-2:
This belt is recommended for all general duties where mobility is essential and the point of anchor is not very close. This belt shall consist of one body belt and two shoulder straps. The design shall be such that the waist belt as well as the shoulder straps has provision for adjustments. A D-ring shall be provided on the back to which the safety line is attached. The recommended length of safety line for this type of safety belt is 3m. It should be ensured that the wearer’s fall is arrested within 1.8 m from the point of anchorage.

Fig.8.5 : Safety Belt Type - 2

Man Hoisting Belt - Type-3:
This belt shall be used for hoisting the wearer in vertical position in confined places. This safety belt shall consist of one waist belt and two long hoisting straps and one D-ring. In this case, the hoisting straps are so arranged that the D-ring has a free movement and in the event of the user being hauled out, he keeps his position vertical and his head does not obstruct the straps. The length of the life line and the safety line is not restricted in this type of belt, but only a limited allowance is made for the fall so that the user is arrested within a distance of 2m.

Pole Safety Belt - Type-4:
This belt is suitable for use by electricians and servicemen engaged in the erection, installation and maintenance of electrical feeder line poles. This type of belt shall consist of a waist belt and a pole strap with special type of freely moving S-buckle. The stress and the weight of the user would help to hold the pole strap more securely.
The length of the strap shall be 85cm to 125cm.

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8.9 MATERIALS

Webbing: All belts and harnesses shall be made from nylon or other synthetic material such as polyester. The material shall have a uniform thickness & uniform width. The waist belt, shoulder straps, hoisting straps & pole straps of all types of safety belts & harnesses shall be made from nylon/polyester webbing which shall not break under a minimum tensile load of 2000 kgs. Minimum width & thick-ness should be 44mm and 3mm respectively.

Best quality nylon/polyester threads made from fibre of thickness equal to the thickness of yarn and of adequate strength shall be used in the webbing. The webbing shall be resistant to heat and fire.

All rivets and washers used for joining the various sections shall be made from copper and should be tinned (plated) for protection against corrosion.

Life line/Safety line only of nylon or polyester or other synthetic fibre shall be used. It shall not break under a minimum tensile load of 2000 kgs.

All metal components shall be solid or forged in such a manner that the joints are not visible and the joined part of metal does not impair the strength or quality.

8.10 SPECIAL REQUIREMENTS

Hooks and main load bearing metal parts and fittings shall not break under the test load of 2000 kgs.

Aluminium, magnesium or titanium metals or alloys thereof shall not be used.

All materials used in the production of safety belts including webbing and rope, shall pass the heat resistance and flammability test as given in IS: 2925.

Only friction type buckles shall be used and the design should be of “No-slip” type.

8.11 PACKING

The safety belts and straps shall be suitably packed as agreed to between the purchaser and the supplier.

8.12 INSTRUCTIONS AND MARKING

- Name or trade-mark or other means of identification of the manufacturer
- Year of manufacture
- Words in red letters “MAXIMUM SAFE DROP__________”

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- Type of belt
- Lot/Batch number

Instructions shall be supplied with each safety belt and harness.
Safety belts may also be marked with the ISI certification mark or approval from certifying authority like DGFASLI/DGMS.

8.13 MAINTENANCE AND CARE OF BELTS & HARNESSSES

Aprons, belts and harnesses should be stored in a cool & dry place and shall not be subjected to direct sunlight.

It is recommended to have such storage in properly designed cabinets with enough ventilation & prevention from excessive heat/humidity/contact with sharp edges & corrosion.

Life belts must be inspected carefully before each use. Fabric belts should not be used if the outer plies are cut or worn through or if there is any sign of chemical damage. All belt hardware must be inspected and replaced if it shows any sign of wear. If the belt is riveted, each rivet should be examined separately. The life line must be carefully inspected for any sign of damage or wear.

If in doubt, replace the rope. Be sure that the lifeline is securely attached to the D-Ring of the belt. Be sure that the tie-off point is of adequate strength.

Limitations and Cautions:

If the safety belt is exposed to or comes in contact with a chemical during use, this would weaken the belt and pose a hazard to the next user. Report such cases while returning the belt so that proper examination can be made and they can be discarded, if required.

- Safety belt and harness must be worn when an altitude hazard exists above two meters.
- Safety belts and harness must be worn when working from swinging scaffolds, boat-wains chairs and spider stagings. Life line must be supported independently of the equipment and care must be exercised to protect the lines from rubbing on rough surfaces and also from burner flames or welding arcs.
- Safety belts and harness must be worn when entering a vessel from the top and if this is the only route to enter.

9.0 FOOT AND LEG PROTECTION

In an industrial scenario, the legs are prone to either direct hazard which has the potential to cause direct injury like mechanical hazards (e.g. falling objects), chemical hazards (e.g. contact with acid/alkali), heat hazard (e.g. exposure to hot surfaces) and fungal infection or indirect hazard like slipping (wet/ slippery surface), electrical hazard (electrocution) and sanitation hazards (infection from insanitary conditions). These hazards can be eliminated or atleast minimised by the use of suitable protective equipment.

9.1 CLASSIFICATION OF HAZARDS RELAT-ED TO LEG & FOOT PROTECTION

Hazards against which Protective Equip-ment need to be used for leg and foot protection, are given in Table 9.1.
Table 9.1

<table>
<thead>
<tr>
<th>Hazard Code No.</th>
<th>Protection Against hazard</th>
<th>Typical Industrial Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>Impact</td>
<td>Striking against stationary object/falling object</td>
</tr>
<tr>
<td>H-2</td>
<td>Thermal</td>
<td>Stepping on hot objects</td>
</tr>
<tr>
<td>H-3</td>
<td>Thermal</td>
<td>Welding sparks or heat radiations</td>
</tr>
<tr>
<td>H-4</td>
<td>Chemical burns</td>
<td>Chemical spillage</td>
</tr>
<tr>
<td>H-5</td>
<td>Slippery surface</td>
<td>Skidding</td>
</tr>
<tr>
<td>H-6</td>
<td>Electrical Flash</td>
<td>Electrical sub-station/non-static area</td>
</tr>
</tbody>
</table>

9.2 TYPES OF PROTECTIVE EQUIPMENT

Safety shoes and boots may be made from leather, rubber, synthetic rubber or plastic and may be made by sewing, vulcanising or moulding. Since the toes are most vulnerable to impact injuries, a steel toe-cap is the essential feature. For comfort, the toe-cap must be reasonably thin & light and carbon tool steel is, therefore, used. These safety toe-caps may be incorporated in many types of boots and shoes. In some trades, where falling objects present a particular risk, metal instep guards may be fitted over safety shoes.

9.3 SELECTION OF EQUIPMENT

Different types of hazards call for different types of foot wear. The following criteria may be kept in mind before selecting the type of foot wear for a particular job. The types of foot wear suitable against a particular type of hazard are summarised in Table 9.2.

Table - 9.2

<table>
<thead>
<tr>
<th>Brief description of Equipment</th>
<th>Recommended for use against hazard</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leather upper with rubber/synthetic sole &amp; steel cap</td>
<td>H-2, H-5</td>
<td>These are safety shoes generally used.</td>
</tr>
<tr>
<td>Leather upper without nails, with rubber/synthetic sole</td>
<td>H-6</td>
<td>Used in non-static area/substation.</td>
</tr>
</tbody>
</table>

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9.3.1 Rubber or synthetic outsoles with various tread patterns are used to prevent risk of slipping. This is especially important where floors are likely to be wet or slippery. The material of the sole is of more importance than the tread pattern and should have a high coefficient of friction.

9.3.2 Reinforced & puncture-proof sole is necessary in such places as construction sites. Metallic insoles can also be inserted into other types of footwear.

9.3.3 Where an electrical hazard exists, shoes should be entirely stitched or cemented to obviate the use of nails. Where static electricity may be present, safety shoes should have electrically conductive rubber outsoles.

9.3.4 Synthetic rubber boots are useful protectors from chemical injuries. The material should show not more than 10% reduction in tensile strength or elongation after immersion in a 20% solution of hydrochloric acid for 48 hrs. at room temperature.

9.3.5 Rubber, asbestos spats, gaiters or leggings may be used to protect the leg above the shoe line, especially from burning risks. Protective pads may be necessary, especially where work involves kneeling, for example in foundry moulding.

9.3.6 Aluminised heat-protective shoes, boots or leggings will be necessary near sources of intense heat.

9.4 USE AND MAINTENANCE

9.4.1 All safety footwear should be kept clean and dry when not in use and should be replaced as soon as necessary.

In places where the same rubber boots are used by several people, there should be regular arrangements for disinfection between usage to prevent spread of foot infections. There is a risk of foot mycosis resulting from the unnecessary use of foot tight and heavy types of boots or shoes.

9.4.2 The success of any protective footwear depends upon its acceptability and this is now widely recognised in far greater attention to styling. Confort is a prerequisite and the shoes should be as light as possible. Shoes weighing more than 1 kg should be avoided.

10.0 PERSONAL PROTECTION FOR SPECIFIC HAZARDS

10.1 PERSONAL PROTECTIVE EQUIPMENT FOR ELECTRICAL HAZARDS

The activity of “Electrical Isolation” or “De-energisation” & subsequent earthing of electrical equipment is of utmost importance for safety during electrical operation/maintenance. Though, adherence to the “Permit to Work System” does not need any further emphasis and must be strictly followed which ensures safe “Electrical Isolation” or “De-energisation”, the following tools/equipments must be used during electrical operation/maintenance viz:

- Electrical discharging/ Earthing Rod
- Non-contact type Indicating Rod
- Earthing Switches/Breakers
- Hand Gloves
- Insulating mats conforming to IS:15652:2006 having ISI mark
- Face Shield

Though the first three items strictly do not fall under the category of PPE, these are essential for safety of electrical operation/maintenance personnel & their usage must be ensured.

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10.1.1 Hand Gloves

These hand gloves are rubber insulating gloves used for protection of electrical workers from electric shocks while working on energised conductors & equipments.

Types of Hand Gloves:
As per relevant Indian Standard, four types of gloves are available, suitable for 650, 1100, 3300 and 4000 volts.

Material of Construction and Manufacture:
Gloves shall be made from natural or synthetic rubber either by dipping process or from calendered sheets. Gloves shall have a smooth surface and shall be free on both inner and outer surfaces from visual defects like patches, blisters, porosity or embedded foreign matter.

Thickness:
Thickness for various types of rubber gloves are prescribed in Table 10.1 and a typical rubber glove is shown in Fig.10.1

<table>
<thead>
<tr>
<th>Gloves</th>
<th>Minimum Thickness in millimeters at</th>
<th>Maximum Thickness in millimeters at</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crotch Area</td>
<td>Other Area</td>
</tr>
<tr>
<td>Type 1</td>
<td>0.60</td>
<td>0.65</td>
</tr>
<tr>
<td>Type 2</td>
<td>0.75</td>
<td>0.90</td>
</tr>
<tr>
<td>Type 3</td>
<td>1.00</td>
<td>1.15</td>
</tr>
<tr>
<td>Type 4</td>
<td>1.25</td>
<td>1.55</td>
</tr>
</tbody>
</table>

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**Fig.10.1 : Rubber Hand Glove**

**Electrical Properties:**
Test potential, leakage current and break-down voltage for various types of rubber gloves are summarised in Table 10.2.

<table>
<thead>
<tr>
<th>Gloves</th>
<th>Minimum Working Potential (rms)</th>
<th>Test Potential (rms)</th>
<th>Maximum Leakage Current (rms) at Test Potential</th>
<th>Minimum Break-down Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>650</td>
<td>5000</td>
<td>4</td>
<td>17000</td>
</tr>
<tr>
<td>Type 2</td>
<td>1100</td>
<td>10000</td>
<td>8</td>
<td>20000</td>
</tr>
<tr>
<td>Type 3</td>
<td>3300</td>
<td>15000</td>
<td>12</td>
<td>25000</td>
</tr>
<tr>
<td>Type 4</td>
<td>4000</td>
<td>20000</td>
<td>14</td>
<td>30000</td>
</tr>
</tbody>
</table>

**Marking:**
The gloves shall be marked with legible and permanent impression at the back with the following information:
- Size & type of gloves
- Maximum working potential
- Manufacturer's name and trade mark
- Month & year of manufacture
- ISI Certification Mark

**Packing:**
The gloves shall be packed in polyethylene bags.

**Storage:**
It is recommended that rubber gloves should be stored in cool and dry place. They should not be unnecessarily exposed to heat or light or allowed to come in contact with solvents, grease, turpentine or acids.

**10.1.2 Insulating Mats**
Insulating mats conforming to IS:15652:2006 having ISI mark, are to be used for covering floor around electrical apparatus in sub station.

**A) Material of Construction & Manufacture**
The materials shall be made from the material – Elastomer, free from any insertions leading to deterioration of insulating properties. Upper surface shall have small aberrations (rough surfaces without edges) to avoid slippery effects while the lower surface shall be smooth or be finished slip resistant without affecting adversely the dielectric property of the mat.

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i) **Thickness:**

The thickness of plane or patterned insulating mats shall as under:-

a) Class-A (3.3. KV): not less than 2.0 mm.
b) Class-B (11 KV): not less than 2.5 mm.
c) Class-C (33 KV): not less than 3.0 mm.

ii) **Colour:**

Any colour approved by the indenter in the specifications. However, no colour with metallic derivatives shall be used.

B) **Physical Properties**

i) **Tensile Strength (TS) & Elongation at break:**

The insulating mat shall have TS and Elongation as under:

a) TS: Min 15 N/mm²  
b) Elongation (%): 250

C) **Electrical Properties**

i) **Voltage Test:** The insulating mats shall withstand depending upon the class of the mats (Class A to C) minimum voltage of 10000 volts to 30000 volts for 1 minute as per procedure given in IS:15652. The mats shall not puncture or become appreciably warm at any spot.

ii) **Leakage Current:** The leakage current shall not exceed 10mA for all classes of insulating mats as per procedure described in IS:15652.

iii) **Breakdown Strength:** The insulating mats (Class A to C) shall not fail at less than 30 KV, 45 KV and 65 KV for 3.3 KV, 11 KV and 33 KV class insulating mats respectively when tested in air between electrodes.

iv) **Insulation Resistance in Wet Condition:** Minimum insulation resistance for all classes of insulating mats in wet condition will be 1000,000 Mohms with 500 V Meggar as per procedure prescribed in IS:15652.

D) **Chemical Properties**

i) **Effect of Acid / Alkali & Oil Resistance:** The insulating mats shall not show any deterioration and chemical damage by acids, alkalis and oils and the tensile strength and elongation shall not be less than 80% of the corresponding values obtained in tests at the manufacturers works on fresh samples.
ii) **Flame Retardance:** Fire should extinguish itself within 5 seconds after removal of blue flame when tested as per procedure prescribed in IS:15652.

iii) **Ageing Properties:** TS & percentage elongation at break when measured after subjecting the insulating mat to ageing of 168 hours at 70±1 deg C shall not be less than 75% of the corresponding values obtained for unaged test pieces of the same lot.

E) **Miscellaneous:**

i) **Packing:** The insulating mats shall be packed in roll or flats using Gunny / Jute material for transportation over long distances.

ii) **Storage:** For storage and other details, Annexure A (Clause 1.3.1) of IS:15652:2006 shall be referred.

10.1.3 **Face Shield**

The face shield recommended for use here is similar to the face shield used by welders i.e. the welder’s helmet held face shield and this has been covered under the section on “Eyes and Face protection”. However, the glass/filter lenses should be transparent and colourless and should not hamper the working of the electrician.

10.2 **PERSONAL PROTECTIVE EQUIPMENT FOR RADIOGRAPHY**

Radiography is a non-destructive testing used during the fabrication of equipments and is monitored by the concerned department. This quality control non-destructive testing technique is used for the weldments and castings to assess the internal defects. IR 192 (Iridium Isotope) is used during the process which emits radioactive rays. Though use of no separate PPE is envisaged during Radiography operation, in order to ensure that harmful effects of these rays do not reach to the personnel working in the vicinity, the following precautions must be taken:

1. Always keep radio-isotopes inside safe containers which should be stored under locked storage facility as approved by Atomic Energy Regulatory Board, India.
2. Radiographers must wear film badges or dosimeters for monitoring radiation exposure levels.
3. Cordon off the area upto 15 metres during field radiography and display radiation symbols prominently.
4. Radiography must be carried out at a time when occupancy is minimum.
5. All radiation workers shall be subjected to medical examination as prescribed by Atomic Energy Regulatory Board, India, at least once a year.

10.3 **PERSONAL PROTECTIVE EQUIPMENT FOR X-RAYS**

Exposure to X-rays is responsible for X-ray dermatitis and X-ray cancer.

For protection against ionising radiations of X-rays, use of lead aprons is recommended.

10.4 **PERSONAL PROTECTIVE EQUIPMENT FOR HANDLING TETRA ETHYL LEAD**

Tetra Ethyl Lead (T.E.L.) is added in gas-o-line to increase its octane number. Tetraethyl lead & the compounds of lead are poison-ous. They are dangerous either in the liquid or vapour form. Serious health hazards can result from skin contact with the liquid, inhalation of its vapours and from ingestion. TEL is a colourless liquid. It is an organic compound of lead, soluble in oil (gasoline, kerosene etc.) but not soluble in water.

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10.4.1 Personnel

Only male employees should be engaged in work involving handling of TEL.

TEL Operators should be:
- intelligent and reliable
- physically fit
- medically examined at regular intervals.

There should be as few operators as possible. The precise number will depend upon the type and size of the plant, the method and volume of the compound deliveries and the extent of work involved.

A medical consultant is to be engaged to supervise the health of personnel engaged in the handling of TEL in blending plants. The consultant will also examine personnel engaged in the handling of TEL & mainten-ance staff in laboratories. Details of the recommended standards of fitness and examination procedures can be obtained from the manufacturer/supplier of TEL.

10.4.2 Toxic Hazards

(i) Toxicity

Lead alkyles are highly toxic. They may enter the body by:
- Inhalation of the vapour
- Ingestion of the liquid
- Penetration of the liquid through the skin.

(ii) Exposure

Exposure to toxic vapour can occur:
- when drums are opened.
- when TEL escapes due to leaks & spills.

(iii) Threshold Limit Values

The toxicity of gases and vapours is usually expressed in terms of the Threshold Limit Value (T.L.V.). This is the maximum permissible time-weighted average con-centration in air over an eight-hours working day.

The TLV for TEL is 100 mg Pb/cu.m. which is equivalent to approximately 0.01 ppm (v/v) organic lead vapour in air.

10.4.3 Respiratory Equipment

The respiratory equipment recommended to provide protection against toxic atmosphere will depend on the conditions under which it is used (refer Table 10.3).

For details of respiratory protective equip-ment, refer OISD-STD-155, Part-II of the Standard.

The respiratory equipment that is suitable for use with TEL consists of a facepiece covering the face from chin to forehead and held in place by straps passing over the head. As these facepieces are normally manufactured to a standard size, it is impossible to get a close fit to the face of every individual. When the wearer inhales, there is a reduction of pressure inside the facepiece and if it does not fit properly, leakage may cause toxic vapours to be inhaled. Air-supplied respiratory equipment overcomes this problem by maintaining a positive pressure inside the facepiece.

Air-supplied respiratory equipment should not be supplied with air from hand-blowers, as they do not provide an adequate margin of excess air flow.

Respiratory equipment is tiring to wear for long periods, so the working day should be restricted to eight hours to prevent undue fatigue.

Table - 10.3

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## Recommendations for the use of Respiratory Equipment in atmospheres containing TEL

<table>
<thead>
<tr>
<th>Situation/Operation</th>
<th>Canister Respirator</th>
<th>Air-supplied Respirator</th>
<th>Self-contained breathing apparatus</th>
<th>Air-supplied suit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency use in case of TEL spill</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Emergency use in case of TEL Spill (open situation)</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Emergency use in case of fire involving TEL</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Drum emptying TEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEL transfers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blending plant operations with good ventilation</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blending plant operations with poor ventilation</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work inside leaded gaso line tanks</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Work outside leaded gaso line tanks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### (I) Canister Respirator

Canister respirators are recommended for normal operations in blending plants and for work in open areas. They are also suitable for use in emergency situations involving spills of TEL in the open. They should never be used, even for inspection purposes, inside confined spaces where an oxygen deficiency or a high concentration of toxic vapours is likely to be present.

It is recommended to use CC type canister respirator as listed in British Standard 2091 (1969), Table 1 (List of Substances & Re-commended Canisters). Special absorbent is not required for lead alkydes and the CC type canister affords protection against a wide variety of hydrocarbon vapours. The equipment is light weight. The canister weighs only 0.5 kg and the wearer has complete freedom of movement.

The efficiency of this type of respiratory protection depends upon the contact between face & facepiece and will be adversely affected by beards (even one day’s growth), side whiskers and normal spectacles. In a study of facepiece leakage, using new canister respirators carefully fitted to clean shaven people without spectacles, leakage of at least 1% of the air inhaled occurred in 15% of the tests.

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A long tube fitted to the respirator enables the canister to be worn on the back. This is more comfortable & keeps the canister away from the immediate source of the hazard.

The time spent in the toxic atmospheres should be as short as practicable.

It is recommended that the canister with 500 cc of activated carbon should be replaced after 100 hours of use or 24 months after removal of the seal, whichever is shorter. Canisters containing less than 500 cc absorbent will have a shorter life. The CC type canister has a maximum sealed shelf life of five years and for other types of canisters, the manufacturer’s instructions should be followed. A record of canister’s use shall be kept and the canister discarded when its useful life has expired.

Gasoline vapours, atmospheric moisture and other vapours absorbed by the canister can reduce it’s life. Canister respirators should not be used where high concentration of TEL in air exists.

(ii) **Air-supplied Respirator**

Air-supplied respirators should be used when the lead-in-air concentration is expected to be high. The air flow should be sufficient to maintain a slight pressure within the facepiece during the entire respiratory cycle. A minimum of 7.2 cu.m./ hr of air is required for each respirator. In order to keep the face cool when a man is working hard or in hot weather, a higher flow of air is found to be advantageous.

To ensure the supply of clean and dry air to the wearer, a suitable filter should be fitted in the air supply line, downstream of the compressor to remove entrained oil, moisture & dust. This should be supplemented by a small filter on the man’s belt to remove any dust etc. which may have been picked up from the hose. The air compressor should be outside & upwind of the area of contamination.

The main disadvantage of an air-supplied respirator is that the air hose limits mobility of the wearer.

(iii) **Self-contained Breathing Apparatus**

In case of fire involving TEL, self-contained breathing apparatus with positive pressure is most suitable as it gives complete mobility to the wearer. The apparatus is also suitable for emergency use in case of TEL spills. Only equipment which permits air from the cylinder to be fed continuously to the facepiece should be used, thus maintaining a positive pressure. Equipment fitted with a demand valve is not recommended.

The life of the cylinder charge depends on the amount of work performed by the wearer. Breathing rates will vary according to the rate of work and will generally be between 32-40 lpm, using standard 1200 litres air cylinder. A full cylinder will not last more than 20 mins. for light work and 10 minutes for hard work.

(iv) **Air-supplied Suit**

In the cleaning of leaded gasoline tanks and lead compound tanks, it is recommended that air-supplied suit be used as it has been specially designed and tested to meet the severe conditions encountered.

The air-supplied suit with integral helmet, is fed from the compressor through a 13 mm bore hose. A regulating valve is fitted to the suit to allow the wearer to adjust the airflow. In case of an accident, such as a breakdown of the compressor, an emergency bottle supplies oxygen through a needle valve for approximately four minutes, allowing enough time for the operator to leave the tank. In tropical climates or during hot weather in temperate climates, a vortex tube provides cooled air to the suit.

10.4.4 **Air Hoses**

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
The use of incorrect hoses had caused accidents, so great care should be taken to obtain the correct hose and to test, maintain and when necessary, replace it.

(i) Types of Hoses
Hoses detailed in Table 10.4 satisfy the requirements necessary for breathing equipment. Hose lengths should be as long as practicable.
Any hose other than those described in Table 10.4 is liable to be at best unsuitable and at worse unsafe. For example, natural rubber is likely to be affected by hydrocarbons and be permeable to organic lead compounds. All fabric covered hoses are unsuitable. PVC hoses without reinforcement, though resistant to lead alkyles etc., will not stand the pressures and may kink.
When in difficulty or doubt, consult manufacturer/ supplier of TEL.

(ii) Routine Physical Examination of Hoses
Hoses should be checked before and after each use for physical deterioration e.g. cracks, separation of wall layers & excessive abrasion. If the outer layer has worn at any point to expose the reinforcement, the hose should be discarded immediately.

(iii) Testing Hoses for Lead
Hoses should be tested after every 100 hours of use. If the lead content of the air is below the TLV (100 mg Pb/cu.m.), the hose is still safe to use. If it is near this figure, the tests should be done more often.

(iv) Marking Hoses
Each length of hose should be marked with a reference number on a copper sleeve so that a record of its use & testing can be kept.

(v) Care and Maintenance of Hoses
Hoses should be cleaned by wiping over with the kerosene-soaked rag and then washed with water, containing detergent. Equipment should be protected against exposure to heat.

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### Table 10.4
Air Hoses for use with Air-supplied Equipment

<table>
<thead>
<tr>
<th>Type of hose</th>
<th>Air-supplied Suit</th>
<th>Air-supplied hood, helmet respirator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cold</td>
<td>Medium</td>
</tr>
<tr>
<td>PVC reinforced Terylene / Nylon Nominal dia (mm) Int. 6; Ext. 13; (1), (2)</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>PVC reinforced with steel spring wire embedded in wall, Nominal dia (mm) Int. 6; Ext. 13; (1)</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>PVC reinforced with steel spring wire embedded in wall Nominal dia (mm) Int. 13; Ext. 22; (1), (3)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PVC outer wall and Polyurethane (3.2 mm min.) inner wall, Terylene reinforced between inner and outer walls, Nominal dia (mm) Int. 13; Ext. 22; (1), (4)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**NOTES:**

Star (*) denotes recommended air hose.

1. Maximum safe working pressure for each hose is 7 bar.
2. Reinforcement may be embedded in the wall or between the inner wall (2mm min.) and the outer wall (1 mm min.).
3. Only type acceptable with this larger bore, other types are susceptible to kinking / flattening.
4. PVC “creep” at high temperatures can cause couplings to be “blown-off” due to high pressures. Polyurethane does not suffer “creep” to the same degree.

### 10.4.5 Clothing for Blending Plant Operations

In addition to respiratory equipment, personal (work) and protective clothing is required for all engaged in handling of TEL. The requirement for blending plant personnel will depend upon the duties to be performed. These are described in Table 10.5 but in all cases:

* Protective clothing and respiratory equipment should be readily available in case of an emergency.
* All clothing should preferably be white so that the dye from any contamination by TEL can be clearly seen.

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After use, protective clothing should be cleaned with kerosene-soaked rags, then with detergent solution in water. The used rags should be placed in a suitable container with a lid until they can be burnt / buried.

Table 10.5

**TEL BLENDING PLANT OPERATIONS**  
**CLOTHING AND PROTECTION REQUIRED**

**(A) PERSONAL (WORK) CLOTHING**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Socks</th>
<th>Vest</th>
<th>Underwear</th>
<th>Shirt</th>
<th>Trousers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emptying compound drums into a storage tank or directly into gasoline stream</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Connecting/disconnecting road tank vehicles rail tank wagons or portable tanks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervising the receipt of compound from bulk ocean tankers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating a totally enclosed blending system</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Maintenance duties which may involve contact with compound, liquid or vapour</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Emergencies involving compound</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

**Note:**
Star (*) denotes requirement for a specific task.

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## (B) PROTECTIVE CLOTHING

<table>
<thead>
<tr>
<th>Operation</th>
<th>Industrial Footwear</th>
<th>Overall</th>
<th>Apron</th>
<th>Boot</th>
<th>Glove</th>
<th>Sleeve</th>
<th>Head Covering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emptying compound drums into a storage tank or directly into gasoline stream</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Connecting/disconnecting road tank vehicles rail tank wagons or portable tanks</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervising the receipt of compound from bulk ocean tankers</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating a totally enclosed blending system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance duties which may involve contact with compound, liquid or vapour</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
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<td></td>
</tr>
<tr>
<td>Emergencies involving compound</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Star (*) denotes requirement for a specific task.
2. The inside of gloves and boots should be clean and dry.
3. If an emergency occurs involving spillage of compound on the operator’s clothing, the operator should shower thoroughly using soap and report for a medical check-up. The clothing should be burnt.

### 10.4.6 Emptying TEL Drums into a Storage Tank or Directly Into Gasoline Stream

This operation exposes the operator to TEL at frequent intervals, usually over a prolonged period. The operator should be provided with a complete change of personal (work) clothing, reserved specifically for use in the TEL area and consisting of:

- Socks
- Vest
- Underpants
- Shirt
- Trousers

Fresh clean clothes should be issued at least every five days (daily in hot climates) or when, obviously, dirty.

The operator should wear a canister respirator with a long tube and the following protective clothing:

Cotton overall

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Neoprene or PVC apron
Rubber, neoprene or PVC boots
PVC gloves
Neoprene or PVC sleeves
Head covering
Before leaving the TEL area, the operator should change out his personal (work) and protective clothing and shower thoroughly using soap.

10.4.7 Operating Totally Enclosed Blending System
Under these conditions, the exposure of the operator to TEL is negligible and normal refinery operating clothing is adequate but PVC gloves should be worn when handling any equipment.
Before leaving the TEL area, the operator should remove his gloves and wash off his hands thoroughly with soap and water.

10.4.8 Maintenance
Any maintenance personnel assigned to work involving potential or anticipated contact with TEL, liquid or vapour, should be supplied with a complete change of personal (work) and protective clothing and respiratory equipment as specified in Table 10.3 & Table 10.5 for drum emptying operation. An air-supplied respirator should be used if the work is in a confined space where the lead in air concentration is expected to be high.
Before leaving the TEL area, the operator should change out his personal (work) and protective clothing and shower thoroughly using soap.

10.4.9 Tank Cleaning
For leaded gasoline tank cleaning, refer manufacturer’s instructions.
REFERENCES:

2. Guide for Selection of Industrial Safety Equipment for protection of Arms and Hands IS:8807 - 1978
4. Specification for Protective Boots for Oil Field Workmen IS:9885 (Parts-I & II)
5. Specification for Leather Leg Guard IS:3946 - 1960
6. Selection of Industrial Safety Equipment for Protection of Foot & Leg IS:10667- 1989
7. Specification for Industrial Safety Equipments IS:2925 - 1984
9. Encyclopaedia of Occupational Health and Safety, ILO - - -
10. Specification for Rubber Gloves for Electrical Purposes IS:4770
12. Safety Manual of Indian Oil Corporation Ltd. (R&P Division) - - -
13. The Factories Act, 1948 (amended in 1987) - - -
15. Specification for Aprons, rubberised and alkali resistant IS:4501 - 1985
19. Octel Instructional Publication No.3 "Safety & Emergency" of lead alkyl Antiknock Compound - - -
20. Fire Entry Suit IS:7612 - 1974

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28. Maintaining Hygiene in TEL Operation - Du Pont, USA
29. Fire and Safety Manual of
   a) Hindustan Petroleum Corp. Ltd.
   b) Bharat Petroleum Corp. Ltd.
   c) Humble Oil and Refining Co.
30. Manual of American Conference of Governmental Industrial Hygienists
31. Factory Act/Maharashtra Factory Rules, 1963

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### Protective Clothing Compatibility with Selected Chemical Hazards

<table>
<thead>
<tr>
<th>Chemical Hazard</th>
<th>Natural Rubber</th>
<th>Neoprene</th>
<th>Polyvinyl Alcohol</th>
<th>Polyvinyl Chloride</th>
<th>Nitrile Rubber</th>
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<tbody>
<tr>
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<td>G</td>
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<td>P</td>
<td>F</td>
<td>F</td>
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<tr>
<th>Chemical Hazard</th>
<th>Natural Rubber</th>
<th>Neoprene</th>
<th>Polyvinyl Alcohol</th>
<th>Polyvinyl Chloride</th>
<th>Nitrile Rubber</th>
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<th>Chemical Hazard</th>
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<th>Nitrile Rubber</th>
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Symbols:

P — Poor;  F — Fair;  G — Good;  E — Excellent

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## Protective Clothing and Durability Characteristics

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<th>Polyvinyl Alcohol</th>
<th>Polyvinyl Chloride</th>
<th>Nitrile Rubber</th>
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<tr>
<td>Tear Resistance</td>
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<td>F</td>
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</table>

Symbols:

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- F — Fair;
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