White Paper

on

Formulation of Regulations in respect of Safety Industrial Work-Wear (Heat & Flame)

Draft Report prepared by:

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Submitted to:

Ministry of Textiles
Govt. of India
PREFACE

Centre of Excellence (Protech) NITRA having shown its concern and interest to the Ministry of Textile Government of India in the matter of the use of safety work wear for the workers in Indian Industries especially for those workers who are engaged by their employers in heat emitting work stations and fire prone zones. The Ministry of Textile Government of India desired CoE (Protech) NITRA to critically examine the same, prepare a white paper in this regard and place it to the Ministry for taking effective measure in this regard. Responding to this CoE (Protech) NITRA took keen and active interest in the matter and prepared the desired white paper examining the issues in detail from legal and technical point of view.

CoE (Protech) NITRA involved me also in this work particularly to render my service on the legal aspect of the matter. The CoE (Protech) NITRA has in fact made sincere efforts with a great devotion and prepared the paper.

I have perused the analysis in detail. Detailed analysis has been made after studying and considering the directives formulated by European Union, United Kingdom, United States of America, South Africa, Japan, China, Canada, Australia and Brazil. While critical analysis was made in relation to Indian industries, special efforts have been made to provide proposed craft amendments in Indian legislations.

Special care and attempts have been made to formulate legislative amendments by including relevant technical standards, both Indian and ISO/EN (wherever IS standards are not available) which will have direct impact on the technical analysis of such safety work wear. This paper has to be studied as a whole and not in a piecemeal.

I am sure that the concerned ministries of Union of India would consider the urgent need to revamp the entire system thereby protecting the rights and privileges of industrial workers as envisaged under the Directive Principles of State Policy.

11th May 2011

(U.N.BHACHAWAT)
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Boiler Act, 1923

Building and other construction Workers (Regulation of Employment and Conditions of Services) Act, 1996

Contract Labour (Regulation and Abolition) Act 1970

Dangerous Machine (Regulation) Act, 1983

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Industrial Employment (Standing Order) Act, 1946


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It is estimated that unsafe work conditions is one of the leading causes of death and disability among India’s working population. These deaths are needless and preventable. ILO estimates that around 403,000 people in India die every year due to work-related problems. In India, Industrial workers do not enjoy privileges and rights that are available to industrial worker of developed countries. For example, the employers of European foundries provide to their employees all kinds of safety equipment like fire retardant clothing, safety goggles, safety gloves, specially designed boots and other safety equipment. Apart from these Personal Protective Equipment (PPE), gas masks, oxygen cylinders, first aid equipment and other gadgets for human condition are available at all times in perfectly working condition. It has become a culture in the developed countries. However, in India the scene is entirely different. For example, the Indian foundry workers work in dangerous conditions with no safety work wear; often bare body or with just under garments. Industries do not provide safety work wear to the employees because of two reasons. The first reason is ignorance of employees about safety norms. Secondly, there is no legislation in India which talks about compulsory use of safety work wear for hazardous industries. Since there is no legislation
employers take the same for granted and do not provide a safe work
environment. Labour Inspectors inspecting factories do know that there
is no safety for such workers, yet they do not take any action because
of the laws have been drafted precisely with no place for safety work
wear.

Therefore it is essential to review the entire set of 69 Industrial Laws to
provide for legislative amendment. As a first step, legislations which are
required to be amended through Parliament are as under:

1. Boilers Act, 1923;
2. Building and other construction workers (Regulation of Employment
   and Conditions of Service) Act, 1996;
4. Dangerous Machines (Regulation) Act, 1983;
5. Dock Workers (Safety, Health & Welfare) Act, 1986;
6. Employees Liability Act, 1938;
8. Chemical Accidents (Emergency Planning, Preparedness &
   Response) Rules, 1996;
10. Manufacture, Storage & Impose of Hazardous Chemicals Rules,
    1989;
11. Factories Act, 1948;
12. Fatal Accidents Act, 1855;
13. Industrial Employment (Standing Orders) Act, 1946;
15. Mines and Minerals (Development & Regulation) Act, 1957;
16. Plantation Labour Act, 1951;

The above legislations provide for safety of workers through only certain
types of PPE like wearing helmets, providing fence along with moving
wheels and shafts and similar gadgets. However, they do not provide for
mandatory provision for providing safety work wear to workers by
employers and their compulsory use. Since there is no mandatory
provision, employers do not get much interest in purchasing and providing
them to the workers. The cascading effect is that the manufacturers are not interested to manufacture safety work wear for which there is no market demand.

The implementation of legislations will be possible only when the standards of are made available. The standards are one way to set a certain minimum level of requirements. In India, BIS standards are primitive in relation to PPE. Many of these standards are required to be revised keeping in view of the current needs and the technological developments. Further, fresh standards have to be formulated due to the induction of new technologies in all economic activities which resulted in new types of risks and hazards like biological, nuclear, chemical hazards.

With Ministry of Textiles, GoI initiative, in this report, the CoE, (Protech), NITRA has made suggestions showing the areas in which legislations and standards are required to be amended or introduced. It is believed that this initiation would enable to form guidelines for all policy makers and stakeholders to bring in appropriate measures to provide safety to industrial workers working in hazardous and high risk environment, especially flame and radiant heat.
Government of India firmly believes that without safe, clean environment and healthy working conditions, social and economic growth cannot be achieved and that safe and healthy working environment is recognized as a fundamental human right.

The changing job patterns and outsourcing of work are posing problems to management of occupational safety and health risks at workplaces. New safety hazards and health risks will be appearing along with the transfer and adoption of new technologies. In addition, many of the well known conventional hazards will continue to be present at the workplace till the risks arising from exposure to these hazards are brought under adequate control. While advancements in technology have minimized or eliminated some hazards at workplace, new risks are emerging in their place which needs to be addressed. Particular attention needs to be paid to the hazardous operations and of employees in risk prone conditions such as persons working in close vicinity of fire and high degree of radiant heat in industries such as Iron and Steel foundries, Nonferrous foundries, Boiler rooms, Ceramic, Glass, Rubber & Chemical plants, Brick-firing, Electrical utilities, Mining sites, Laundries and commercial kitchens.

The furnaces and molten metal create a hot working environment resulting in dehydration, heat cramps, heat exhaustion and heat stroke; may also develop eye cataracts from IR & UV radiation which emit when pouring white hot metal. The workers may come into contact with molten metal splashes and electromagnetic radiation. Splashes, sparks, radiant heat and radiation from molten metal can result in serious burns and eye damage. Therefore it is important that such workers are provided with properly designed and guarded Personal Protective Equipment (PPE).

A recent survey of 17 well organized large primary Aluminum and Steel foundries across India conducted by CoE (Protech), NITRA for safety practices followed by them to protect their workers against various
hazards revealed that some of them provide to their own workers fire retardant chemical coated cotton work wear in addition to other PPE; while for subcontract workers other PPE is provided by the contractors but not the protective work wear. It is worthwhile to mention here that the subcontract workers are the ones who work in very high risk areas but they are not provided with any sort of safety protective work wear and are exposed to severe risk of major accidents which may cause death. Many of the factories seem to be ignorant on the safety practices since there are no strong directives from government and insurance companies. The labour unions are also completely ignorant of the various options available for protection. It appears from the survey that many of them are not aware of the technological developments that have taken place in the production of work wear which protect from radiant heat and flame.

From the above survey, with high level of confidence, one could infer that the safety aspect of workers working in medium, small and tiny factories must have been dismally poor.

In view of prevailing unsafe working conditions in the industries, there is an immediate need to closely scrutinize the existing industrial acts and amend them to ensure that the Indian workers as in the case of developed countries like EU and USA are well protected against various types of hazards and high risk environments. Simultaneously BIS will have to revise some of the standards and develop new standards based on the technological developments. Once these sets of measures are undertaken by the competent authorities, they should be strictly enforced through an efficient and effective mechanism as Government of India firmly believes that safe and healthy working environment is the fundamental human right of every citizen of this country.

This report is prepared by CoE (Protech), NITRA at the instance of Ministry of Textiles, GoI to address the issues related to workers’ safety while working in hazardous and high risk environments. The report dealt with issues related to workers working in the close vicinity of fire and high degree of radiant heat.
The first section of the report deals with the harmful effects of occupational heat on human body and measures to control it. The types of hazards and safety & health measures to be observed by three major industries – Iron & Steel, Oil & Gas and Chemical are also given in this section.

An overview of directives and enforcement mechanisms pertaining to PPE in EU, UK, USA, Japan, Australia, Canada, China, South Africa and Brazil and the approach for standardization of PPE by ISO, EU and USA and the standards developed by these organizations are described in second and third sections respectively.

The present Indian scenario with regard to worker’s safety, GoI initiatives to create “green jobs”, the goals, objectives and action programs formulated by Ministry of Labour and Employment under National Policy on Safety of Workers are highlighted in Section four. The Section also brought out as a first step, a list of 16 legislations which are to be amended. Draft amendments in all the 16 legislations are also suggested. The standards (technical regulations) on protective work wear against heat, flame and electrical arc are also included in the Section. Wherever IS standards are not available it is suggested to adopt ISO/EN standards. Standards proposed to be incorporated in 16 legislations are as given below:

ISO 11611 : Building & other Construction Workers Act,1996; Dangerous Machines Act,1983
ISO 11612 : Boiler Act,1923,Contract Labour Act,1970
ISO 14116 : Dock Workers Act,1986
ISO 17491 : Plantation Labour Act,1951
The action plan to implement the suggestions made in the above section is given in Section 5. The action plan begins with vetting of the suggestions given in the report by all stakeholders – policy makers (central & state governments); industry (manufacturers, & end users); BIS, Legal experts, Trade Unions, Test Houses, Insurance companies, others such as R&D institutions and universities. Further to give wide publicity to the intentions of the Ministry of Textiles and seek public opinion it is suggested that the report may be uploaded in the ministry’s web site and circulate the report to all chambers of commerce and trade associations. BIS should give top priority to prepare the required standards and it should be impressed upon the Ministry of Consumer Affairs, Food and Public Distribution to bring the protective industrial work wear under ISI label. The four ministries – Ministry of Textiles, Ministry of Labour and Employment, Ministry of Law and Justice and Ministry of Consumer Affairs, Food and Public Distribution should join together to push the proposal to the Parliament Secretariat for necessary action for tabling before the august houses. The action plan also includes conducting a series of workshops, seminars and training programs by CoE (Protech), NITRA in association with Ministry of Textiles and all stakeholders. The programs will focus on the issues like sensitizing the user industry to adopt safe work practices, promote manufacture of state of art safety work wear and educate the stakeholders on standards, quality evaluation and latest developments.
Workers are routinely exposed to potentially harmful situations or hazards in industries – especially in manufacturing, petrochemicals and construction. These hazards may be physical such as fire, fluctuating temperature, flying sparks, electrical, moving objects or sharp edges. They may also be health related such as exposure to radiant heat, loud noise, harmful dusts, chemicals or viruses. These hazards are responsible for wide range of injuries and illness starting from a simple headache to severe burns and respiratory diseases. According to International Labour Organization (ILO), more than 2 mn people worldwide die of work related accidents and diseases each year. The death toll is higher in developing countries than in developed countries.

This section of the report deals with the potential hazards posed and means of controlling them by different types of industries such as foundries, chemicals and oil & gas. The main categories of protective work wear to minimize industrial risks and the effect of occupational heat on worker’s health are also reported in this section.

There are different types of industries like heavy and light engineering, heavy and light chemical industries, petrochemicals, pesticides, fertilizers, textiles, Electronic Industries etc. All of them pose their own potential hazards, which may cause acute and chronic side effects on the health and safety of the workers. Heat radiation is one another factor which is equally fatal for workers. The typical industries which emit significant heat radiation are Iron & Steel Foundries, Brick Firing & Ceramics, Construction, Glass Products, Rubber Products, Utilities, Bakeries, Canneries, Mining, Chemical Processing, Smelters, Steam Turners, Laundries and Fire Fighting. Among all these, foundries generally have a very hot working environment because of the furnaces and molten metal. The molds and core heating, the ladles preheating and the heat treatment of metal castings make additional sources of heat. Personnel employed in furnace or ladle slagging and those executing tasks in
close proximity to the molten metal, including furnace workers, welders, arc-air operators, oxy-cutters and crane operators, are most vulnerable to severe heat effects.

Some of the potential health effects for persons working under high heat stress environments include – discomfort, reduced concentration or attention, irritability, heat rash, prickly heat, dehydration, reduced tolerance to chemicals and noise, heat exhaustion, heat cramps, heat fainting and heat stroke etc.

**Heatstroke**

It is the most serious effect of heat. The condition is characterized by hot dry skin, mental confusion, loss of consciousness, convulsions and eventually coma. It is associated with failure of the normal body temperature regulating mechanisms resulting in the deep body temperature of about 41°C and above.

Heatstroke is usually fatal if not treated. The heatstroke victim must be cooled immediately by removing clothes, spraying with cold water and fanning vigorously to assist evaporation. This should be carried out in a cool area and must continue until medical attention is obtained. Body temperature should be reduced to 38°C before the patient is moved to hospital. The human body functions normally within 1°C to 1.5°C of the core body temperature of 37°C. The body sustains this temperature by balancing the heat generated within the body and the transfer of heat from body to the environment. Working in hot environments causes strength to decline, and may result in fatigue sooner than it would otherwise. It may also affect alertness and mental capacity.

When the body is unable to loose heat as required through the evaporative cooling procedure to maintain a steady core body temperature, it starts experiencing physiological heat strain with several illnesses depending on the degree of heat stress. Heat cramps, heat exhaustion and heat stroke are the most severe heat illnesses. Heat stroke is a life endangering condition, which may result in permanent damage to the heart, brain or kidneys. Effects of heat stroke are most likely to increase during the months of summer.
Heat Stress and Heat Strain (Heat Index)

The heat index (HI) is an index that combines air temperature and relative humidity in an attempt to determine the human-perceived equivalent temperature — how hot it feels, termed the felt air temperature. The human body normally cools itself by perspiration or sweating, which evaporates and carries heat away from the body. However, when the relative humidity is high, the evaporation rate is reduced, so heat is removed from the body at a lower rate causing it to retain more heat than it would in dry air. Measurements have been taken based on subjective descriptions of how hot subjects feel for a given temperature and humidity, allowing an index to be made which relates one temperature and humidity combination to another at a higher temperature in drier air. Calculating the heat index requires numerous mathematical steps, so it is more practical to refer to a heat index chart.

Almost everyone is aware that exposure to high levels of heat is, to some varying degree, detrimental to human health. Most of us know there are various levels of heat stress. Almost everyone understands that heat stress is lessened by taking rest periods to allow the body to cool down, and that workers must be properly nourished and hydrated. Some authorities suggest, via an extrapolated work-to-rest schedule, that no work should be performed at temperatures greater than about 92 degrees F (33.3 degrees C). People in the “real” world know that this is not practical. While environmental conditions may be hot, there is nonetheless work that must be done. While it is true the work-to-rest
cycle must provide more time for rest during hot (and other adverse) conditions, it is known that healthy human beings, when properly equipped, nourished, and hydrated, can safely perform work so long as the heat index is below 130 degrees F (54.4 degrees C). This is true only if they are adequately hydrated, nourished, acclimated to the heat, properly equipped and in robust health. Such workers can work for appreciably long periods when the heat index is close to 130 degrees F.

Often, the work accomplished in hot environments requires extraordinary physical effort. In some cases, there are psychological demands that accompany this work, and these mental demands add to the possibility that a heat-related injury might occur. So, what can the employer do to decrease the likelihood that a heat-related incident might occur in the workplace?

The most important thing an employer can do is to know the full range of temperature and humidity of the workplace. If the conditions are prone to significant variations, some device or method must be incorporated—and continually monitored—to ensure the worker is not exposed to excessive temperatures.

The second-most-important factor the employer must realize is that there are limitations to human endurance, and each individual has a unique endurance level. Furthermore, an individual’s endurance level can and does change.

Sunlight increases the heat index. Anyone who has ever touched the hood of a car that has been parked in the sun on a hot day knows this to be true. Just as a car or building will absorb heat, so do people. How much? It depends.

**Acclimatization**

Persons who regularly work in a hot working condition become acclimatized to a specific degree of heat. Acclimatization reduces heat discomfort, increases the effectiveness of sweating, reduces salt loss and returns recovery rate to normal. Persons differ in their ability to acclimatize to heat.
Acclimatization provides only a partial protection from extreme heat and workers may still suffer from adverse health effects. Once the exposure to heat has discontinued, the protection from acclimatization is progressively lost. If a worker who has been absent from a hot work environment for a long period, such as a week; he should be first re-acclimatized to the hot environment for protection against heat related effects.

Minimizing the risk of heat illness

It is important to identify those workers who are frequently exposed to high levels of heat as they are at the risk of suffering heat-induced illness.

- People who have any history of heat intolerance or a circulatory disorder, anyone recovering from a fever, and any dehydrated worker must be regarded as being in a high-risk category for heat-induced illness. All workers who are exposed to heat at work should be encouraged to be physically fit and to achieve their ideal body weight.

- Certain tranquillizers, motion sickness medications and alcohol may impair body temperature regulation mechanisms.

- It should be noted that physical fitness and acclimatization are not identical qualities. Even a very fit person who has not been previously exposed to hot conditions may display intolerance to working in the heat. Non-acclimatized persons must be given time to acclimatize to work in the heat. It is recommended that those who have not previously been exposed to work in hot conditions should begin with half of the anticipated workload and half of the normal exposure time on their first day. The exposure can then be gradually increased to the total workload/time combination on the sixth day. Previously acclimatized personnel who return to work in the heat after an absence of approximately nine or more consecutive days should undergo a four day re-acclimatization period, commencing with half of the regular workload and half of the normal exposure time as outlined above.
Job rotation helps

- Planned job rotation can assist in reducing exposure to heat. It may be necessary to place some workers at cooler workstations for periods of time or to transfer them permanently to more moderate environments.

Cool water and rest breaks should be taken

- Cool water should always be available in close proximity to hot working areas and encouragement given for the use of these facilities. Adequate rest breaks should be taken, as outlined in the National Health and Medical Research Council publication.

Reduce radiant heat

- The exposure of workers to radiant heat can be reduced by the strategic positioning of shields between workstations and heat sources.

Protective and comfort clothing

- Clothing should be carefully selected so that a balance between protection and facilitation of heat loss through evaporation is achieved.

Good ventilation

- Attention to ventilation and the provision of adequate air movement are essential. Some hot processes, for example, hot metal pouring in a foundry, may be partially or fully enclosed to reduce heat exposure.

Heat illness factors associated with job

- Work of an arduous nature
- Work, which is prolonged for extended periods
- Uncomfortable or awkward body position
- Insufficient cooling off or rest periods

Heat illness factors associated with the environment and season

- Extreme air temperatures
- Radiation heat from hot objects such as machinery
- Radiation heat from the sun if working in outdoors
- Higher levels of relative humidity
- Low air movement
Heat illness factors associated with workers

- Inappropriate clothing
- Level of acclimatization
- Degree of adequate hydration
- Approachability to water and cool recovery regions
- Health condition e.g. heart, circulatory or skin disorders
- Medication, which impairs temperature regulation or perspiration (consult with doctor)
- Age and weight
- Level of physical fitness
- Insufficient salt in the diet

Elimination controls

The best control measure is to eliminate situations, which may result in heat related illnesses. This can be done by - eliminating radiant heat sources that are not essential; eliminating the sources of water vapor in the workplace (e.g. leaks from steam valves, evaporation of water from wet floors, etc.).

Modifying the work environment

Several control measures, which have found to be effective in preventing or minimizing the vulnerability to risk by reducing heat in the workplace include -

- Reducing the emissions of radiant from hot objects and surfaces (insulation and shielding);
- Altering the air temperature, air movement and relative humidity using local or general ventilation, spot coolers, fans, blowers and air conditioning;
- Reducing the metabolic heat production of body using automation and mechanization of tasks;
- Using ventilation e.g. setting flues extending from a foundry to the open air to ventilate cooling racks and fixed sources of heat; and
- Humidity reducing techniques (e.g. set a dehumidifier — seek engineering advice).
Administrative controls

Administrative controls generally include the development of safe working procedures and practices. Some of these controls are -

- Scheduling the hot tasks to cooler times of the day and maintenance to cooler seasons;
- Supporting the workers to take short breaks;
- Providing opportunity to the new workers or workers returning from holidays to acclimatize to the heat;
- Rotating workers to reduce the heat exposure duration;
- Programming routine work / rest breaks in cool, shady areas with protective clothing removed;
- Keep apart the hot work practices to times / locations distant from other workers;
- Use extra workers or ensure job sharing / rotation of workers;
- Workers with heart and blood pressure problems or previous heat illness should not be allowed to work in extremely hot areas;
- Providing training to workers in the hazards related with working in hot environments, recognizing heat related illnesses, adopting safe work practices, control measures and the use and maintenance of personal protective equipment;
- Restricted consumption of diuretics (caffeinated drinks and alcohol);
- Access to sufficient supply of clean and cool drinking water; and
- Formulate a contingency plan for the treatment of affected workers.

Personal protective equipment (PPE)

Where heat exposure cannot be reduced or prevented by any other form of control, all exposed persons should be provided with personal protective equipment. Personal protective equipment used to prevent heat associated problems include - Eye wear, such as UV glasses; Non-flammable and heat reflective equipment and clothing; Water cooled bodysuits / vests and other equipment; Protective footwear and gloves;
CATEGORIES OF PROTECTIVE CLOTHING

PPE acts as a barrier between an individual and a hazard which enables the individual to stay in the vicinity of the hazard with a reduced risk of injury.

Growing concerns about worker safety on one hand and increased instances of terror attacks and epidemics on the other have raised awareness about the need for personal protection. Technological advances have combined technical requirements with comfort and style.

There are many types of PPE which depends on the specific environment and conditions.

Personal protective equipment (PPE) is a term used to describe clothing and equipment which is worn or held by individuals to protect them against risks to their health and safety at the workplace. Essentially, PPE acts as a barrier between an individual and a hazard which enables the individual to stay in the vicinity of the hazard with a reduced risk of injury. In other words, PPE offers a practical solution to eliminating or at least minimizing the risk of accidents, injuries, or infection in the workplace. More specifically, it provides an effective safeguard against hazards such as extreme temperatures, fire, potentially dangerous objects, and harmful substances. The main categories of protective clothing include chemical and hazardous material (hazmat) clothing, clean room clothing, combat uniforms, cut resistant work wear, flame resistant work wear, high visibility apparel, medical protective clothing, and multi-functional protective wear.

Growing concerns about worker safety on one hand and increasing instances of terror attacks and epidemics on the other have raised awareness about the need for personal protection. This awareness coupled with rising costs associated with workplace injuries, has resulted in a growing emphasis on compliance with health and safety regulations and performance standards for protective apparel and accessories.

Technological advances in the personal protective equipment (PPE) industry have led to the development of products which not only meet these stringent performance standards but also offer advances in comfort and style. Such advances have helped to increase the proportion of end users who comply with health and safety regulations.
Items of PPE are designed to protect employees from injuries or illnesses caused by a wide range of hazards. The most common of these are: abrasion; blunt impacts; chemicals; electric arc flashes; extreme temperatures; drowning; falls; fire; hazards requiring breathing equipment; infection; inhalation of dangerous substances; injury by machinery; mechanical vibration; noise; radiation; and skin or eye contact with dangerous substances.

There are many types of PPE, and the suitability of a particular type depends on the specific environment and conditions in which it is to be worn or used. Examples include: high visibility waistcoats; life jackets; protective glasses; protective gloves; respirators; safety footwear; safety harnesses; safety headwear; and workwear.

Much PPE is expensive relative to ordinary workwear as it is, by necessity, more sophisticated in terms of materials used and technologies employed. However, PPE does provide cost benefits in the form of reducing the number of work-related injuries or illnesses and their associated costs, as well as saving lives. Indeed, the Occupational Safety and Health Administration (OSHA) in the USA estimates that for every US$1 spent on an effective health and safety programme about US$4 are saved. While the primary purpose of PPE is to prevent injuries, it should also be comfortable to wear or use. Otherwise, the wearer or user may be distracted and prevented from concentrating on a specific task. Importantly, a PPE garment or accessory must be designed so that it fits well and does not impair dexterity, hinder mobility or cause physical distress.

**Flame resistant workwear**

Flame resistant workwear protects the wearer from: flames or flares; flying slag; metal droplets; and red-hot sparks. The primary purpose of flame resistant clothing is to delay the increase in skin temperature caused by heat exposure in order to give the wearer time to escape the source of the flames and avoid or minimize the risk of burns.
There are two main types of fabric used to manufacture flame resistant clothing. Chemically treated fabric; and fabric composed of inherently flame resistant fibres. Fabrics which have been treated with flame retardant chemicals—unlike inherently flame resistant fabrics—suffer from the drawback that their efficacy will diminish over time if their flame resistant properties gradually wash out or wear away. By contrast, the flame resistant properties of fabric composed of inherently flame resistant fibres are permanent and will remain effective until the garment itself has worn out.

**Firefighters’ clothing**

Firefighters’ clothing is designed primarily to protect the wearer from flames, thermal radiation, hot gas convection, and direct contact with hot surfaces.

A typical firefighter’s ensemble comprises: a flame resistant outer shell; and an inner liner. The outer shell resists ignition when exposed to thermal radiation or brief contact with flames. The inner liner comprises: a moisture barrier, which prevents liquid from penetrating; and a thermal barrier, which retards heat flow through the garment.

**Cut resistant workwear**

Cut protection represents a crucial element of workplace safety in a number of industries—including automotive, steel, glass and metal handling, where finger and hand injuries rank among the most common workplace accidents. However, these injuries are considered to be the most preventable in the working environment. Cut resistant workwear is designed to protect workers from hazards such as severe cuts, lacerations, abrasions or punctures. Typically, such workwear is made from high strength fabrics which have a minimum specified level of cut resistance. The cut resistance of a fabric is, in turn, determined by several factors, including: the material used in the fabric’s construction; the weight of the fabric per unit area; the type of weave; the number of threads and stitches per unit area; and the presence of coatings. As a rule of thumb, a heavyweight, coated fabric constructed from a high
strength material will offer more cut resistance than a lightweight, uncoated fabric constructed from a low strength material.

**Chemical and hazardous material (hazmat) clothing**

The purpose of chemical and hazardous material (hazmat) clothing is to prevent chemicals and other potentially harmful substances from contacting the skin of the wearer. Applications for this type of clothing include: application of pesticides in agriculture; chemicals manufacturing; emergency response; hazardous waste site clean-up and disposal; and removal of asbestos and other particulates.

Protective clothing for these applications functions essentially as a barrier against hazardous materials and chemical contaminants, such as organic liquids and vapours. It takes the form of suits which may be encapsulating or non-encapsulating—depending on the application and severity of the hazard—together with accessories such as chemically resistant gloves and boots. All materials used in such clothing, including zippers, should resist chemical permeation and degradation. One important factor is the way that seams are constructed. In fact the method used to construct seams can be critical in garments designed to protect the wearer against liquids and against hazardous dry particles, such as asbestos. In poorly designed seams, stitches, for example, can leave holes in the fabric which are big enough for these particles and liquids to pass through.

**Combat uniforms**

Combat uniforms are worn mainly by the military and law enforcement personnel. A combat uniform ensemble and its components may be required to possess some or all of the following properties: ballistic protection; chemical, biological, radiological and nuclear (CBRN) protection and flame resistance. However, these protective properties should not, compromise other performance features—including those which affect wear comfort. Particularly important in this respect are breathability and lightness of weight. The single most important component of a combat uniform is body armor as it is critical for survival in the event of physical, ballistic or stab attacks. It is routinely worn by
High visibility apparel has become increasingly common in certain working environments like constructions sites, road maintenance and other potentially hazardous environments.

High visibility apparel

High visibility apparel has become increasingly common in certain working environments. In particular, it is now regarded as essential for individuals carrying out maintenance on roads, railway lines, construction sites and other potentially hazardous locations where the danger of not being seen can prove fatal. Also, it has become a requirement for drivers in a number of European countries to carry high visibility over-clothing in their vehicles in case roadside repairs are needed. Apparel can be made highly visible by using: fluorescent materials; reflective materials; and light emitting diodes (LEDs).

Fluorescent materials

The principle of fluorescence is that certain substances have the ability to absorb ultraviolet radiation which is invisible to the human eye and to re-emit it at wavelengths which are in the visible part of the spectrum.

Clothing can be made to fluoresce by incorporating fluorescent pigments into the fibres or fabrics from which it is made. These pigments were developed after it was noticed that certain basic dyes exhibited fluorescent properties—but only when they were in solution. The next step was for a basic dye to be incorporated into a resinous material in the form of a solid solution. Once the resin was ground into very fine particles it could then be used as a fluorescent pigment. The principle of fluorescence is that certain substances have the ability to absorb ultraviolet radiation—which is invisible to the human eye—and to re-emit it at wavelengths which are in the visible part of spectrum. This has the effect of producing colors of exceptional brightness in some shade areas, particularly greenish yellow, orange, red and magenta. The fluorescent effect is greatest in evening light, when the ultraviolet component of daylight is at its highest.

Reflective materials

Reflective materials use the “cat’s-eyes” principle, in which light falling on them is reflected back—or retroreflected—towards the light source.
The fabric is provided with a coating containing tiny spheres of glass or resin, which act as mirrors and reflect the light back towards its source.

**Light emitting diodes (LEDs)**

Another way of making apparel highly visible is to attach or incorporate light emitting diodes (LEDs).

**Clean room clothing**

Clean room clothing is designed to prevent substances released from the wearer’s body from contaminating the environment. This is critical in the pharmaceutical and semiconductor industry. Also, they should have antistatic properties.

Clean room clothing is designed to prevent substances released from the wearer’s body from contaminating the environment. In the semiconductor and pharmaceutical industries, such contamination can degrade product performance. The ability of a garment to prevent contaminants, such as hair and skin, from escaping into the environment is determined by a number of factors. These factors include: the type of fabric; the permeability of the fabric; seam construction; and the presence of fasteners. Garments for clean room use should have seams which ensure that all cut fabric edges are enclosed. The importance of satisfactory seam construction is highlighted by the fact that more particles can pass through traditional seams and fasteners than through the whole of the fabric—even though the seams and fasteners typically account for less than 1% of the total area of the garment. Contaminants can also pass through gaps between the clothing and the body, most commonly at the neck.

Garments for clean room use should also have antistatic properties. Static electricity is a critical issue in the electronics industry as many electronic devices and components are sensitive to static discharge. Consequently, static electricity can cause significant damage to such items. Furthermore, static electricity can ignite gases and vapors, resulting in fires or explosions.

**Medical protective clothing**

Medical protective clothing comprises garments worn by health care workers for everyday use in clinical environments. Such clothing has several purposes, the most important of which are: to minimise the risk
Medical protective clothing has several purposes like minimizing the risk of infection and protecting the health care worker from exposure to the body fluids of the patient.

of infection; and to protect the health care worker from exposure to the body fluids of a patient, as well as providing protection from chemicals and hazardous substances. Garments worn by health care workers must therefore provide an effective barrier against substances which carry micro-organisms that are capable of causing infection. Such garments must also be resistant to lint, flames, stains, static and wrinkles. The choice of medical clothing is based on the environment in which it is to be used. More specifically, it should be appropriate for the level of infection risk. In environments where the level of infection risk is high—such as in operating theatres—it is important that all surgical attire should resist the penetration of blood, micro-organisms and particulates.

Multi-functional protective wear

Multi-functional protective wear is designed to protect the wearer from more than one hazard. For example, garments which combine flame resistance with high visibility can be used to protect employees who are exposed to high temperatures in low light conditions. Applications for such garments include law enforcement, military operations and firefighting.

IRON AND STEEL INDUSTRY

In the iron and steel industry, large amounts of materials are processed, transported and conveyed by massive equipment that dwarfs that of most industries. Steel works typically have sophisticated safety and health programmes to address hazards in an environment that can be unforgiving. An integrated approach combining good engineering and maintenance practices, safe job procedures, worker training and use of personal protective equipment (PPE) is usually required to control hazards.

Spills, Spatters and eruptions of hot metal can cause injuries.

Burns may occur at many points in the steel-making process: at the front of the furnace during tapping from molten metal or slag; from spills, spatters or eruptions of hot metal from ladles or vessels during processing, teeming (pouring) or transporting; and from contact with hot metal as it is being formed into a final product.
Water entrapped in molten metal or slag may generate explosive forces that launch hot metal or material over a wide area. Inserting a damp implement into molten metal may also cause violent eruptions.

Mechanical transport is essential in iron and steel manufacturing but exposes workers to potential struck-by and caught-between hazards. Overhead travelling cranes are found in almost all areas of steel works. Most large works also rely heavily on the use of fixed-rail equipment and large industrial tractors for transporting materials.

Safety programs for crane use require training to ensure proper and safe operation of the crane and rigging of loads to prevent dropped loads; good communication and use of standard hand signals between crane drivers and slingers to prevent injuries from unexpected crane movement; inspection and maintenance programs for crane parts, lifting tackle, slings and hooks to prevent dropped loads; and safe means of access to cranes to avoid falls and accidents on crane transverse ways.

Maintaining proper clearance for passage of large industrial tractors and other equipment and preventing unexpected start-up and movement are necessary to eliminate struck-by, struck-against and caught-between hazards to equipment operators, pedestrians and other vehicle operators. Programs are also necessary for inspection and maintenance of equipment safety appliances and passageways.

Good housekeeping is a cornerstone of safety in iron and steel works. Floors and passageways can quickly become obstructed with material and implements that pose a tripping hazard. Although mechanization has greatly lessened the amount of manual handling in the industry, ergonomic strains may still occur on many occasions.

Tools are subject to heavy wear and soon become compromised and perhaps dangerous to use. Although mechanization has greatly lessened the amount of manual handling in the industry, ergonomic strains still may occur on many occasions.
Sharp edges or burrs on steel products or metal bands pose cut and puncture hazards to workers involved in finishing, shipping and scrap-handling operations. Cut-resistant gloves and wrist guards are often used to eliminate injuries.

Protective eye-wear programs are particularly important in iron and steel works. Foreign-body eye hazards are prevalent in most areas, especially in raw material handling and steel finishing, where grinding, welding and burning are conducted.

Programmed maintenance is particularly important for accident prevention. Its purpose is to ensure the efficiency of the equipment and maintain fully operative guards, because failure may cause accidents. Adhering to safe operating practices and safety rules is also very important because of the complexity, size and speed of process equipment and machinery.

**Carbon monoxide poisoning**

Blast furnaces, converters and coke ovens produce large quantities of gases in the process of iron and steel manufacturing. After the dust has been removed, these gases are used as fuel sources in the various plants, and some are supplied to chemical plants for use as raw materials. They contain large amounts of carbon monoxide (blast-furnace gas, 22 to 30%; coke oven gas, 5 to 10%; converter gas, 68 to 70%).

Carbon monoxide sometimes emanates or leaks from the tops or bodies of blast furnaces or from the many gas pipelines inside plants, accidentally causing acute carbon monoxide poisoning. Most cases of such poisoning occur during work around blast furnaces, especially during repairs. Other cases occur during work around hot stoves, tours of inspection around the furnace bodies, work near the furnace tops or work near cinder notches or the tapping notches. Carbon monoxide poisoning may also result from gas released from water-seal valves or seal pots in the steel-making plants or rolling mills; from sudden shutdown of blowing equipment, boiler rooms or ventilation fans; from leakage; from failure to properly
ventilate or purge process vessels, pipelines or equipment prior to work; and during closing of pipe valves.

**Dust and fumes**

Dust and fumes are generated at many points in the manufacture of iron and steel. Dust and fumes are found in the preparation processes, especially sintering, in front of the blast furnaces and steel furnaces and in ingot making. Dusts and fumes from iron ore or ferrous metals do not readily cause pulmonary fibrosis and pneumoconiosis is infrequent. Some lung cancers are thought to be connected with carcinogens found in coke-oven emissions. Dense fumes emitted during the use of oxygen lances and from the use of oxygen in open-hearth furnaces may particularly affect crane operators.

Exposure to silica is a risk to workers engaged in lining, relining and repairing blast furnaces and steel furnaces and vessels with refractory materials, which may contain as much as 80% silica. Ladles are lined with fire-brick or bonded crushed silica and this lining requires frequent repair. The silica contained in refractory materials is partly in the form of silicates, which do not cause silicosis but rather pneumoconiosis. Workers are rarely exposed to heavy clouds of dust.

Alloy additions to furnaces making special steels sometimes bring potential exposure risks from chromium, manganese, lead and cadmium.

**Miscellaneous hazards**

Bench and top-side operations in coking operations in front of blast furnaces in iron making and furnace-front, ingot-making and continuous-casting operations in steel making all involve strenuous activities in a hot environment. Heat-illness prevention programs must be implemented.

Furnaces may cause glare that can injure eyes unless suitable eye protection is provided and worn. Manual operations, such as furnace bricklaying, and hand-arm vibration in chippers and grinders may cause ergonomic problems.
Blower plants, oxygen plants, gas-discharge blowers and high-power electric furnaces may cause hearing damage. Furnace operators should be protected by enclosing the source of noise with sound-deadening material or by providing sound-proofed shelters. Reducing exposure time may also prove effective. Hearing protectors (earmuffs or earplugs) are often required in high-noise areas due to the unfeasibility of obtaining adequate noise reduction by other means.

Safety and Health Measures

Safety organization

Safety organization is of prime importance in the iron and steel industry, where safety depends so much on workers’ reaction to potential hazards. The first responsibility for management is to provide the safest possible physical conditions, but it is usually necessary to obtain everyone’s cooperation in safety programs. Accident-prevention committees, workers’ safety delegates, safety incentives, competitions, suggestion schemes, slogans and warning notices can all play an important part in safety programs. Involving all persons in site hazard assessments, behavior observation and feedback exercises can promote positive safety attitudes and focus work groups working to prevent injuries and illnesses.

Accident statistics reveal danger areas and the need for additional physical protection as well as greater stress on housekeeping. The value of different types of protective clothing can be evaluated and the advantages can be communicated to the workers concerned.

Training

Training should include information about hazards, safe methods of work, avoidance of risks and the wearing of PPE. When new methods or processes are introduced, it may be necessary to retrain even those workers with long experience on older types of furnaces. Training and refresher courses for all levels of personnel are particularly valuable. They should familiarize personnel with safe working methods, unsafe acts to be banned. Training should be conducted by experts and should make use of effective audio-visual aids. Safety meetings or contacts
should be held regularly for all persons to reinforce safety training and awareness.

**Engineering and administrative measures**

All dangerous parts of machinery and equipment, including lifts, conveyors, long travel shafts and gearing on overhead cranes, should be securely guarded. A regular system of inspection, examination and maintenance is necessary for all machinery and equipment of the plant, particularly for cranes, lifting tackle, chains and hooks. An effective lockout/tagout program should be in operation for maintenance and repair. Defective tackle should be scrapped. Safe working loads should be clearly marked, and tackle not in use should be stored neatly. Means of access to overhead cranes should, where possible, be by stairway. If a vertical ladder must be used, it should be hooped at intervals. Effective arrangements should be made to limit the travel of overhead cranes when persons are at work in the vicinity. It may be necessary, as required by law in certain countries, to install appropriate switchgear on overhead cranes to prevent collisions if two or more cranes travel on the same runway.

Locomotives, rails, wagons, buggies and couplings should be of good design and maintained in good repair, and an effective system of signaling and warning should be in operation. Riding on couplings or passing between wagons should be prohibited. No operation should be carried on in the track of rail equipment unless measures have been taken to restrict access or movement of equipment.

Great care is needed in storing oxygen. Supplies to different parts of the works should be piped and clearly identified. All lances should be kept clean.

There is a never-ending need for good housekeeping. Falls and stumbles caused by obstructed floors or implements and tools left lying carelessly can cause injury in themselves but can also throw a person against hot or molten material. All materials should be carefully stacked, and storage racks should be conveniently placed for tools. Spills of grease or oil should be immediately cleaned. Lighting of all parts of the shops and machine guards should be of a high standard.
Industrial hygiene

Good general ventilation throughout the plant and local exhaust ventilation (LEV) wherever substantial quantities of dust and fumes are generated or gas may escape are necessary, together with the highest possible standards of cleanliness and housekeeping. Gas equipment must be regularly inspected and well maintained so as to prevent any gas leakage. Whenever any work is to be done in an environment likely to contain gas, carbon monoxide gas detectors should be used to ensure safety. When work in a dangerous area is unavoidable, self-contained or supplied-air respirators should be worn. Breathing-air cylinders should always be kept in readiness, and the operatives should be thoroughly trained in methods of operating them.

With a view to improving the work environment, induced ventilation should be installed to supply cool air. Local blowers may be located to give individual relief, especially in hot working places. Heat protection can be provided by installing heat shields between workers and radiant heat sources, such as furnaces or hot metal, by installing water screens or air curtains in front of furnaces or by installing heat-proof wire screens. A suit and hood of heat-resistant material with air-line breathing apparatus gives the best protection to furnace workers. As work in the furnaces is extremely hot, cool-air lines may also be led into the suit. Fixed arrangements to allow cooling time before entry into the furnaces are also essential.

Acclimatization leads to natural adjustment in the salt content of body sweat. The incidence of heat affections may be much lessened by adjustments of the workload and by well-spaced rest periods, especially if these are spent in a cool room, air-conditioned if necessary. A plentiful supply of water and other suitable beverages should be provided and there should be facilities for taking light meals. The temperature of cool drinks should not be too low and workers should be trained not to swallow too much cool liquid at a time; light meals are to be preferred during working hours. Salt replacement is needed for jobs involving profuse sweating and is best achieved by increasing salt intake with regular meals.
In cold climates, care is required to prevent the ill-effects of prolonged exposure to cold or sudden and violent changes of temperature. Canteen, washing and sanitary facilities should preferably be close at hand. Washing facilities should include showers; changing rooms and lockers should be provided and maintained in a clean and sanitary condition.

Wherever possible, sources of noise should be isolated. Remote central panels remove some operatives from the noisy areas; hearing protection should be required in the worst areas. In addition to enclosing noisy machinery with sound-absorbing material or protecting the workers with sound-proofed shelters, hearing protection programs have been found to be effective means of controlling noise-induced hearing loss.

**Personal protective equipment**

All parts of the body are at risk in most operations, but the type of protective wear required will vary according to the location. Those working at furnaces need clothing that protects against burns-overalls of fire-resistant material, spats, boots, gloves, helmets with face shields or goggles against flying sparks and also against glare. Safety boots, safety glasses and hard hats are imperative in almost all occupations and gloves are widely necessary. The protective clothing needs to take account of the risks to health and comfort from excessive heat; for example a fire-resistant hood with wire mesh visor gives good protection against sparks and is resistant to heat; various synthetic fibres have also proved efficient in heat resistance. Strict supervision and continuous propaganda are necessary to ensure that personal protective equipment is worn and correctly maintained.

**Ergonomics**

The ergonomic approach (i.e. investigation of the worker-machine-environment relationship) is of particular importance at certain operations in the iron and steel industry. An appropriate ergonomic study is necessary not only to investigate conditions while a worker is carrying out various operations, but also to explore the impact of the environment on the worker and the functional design of the machinery used.
Medical supervision

Pre-placement medical examinations are of great importance in selecting persons suitable for the arduous work in iron and steel making. For most work, a good physique is required: hypertension, heart diseases, obesity and chronic gastroenteritis disqualify individuals from work in hot surroundings. Special care is needed in the selection of crane drivers, both for physical and mental capacities.

Medical supervision should pay particular attention to those exposed to heat stress; periodic chest examinations should be provided for those exposed to dust, and audiometric examinations for those exposed to noise; mobile equipment operators should also receive periodic medical examinations to ensure their continued fitness for the job.

Constant supervision of all resuscitative appliances is necessary, as is training of workers in first-aid revival procedure.

A central first-aid station with the requisite medical equipment for emergency assistance should also be provided. This may include an ambulance.

OIL & GAS INDUSTRY

The oil and gas industry is potentially more hazardous than many other industries as it has many diverse activities, including processes, operations and materials which can pose risks to health, safety and the environment. As the result of these, workers are exposed to large number of hazards such as Physical, Chemical, Biological and Psychological hazards that can pose a potential risk to health and wellbeing.

Virtually all the health hazards common to industry are present offshore. They include: chemical hazards (toxic, corrosive, irritant and sensitizing substances and possible carcinogens); physical hazards (noise, vibration, various forms of radiation, thermal extremes); biological hazards
(food poisoning, Malaria); ergonomic hazards (manual handling activities, workstations, VDUs); and psychosocial hazards associated with either the work (Isolation, hours of work, tours, shifts, work load and content, fatigue, etc all of which can contribute to psychological stress.

The below table illustrates the health hazards during various phases of operations in Oil and gas industry.

<table>
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<tr>
<th>Phases</th>
<th>Employee health effects</th>
<th>Community health effect</th>
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<tbody>
<tr>
<td>Geological Survey</td>
<td>Biological &amp; Physical agents - Infectious disease - Food/Water borne illness - Wild life and Vector induced illness - Noise</td>
<td>Biological and Physical agents - Infectious disease - Food/Water borne illness - Wild life and Vector induced illness - Noise</td>
</tr>
<tr>
<td>Drilling</td>
<td>Physical agents - Drilling Mud - Petroleum products - Radioactive sources - Noise - Ergonomic - Psychosocial</td>
<td>Physical agents - Drilling Mud - Petroleum products - Noise</td>
</tr>
<tr>
<td>Production</td>
<td>Chemical &amp; Physical agents - Drilling Mud - Petroleum products - Radioactive sources - Treatment chemicals and metals - Temperature (Hot/cold) - Silica/asbestosis - Noise and vibration - Solvents - Ergonomic - Psychosocial</td>
<td>Biological &amp; Physical agents - Drilling Mud - Petroleum products - Metals - Noise</td>
</tr>
</tbody>
</table>

Most countries reinforce Occupational Health and Safety by implementing laws, which regulate the measures the companies have to take with regards to health and safety. In India, the applicable regulations on Occupational health for oil and gas industry broadly fall under:
• The Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008 Provides regulation of health and safety in offshore oil and gas exploration, exploitation, production/ drilling and matters connected therewith.
• Mines Act 1952: Provide regulations relating to the health, safety and welfare of workers in oil mines.
• The Factories Act 1948: Regulates health, safety, welfare and other working conditions of workers in factories.

Coke Operations - Hazards, Health and Safety measures

Physical hazards

During the coal unloading, preparation and handling operations, thousands of tonnes of coal are manipulated, producing dust, noise and vibrations. The presence of large quantities of accumulated dust can produce an explosion hazard in addition to the inhalation hazard.

During coking, ambient and radiant heat are the major physical concerns, particularly on the topside of the batteries, where the majority of the workers are deployed. Noise may be a problem in mobile equipment, primarily from drive mechanism and vibrating components that are not adequately maintained. Ionizing radiation and/or laser producing devices may be used for mobile equipment alignment purposes.

Chemical hazards

Mineral oil is typically used for operation purposes for bulk density control and dust suppression. Materials may be applied to the coal prior to being taken to the coal bunker to minimize the accumulation and to facilitate the disposal of hazardous waste from the by-products operations.

The major health concern associated with coking operations is emissions from the ovens during charging of the coal, coking and pushing of the coke. The emissions contain numerous polycyclic aromatic hydrocarbons (PAHs), some of which are carcinogenic. Materials utilized for sealing leaks in lids and doors may also be a concern during mixing and when lids and doors are removed. Asbestos and refracting ceramic

The presence of large quantities of accumulated dust can produce an explosion hazard apart from an inhalation hazard. Mineral oil is generally used for dust suppression.

Carcinogenic materials like polycyclic aromatic hydrocarbons are sometimes contained in emissions and in the refracting ceramic filters.
filters may also be present in the form of insulating materials and gaskets, although suitable replacements have been used for products that previously contained asbestos.

**Mechanical hazards**

The coal-production hazards associated with railroad car, marine barge and vehicular traffic as well as conveyor belt movement must be recognized. The majority of accidents occur when workers are struck by, caught between, fall from, are entrained and entrapped in, or fail to lockout such equipment (including electrically).

The mechanical hazards of greatest concern are associated with the mobile equipment on the pusher side, coke side and the lorry car on top of the battery. This equipment is in operation practically the entire work period and little space is provided between it and the operations. Caught-between and struck-by accidents associated with mobile rail-type equipment account for the highest number of fatal coke-oven production incidents. Skin surface burns from hot materials and surfaces and eye irritation from dust particles are responsible for more numerous, less severe occurrences.

**Safety and Health Measures**

To maintain dust concentrations during coal production at acceptable levels, containment and enclosure of screening, crushing and conveying systems are required. LEV may also be required in addition to wetting agents applied to the coal. Adequate maintenance programs, belt programs and clean-up programs are required to minimize spillage and keep passageways alongside process and conveying equipment clear of coal. The conveyor system should use components known to be effective in reducing spillage and maintaining containment, such as belt cleaners, skirt boards, proper belt tension and so on.

Due to the health hazards associated with the PAHs released during the coking operations, it is important to contain and collect these emissions. This is best accomplished by a combination of engineering controls, work practices and a maintenance program. It is also necessary
to have an effective respirator program. The controls should include the following:

- a charging procedure designed and operated to eliminate emissions by controlling the volume of coal being charged, properly aligning the car over the oven, tightly fitting drop sleeves and charging the coal in a sequence that allows an adequate channel on top of the coal to be maintained for flow of emissions to the collector mains and relidding immediately after charging
- drafting from two or more points in the oven being charged and an aspiration system designed and operated to maintain sufficient negative pressure and flow
- air seals on the pusher machine level bars to control infiltration during charging and carbon cutters to remove carbon build-up
- uniform collector-main pressure adequate to convey the emissions
- chuck door and gaskets as needed to maintain a tight seal and adequately cleaned and maintained pusher side and coke side sealing edges
- luting of lids and doors and maintaining door seals as necessary to control emissions after charging
- green pushes minimized by heating the coal uniformly for an adequate period
- installation of large enclosures over the entire coke side area to control emissions during the pushing of coke or use of travelling hoods to be moved to the individual ovens being pushed
- routine inspection, maintenance and repair for proper containment of emissions
- positive-pressure and temperature controlled operator cabs on mobile equipment to control worker exposure levels. To achieve the positive-pressure cab, structural integration is imperative, with tight fitting doors and windows and the elimination of separations in structural work.

Worker training is also necessary so that proper work practices are used and the importance of proper procedures to minimize emissions is understood.
Routine worker exposure monitoring should also be used to determine that levels are acceptable. Gas monitoring and rescue programs should be in place, primarily due to the presence of carbon monoxide in coke-gas ovens. A medical surveillance program should also be implemented.

CHEMICAL INDUSTRY

Accidents in chemical process industries are dangerous because of their magnitude. A recent report stated that out of 100 accidents studied; nearly 50% are a result of improper storage of chemicals.

Accidents in chemical process industries constitute major threat to property and population because of the magnitude. With the rapid development in Science and Technology, several new innovations have come up and process industries deal with thousands of new materials and several processes. Nevertheless, there are innumerable causes that lead to accidents of major or minor in nature.

A recent report published by Cell for Industrial Safety and Risk analysis, Chennai stated that out of 100 accidents that were studied nearly 50% of them have been found to be due to improper storage of chemicals. As many as 26 accidents have been found to occur when the plant was shutdown and about 21 accidents when the plant was functioning properly. 9 accidents were due to transportation faults and packing, material transfer and heat transfer led to about 7 accidents each and so on. The detailed distribution has been illustrated in the following bar graph.
International Standardization

International standardisation of PPE is mainly carried out by ISO, an affiliation of standardisation organisations from over 90 countries worldwide. Only the principal national standardisation organisation in each country can be a member, e.g., Germany is represented by DIN (Deutsches Institut für Normung). Standardisation of PPE at ISO takes place primarily in Technical Committee (TC) ISO/TC 94 with a series of subcommittees (SC) for different PPE types. Certain other committees, as ISO/TC 83 for sport and leisure equipment and ISO/TU 42/SC 1 for noise, are also of significance for special PPE types. Following table shows the most important ISO groups related to standardisation of protective textiles and clothing

### ISO Technical Committees in the field of PPE

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<th>ISO/TC/SC</th>
<th>PPE FIELD</th>
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<tbody>
<tr>
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<td>Respiratory protective devices</td>
</tr>
<tr>
<td>TC 94/SC 1</td>
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<td>TC 94/SC 3</td>
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<td>TC 94/SC 4</td>
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<tr>
<td>TC 94/SC 12</td>
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<td>TC 94/SC 13</td>
<td>Protective clothing</td>
</tr>
<tr>
<td>TC 188/WG 6</td>
<td>Lifejackets</td>
</tr>
</tbody>
</table>

(TC:Technical Committee, SC:Subcommittee, WG:Working group)

Some ISO standards fundamentally important in the field of textiles and protective clothing are listed in Appendix 1 and 2.)
European standardization in the field of PPE mainly takes place in the seven technical committees (TC) from CEN. These committees are structured into subcommittees (SC) or working groups (WG). The TC 162 with 12 working groups is responsible for protective clothing, hand and arm protection and life jackets. These working groups give an overview of the most important kinds of personal protective clothing, where protective textiles are used. At present, more than 300 harmonized standards exist in the field of personal protective equipment.

European Standard Organization

European standardisation in the field of PPE mainly will be carried out by CEN (European Committee for Standardisation) in Brussels, which deals with all sectors except the electrotechnology and telecommunication sectors; partially by Cenelec (European Committee for Electrotechnical Standardisation) deals with standards in the electrotechnical field; or ETSI (European Telecommunications Standards Institute) covers the telecommunications field and some aspects of broadcasting. European standardisation of PPE takes place in the seven technical committees (TC) from CEN. These committees are structured into subcommittees (SC) or working groups (WG). The TC 162 with 12 working groups is the responsible committee for protective clothing, hand and arm protection and life jackets. These working groups give an overview of the most important kinds of personal protective clothing, where protective textiles are used. Since 1989, the year of foundation of the technical committees, all enormous standardisation programs have been carried out. At present, more than 300 harmonised standards exist in the field of personal protective equipment.

Since the aim is for close interlinking of European, international standardisation work and uniform implementation of international standards an agreement on technical cooperation between ISO and CEN (Vienna Agreement) was concluded in 1991. Advantages are, e.g., the implementation of existing ISO standards by CEN and the cooperation through transfer of work and parallel voting. Since increasing use is being made of the possibility for parallel voting in the field of PPE, international standardization of PPE is gaining in importance.
European standardisation by CEN (European Committee for Standardisation in the field of PPE)

<table>
<thead>
<tr>
<th>CEN Committee</th>
<th>PPE Field</th>
<th>Secretariat</th>
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<tbody>
<tr>
<td>CEN/Tc 79</td>
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</tr>
<tr>
<td>CEN/TC 160</td>
<td>Protection against falls from a height including working belts</td>
<td>DIN (D)</td>
</tr>
<tr>
<td>CEN/TC 161</td>
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<td>BSI (UK)</td>
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<tr>
<td>CEN/TC 162</td>
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<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG3</td>
<td>Chemical</td>
<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG4</td>
<td>Cold and foul weather</td>
<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG5</td>
<td>Mechanical</td>
<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG6</td>
<td>Lifejacket</td>
<td>DIN (D)</td>
</tr>
<tr>
<td>CEN/TC 162/WG7</td>
<td>High visibility and radioactive contamination</td>
<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG8</td>
<td>Gloves</td>
<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG9</td>
<td>Motorcycle equipment</td>
<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG10</td>
<td>Accessories of flotation for children</td>
<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG11</td>
<td>Sports equipment</td>
<td></td>
</tr>
<tr>
<td>CEN/TC 162/WG12</td>
<td>Diving suits</td>
<td></td>
</tr>
</tbody>
</table>

Related to contents standards this can be divided into standards for test methods, product requirements, requirements for quality management in testing, production and certification, standards for the evaluation of conformity of products, and competence of test houses (Appendix 3).
In North America the standardisation in the field of Occupational Safety and Health Standards is mainly carried out by US Department of Labour, Occupational Safety and Health Administration, but there are further organisations involved into the development of standards for protective clothing:

- American Society for Testing and Materials (ASTM) Committee F-23, responsible for the development of test methods to measure the performance of the materials used in these products.
- National Fire Protection Association (NFPA) responsible for the implementation of the test methods and establishing the acceptance criteria for the clothing ensemble. NFPA, a private non-profit organisation, is the leading authoritative source of technical background, data, and consumer advice on fire protection, problems and prevention.
- National Institute for Occupational Safety and Health (NIOSH),
- American National Standard Institute (ANSI) American Association of Textile Chemists and Colorists (AATCC), and
- International Safety Equipment Association (ISEA).

Appendix 4 relate some of the used testing methods, using procedure of the organizations AATCC, ANSI, ASTM, NFPA, etc. In the rest of the world, every country has its own normative system, generally based on ISO procedures.

**Bureau of Indian Standards**

Under the provisions of Bureau of Indian Standards Act 1986, and the rules and Regulations made under it, Bureau of Indian Standards (BIS) has been established for the harmonious development of the activities of standardization, marking and quality certification of goods and for matters connected therewith or incidental thereto.
In the field of Protective textiles, Indian standards on testing and specification for textile protective clothing for the protection from fire and other health/life hazards are formulated by the Protective Textiles Sectional Committee, TX 32 working under the overall control of Textile Division Council. This committee has so far formulated 27 standards on test methods and specifications on the subject.

For the purpose of formulation of Indian standard in respect of articles or processes, technical committees of experts are constituted. Such committees include Division Councils, Sectional Committees, Sub-Committees and Panels.

The procedure employed in establishing Indian standards is designed to ensure that all interested parties have an opportunity to put forward their views, that a consensus has been obtained on the contents of the standard and that there is substantial support for the standard.

Indian standards are voluntary and available to public. Their implementation depends on adoption by concerned parties. However an Indian standard becomes binding if it is stipulated in contract or referred to in a legislation or made mandatory by specific orders of the Govt.

In the field of Protective textiles, Indian standards on testing and specification for textile protective clothing for the protection from fire and other health/life hazards are formulated by the Protective Textiles Sectional Committee, TX 32 working under the overall control of Textile Division Council. This committee has so far formulated 27 standards on test methods and specifications on the subject as given below:

**Indian Standards for Testing and Specification for Textile Protective Clothing for Protection from Fire and other Health/ Life hazards (TXD 32 - Textiles Protective Clothing)**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>IS Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IS 1097:1979</td>
<td>Handloom cotton mosquito netting (first revision)</td>
</tr>
<tr>
<td>2</td>
<td>IS 11871:1986</td>
<td>Methods for determination of flammability and flame resistance of textile fabrics</td>
</tr>
<tr>
<td>5</td>
<td>IS 12722:1989</td>
<td>Textile floor coverings - determination of flame resistance by Tablet test</td>
</tr>
<tr>
<td>6</td>
<td>IS 13501:1992</td>
<td>Textiles - Determination of flammability by oxygen index</td>
</tr>
<tr>
<td>7</td>
<td>IS 15589:2005 / ISO 6940:2004</td>
<td>Textiles fabrics - Burning behaviour - Determination of ease of ignition of vertically oriented specimens</td>
</tr>
<tr>
<td>No.</td>
<td>IS Number</td>
<td>Title</td>
</tr>
<tr>
<td>-----</td>
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</tr>
<tr>
<td>9</td>
<td>IS 15612(Part 1): 2005</td>
<td>Textiles - Burning behaviour of curtains and drapes - Part 1 - Classification scheme</td>
</tr>
<tr>
<td>11</td>
<td>IS 15612(Part 3): 2005</td>
<td>Textiles - Burning behaviour of curtains and drapes - Part 3 - Method for determining the ignitability of vertically oriented specimens (small flame)</td>
</tr>
<tr>
<td>12</td>
<td>IS 15612(Part 4): 2005</td>
<td>Textiles - Burning behaviour of curtains and drapes - Part 4 - Method of determining the flame spread of vertically oriented specimens</td>
</tr>
<tr>
<td>17</td>
<td>IS 15741:2007</td>
<td>Textiles - Resistance to ignition of curtains and drapes - Specification (Based on EN)</td>
</tr>
<tr>
<td>18</td>
<td>IS 15742:2007</td>
<td>Textiles - Requirements for clothing made of limited flame spread materials and material assemblies affording protection against heat and flame - Specification (Based on EN)</td>
</tr>
<tr>
<td>19</td>
<td>IS 15748:2007</td>
<td>Textiles - Protective clothing for industrial workers exposed to heat (excluding firefighters' and welders' clothing)</td>
</tr>
<tr>
<td>24</td>
<td>IS 15764:2008</td>
<td>Textiles - Determination of the burning behaviour of textile floor coverings</td>
</tr>
<tr>
<td>25</td>
<td>IS 15768:2007</td>
<td>Textiles - Resistance of ignition of upholstered composite used for non-domestic furniture (Based on EN)</td>
</tr>
<tr>
<td>26</td>
<td>IS 15781:2007</td>
<td>Textiles-Means for determination of flammability of blankets</td>
</tr>
<tr>
<td>27</td>
<td>IS 15782:2007</td>
<td>Textiles - Method for deterioration of visibility due to smoke released on combustion of materials</td>
</tr>
</tbody>
</table>
APPRAOCH TO STANDARDIZE PERSONAL PROTECTIVE CLOTHING

Personal protective equipment is designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Besides face shields, safety glasses, hard hats, earplugs, respirators, safety shoes and others, PPE includes a variety of protection textiles and protective clothing, such as garments, coveralls, gloves, safety vests, life jackets. The foremost aim of standardization is to facilitate the exchange of goods and services through the elimination of technical barriers to trade. This would include the harmonization and standardization of national regulations, harmonized product safety requirements, harmonised conformance procedures and harmonized specifications for testing and certification bodies.

Industries at international and European level, public authorities, institutes, laboratories, user representatives and other non-governmental organisations such as trade unions are interested parties in the standardisation process, since standardised specifications and test methods facilitate trade and help to reduce costs. Small companies, which produce a lot of products pertaining to the specified standards in the field of PPE, have the opportunity to draw on the knowledge of the standards specifications for their manufacturing processes, although they may not be directly involved in the standardisation process itself. All have a vested interest in a set of standards that creates a terminology for the industry sector, defines generally valid product requirements for protective clothing, hand and arm protection and lifejackets and describe the relevant methods.

The standardisation of personal protective clothing takes place on international and national levels by different technical committees. Standardisation is a voluntary process based on consensus amongst different economic actors (industry, SMEs, consumers, workers, public authorities, etc.). It is carried out by independent standards bodies,
acting at national, European and international level. Originally conceived as an instrument by and for economic operators, standardisation has been used increasingly by authorities.

**ISO Standards for Technical Regulations**

The developed countries adopt ISO Standards as these standards have an advantage of a broad geographical reach and the standards are formulated with a multi-stakeholder involvement to ensure the representation of a wide range of technical views which relate to social and economic interests. Therefore, the value of International Standards from ISO is recognized, accepted and implemented around the globe. They are used by all interested stakeholders, such as manufacturers, trade organizations, purchasers, consumers, certification bodies, testing laboratories and authorities. Since these standards reflect the best experience of industry, researchers, consumers and regulators worldwide and cover common needs in a variety of countries, they constitute one of the important bases for the removal of unnecessary technical barriers to trade.

The incorporation of standards in legislative instruments by means of a reference constitutes a method of drafting a code or regulation in such a way that a detailed statement of technical requirements is replaced in the text of the code or regulation by a reference to one or more standards, or to the relevant parts thereof. The use in regulation of standards, and preferably of ISO is an effective means of supporting national, regional and global policies. It is already widely used in several regions of the world in concepts, agreements and frameworks such as the New Approach in the European Union, Good Regulatory Practice developed by the Asia-Pacific Economic Cooperation, Subcommittee on Standards and Conformance, and the North American Free Trade Agreement ISO standards:

- support the technical aspects of societal and environmental policies and contribute to sustainable development across the world;
• offer the same level of consumer protection whether applied in a mature or an evolving economy;
• allow products to be supplied and used across different markets, facilitating regulatory compliance and enhancing the market access opportunities for small enterprises;
• reflect the state of the art and serve as a vehicle for the dissemination of new technologies and innovative practices;
• can become national standards after a national public enquiry process carried out by a country’s standards body, which can reduce the need for the regulator to hold national consultations;
• can be used as a basis for national technical regulations without causing unnecessary technical barriers to trade
• offer a complete range of tools for the various modes of conformity assessment;
• are used for conformity assessment to enhance confidence in products, systems, processes, services or personnel;
• are developed using procedures which ensure that the thousands of standards available avoid duplication and conflict with each other.

Different types and aspects of ISO standards

The following are examples of the different types of standards and aspects of products and services that ISO standards cover. A single standard could cover one or several of these aspects.

Product specifications

These can often be all-encompassing, dealing with several of the requirements for a specific product as well as fitness for use and performance levels. They can cover sizes, health and safety, protection of the environment, interchangeability and data processing.

Organizational management

A suite of ISO standards is available to provide guidance to organizations on management issues in order to help them implement good practice and an effective management system. These deal with key aspects such as quality, security and environmental management.
Labeling and packaging
There are many standards that focus on providing information on products through labeling. These ensure that consumers and users around the world obtain reliable and clear information on properties of products, such as their size and their impact on the environment. Standards for safe packaging help convey best practice on key user issues, such as child-protective packaging. They can also show good practice procedures in such areas as reuse or storage.

Health and safety principles
There are standards providing generic principles for safety, security and ergonomic design and assessment.

Measurement, test and analytical methods
There are many standards specifying measurement, test and analytical methods. These standards are important because they ensure that measurement and test data produced around the world will be comparable.

Graphical symbols
A comprehensive range of internationally agreed graphical symbols is listed in ISO standards (e.g. ISO 7001, Graphical symbols — Public information symbols). The use of symbols helps to surmount linguistic barriers in fields dealing with safety and situations of emergency.

Terminology and definitions
Some standards are exclusively dedicated to definitions for use when addressing technical barriers to trade and their elimination. They standardize terms and definitions to facilitate mutual understanding in different fields.

Services
When providing services, suppliers have to meet the needs of their clients. ISO provides standards that define a level of service and/or the procedure for performing the service.
**Personnel**

These standards concern specified professions and trades where there exist normative and informative requirements for personnel. These include expected qualifications, work experience and levels of technical competence.

**Conformity assessment**

These standards and guides contain requirements for activities and bodies involved in the assessment of conformity, including suppliers’ declarations of conformity, inspection, certification, accreditation, peer assessment and mutual recognition.

**Methods of using and referencing ISO standards for technical regulations**

**General considerations**

Regulatory authorities decide themselves whether to use ISO standards to support their technical regulation. Once the decision to use an ISO standard in support of a regulation has been taken, the most appropriate method of making the reference in the legal text will need to be chosen.

Some commonly used methods of using and referencing ISO standards in regulation. The methods are available to regulatory activity at the national, regional or international levels.

The main considerations are listed below:

- Regulators will need to decide if they want the use of the ISO standard to be mandatory (providing the only solution) or voluntary (providing a solution).
- Regulators will need to decide what level of checks they wish to put in place to ensure the standard is suitable for use and addresses their needs.
- As ISO standards are subdivided into defined clauses and sub clauses, the regulator can choose to reference the whole standard or selected parts of it.
- ISO standards are regularly revised to keep up with technological and market changes.
Direct references to specific standards in the legal text

General

Direct referencing means that the reference of a specific standard is directly quoted within a legal text using its identification number and title. This method often supports the mandatory use of a standard, so careful wording of the regulation will be necessary if the regulator wants the use of the ISO standard to remain optional (i.e. as one of a number of solutions to help comply with the regulation).

By directly referencing standards in this way, regulators avoid reproduction of the standard in the legal text and eliminate the need to obtain permission for the use of copyright. Another advantage is that certain parts, or even single clauses of a standard, can be referenced where only a small part of a standard supports a regulation. There are two forms of direct referencing: dated and undated.

Direct dated references

Direct dated referencing is when the number and title of the ISO standard is referenced and used with its date of publication. This means that only a particular edition of a standard is used. This can help provide legal certainty by indicating the exact technical solution that may be used to comply with the regulation. Such legal certainty can help give assurance to the regulator and clarity for those who have to comply with the law. This is the most restrictive reference and is used when the objectives of future amendments and editions of a specific standard are uncertain.

As noted previously, ISO standards are reviewed on a regular basis to ensure they keep up to date with technological developments. It is therefore important when using dated references in regulations that any revisions of, or amendments to, ISO standards are taken into consideration by the relevant authority. The legal text will then need to be changed to note any amendments to, or revisions of, the standard. It should be borne in mind that references to specific clauses or sub clauses, tables, figures or annexes of a standard should always be dated. This is because any amendment to, or revision of, a standard
could lead to an alteration of its internal numbering. In areas where there is continuous and rapid technical development, and therefore a similar rapid development of the standards, direct dated references in the regulation could become obsolete. Other methods of referencing standards may be appropriate in such cases.

While completely new editions of a standard (with new dates) will always require a change to the legal text, amendments to the standard could be dealt with by the addition of a phrase such as “as amended” after the reference in the legal text.

**Direct undated references**

In the case of an undated reference, the regulation quotes only the number and title of a specific standard and not the date. This method is therefore more flexible. In the case of a revision of a referenced standard, the regulation itself does not need to be adapted and the reference automatically corresponds to the latest edition of the standard and therefore the state of the art. In other words, the regulation allows the use of subsequent revised editions of the same standard.

It should be noted, however, that the use of an undated reference is not possible when specific clauses or sub clauses, tables, figures or annexes of a standard are cited. In these cases, the reference should always be dated.

As with dated references, any amendments to, or revisions of, the standard should be tracked. In such instances, regulatory authorities could — although they are not obliged to — add the phrase “latest edition of”, the aim being to permit them to respond easily and quickly to technical changes.

**Indirect references to the use of ISO standards**

Indirect referencing involves recognizing and registering standards on an official information source external to the regulatory text. In this way, a list of standards deemed suitable by the regulator is compiled and published by an official process which the regulator controls. If a standard
Indirect referencing involves recognizing and registering standards on an official information source external to the regulatory text. This model has been applied in Europe where it is referred to as the “New Approach”.

Actions by regulators/authorities to encourage the use of ISO standards in some cases, it may be adequate merely to encourage the use of ISO standards on the assumption that their voluntary take-up by the market means those regulators’ objectives are met — for example, enhancing the quality of products or services in a particular sector. Such measures would not imply the creation of legal instruments, but could rather be achieved through, for example, government policy in targeted areas such as procurement. In cases where this occurs, the standard may become the de facto tool for market access.

Other considerations when choosing to use and reference ISO standards for technical regulations

Ensuring no delegation of legislative responsibility

Using ISO standards for technical regulation does not imply that regulators have reduced power or that they delegate responsibility to other parties. Regulators still have the power to change or update their legislation at any time, or to delete a reference if the standard loses its validity for the relevant legislation. Referencing ISO standards in technical regulation simply means that regulators make use of the existing consensus at international level.

The ISO processes benefit from a broad range of expertise and all standards are subjected to a period of public consultation before publication. This helps to ensure that they represent viable solutions which are the fruit of broad consultation.

It is acknowledged that, when a standard is to be used for regulatory purposes, the regulator will wish to ensure that it is fit for that regulatory
purpose. In particular, this will depend on the risks associated with the product, the national/regional situation and the purpose of the regulation. Regulatory procedures are therefore required when approving references to standards regardless of which method of referencing is used. There is a range of regulatory procedures which can be followed to ensure regulators’ confidence. The extent and type of the procedure chosen will depend on the risk posed by the product or service.

To summarize, regulators have a choice of techniques to assess and ensure the suitability of an ISO standard. They have at their disposal a broad range of methods for making reference to, and use of, the standard.

**National and regional adoptions of ISO standards**

ISO standards, as well as being stand-alone documents (with the designation ISO), can be formally adopted as national or regional standards and given designations combined with the ISO or IEC reference. National and regional adoptions of an ISO standard may involve a separate consultation process at national or regional level.

In some countries or regions, adoption may be an important and sometimes necessary element for the use of the ISO standard in technical regulation or public procurement. In other countries, ISO standards may be used or referenced directly in national technical regulation, based on an assessment of their suitability, without the need for them to be recognized as national standards for the country.

ILO periodically reviews standards to ensure that they remain current and abreast of technology.

**Maintenance procedures of ISO standards and recommendations to regulators for their monitoring**

ISO technical committees keep their standards up to date to reflect the state of the art. The committees periodically review standards to ensure that they remain current and abreast of technology. Regulatory authorities can develop procedures to assist them in monitoring the status of
standards referenced in their regulations. This monitoring could include the assessment of updates, amendments and withdrawals so that the regulatory authority can take appropriate action. There are various ways in which regulators can be kept informed of such changes, for example participation in the relevant committee or making arrangements with the relevant ISO national member.

The importance of regulator participation in standards development

The effective development and maintenance of a standard suitable for incorporation by reference in a legislative instrument requires that a cooperative effort between the regulatory authority and the standards development committee be established from the outset. Regulator participation greatly assists rendering the standards suitable for application in regulation. From the outset, the standards committee and regulator should have some understanding of the conformity assessment system that is likely to be in place to assess conformity to the standard in the future.

Participation in the national standardization process is facilitated by the ISO member.

Role of conformity assessment in technical regulations

Conformity assessment is the means of determining whether products, services, processes, systems and persons, meet specified requirements. Depending on the type of product or system and the criteria being examined, regulators may require that conformity assessment procedures be carried out by the supplier, the purchaser, the regulator or by an independent conformity assessment body. Regulations may specify which of these parties will carry out the conformity assessment activity appropriate to the level of risk involved. Conformity assessment can involve certification, inspection and/or the testing of a product or system.

Conformity assessment activities can be undertaken in various forms:
First-party conformity assessment

- First-party conformity assessment: when a person or an organization that provides a product makes a supplier’s declaration of conformity, supported by test results from its own laboratory or from an external laboratory that tests the supplier’s products to required standards.

Second-party conformity assessment

- Second-party conformity assessment: when a person or an organization having a user interest, such as a procurement body, witnesses testing or performs other verification to standards directly, either on prototype or through market surveillance, or both.

Third-party conformity assessment

- Third-party conformity assessment: when an independent conformity assessment body certifies, inspects and/or tests products or systems to standards. The results are proprietary to the conformity assessment body and the supplier. However, they may be provided by the supplier to the authority having jurisdiction, when necessary.

A regulatory authority may be considered a third-party when it undertakes conformity assessment activities itself. In some cases, regulators may wish to have a further level of confidence in conformity assessment results. This may involve the particular technical regulation requiring that the competence of conformity assessment bodies be formally recognized. Such competence may be demonstrated, amongst other means, through accreditation by an independent accreditation body — often established by the government.

ISO developed a series of standards and guides to ensure the international comparability and credibility of conformity assessment. The voluntary criteria these documents contain represent an international consensus on what constitutes best practice in conformity assessment. Regulators who need to include conformity assessment requirements in their technical regulations can use these documents as elements for the specific requirements in those regulations. Using these documents means international compatibility is fostered and technical barriers to trade can be avoided.

Examples of relevant conformity assessment documents from ISO and IEC are provided in the following table:
Market surveillance is accomplished through pre-market assessment and approval systems, or post-market surveillance programs. Market surveillance is a key component of the safety and quality infrastructure of a country. This may be accomplished through pre-market assessment and approval systems, or post-market surveillance programmes. ISO standards can facilitate market surveillance by providing a common, well-known set of requirements which are known to all the market participants.

With pre-market assessment, regulators have the opportunity to assess in advance the data provided by the party responsible for the product and to determine whether or not the product complies with the standards or conformity assessment procedures referenced in a regulation.

Post-market surveillance can be carried out through a variety of mechanisms. These could include:

- ISO 17000 Conformity assessment — Vocabulary and general principles
- ISO 17011 Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies
- ISO 17020 General criteria for the operation of various types of bodies performing inspection
- ISO 17021 Conformity assessment — Requirements for bodies providing audit and certification of management systems
- ISO 17024 Conformity assessment — General requirements for bodies operating certification of persons ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories
- ISO 17040 Conformity assessment — General requirements for peer assessment of conformity assessment bodies and accreditation bodies
- ISO 17050-1 Conformity assessment — Supplier’s declaration of conformity — Part 1: General requirements
- ISO 17050-2 Conformity assessment — Supplier’s declaration of conformity — Part 2: Supporting documentation
- ISO Guide 65 - General requirements for bodies operating product certification systems

Market surveillance

Market surveillance is a key component of the safety and quality infrastructure of a country. This may be accomplished through pre-market assessment and approval systems, or post-market surveillance programmes. ISO standards can facilitate market surveillance by providing a common, well-known set of requirements which are known to all the market participants.

With pre-market assessment, regulators have the opportunity to assess in advance the data provided by the party responsible for the product and to determine whether or not the product complies with the standards or conformity assessment procedures referenced in a regulation.

Post-market surveillance can be carried out through a variety of mechanisms. These could include:
• inspection and testing of products on the market,
• inspection of the requested marking on products and/or accompanying documents,
• validation of conformity assessment procedures followed by the supplier,
• verification of quality systems of the supplier’s manufacturing processes,
• examination of the supplier’s electronic and paper records,
• mandatory reporting of adverse incidents to the regulators, and
• corrective actions for non-conforming products.

-European Approach for Standardization-

In Europe PPE products must be certified. Distinction is drawn between the manufacture and the use. The use of PPE is governed by EC Directive 89/656/EEC concerning the minimum safety & health requirements for the use at the workplace (EC, 1989b). Where the presence of more than one risk makes it necessary than PPE must be compatible and continue to be effective against the risk or risks in question.

In Europe PPE are products that must be certified. Since 1st January 1993, the date for the realisation of the European home market, harmonised regulations for admission and use of PPE were validated in the whole European economic area. Personal protective equipment shall be used when the risks cannot be avoided or sufficiently limited by technical means of collective protection or by measures, methods or procedures of work organisation. In Europe a clear distinction is drawn between the manufacture of PPE and the use of PPE products. The use of PPE is governed by EC Directive 89/656/EEC (called ‘users directive’) concerning the minimum safety and health requirements for the use by workers of PPE at the workplace (EC, 1989b).

Employers are obliged to guarantee a series of requirements. Personal protective equipment must comply with the relevant Community provisions. Where the presence of more than one risk makes it necessary for a worker to wear simultaneously more than one item of personal protective equipment, such equipment must be compatible and continue to be effective against the risk or risks in question. The conditions of use of personal protective equipment, in particular the period of which it is worn, shall be determined on the basis of the seriousness of the risk, the frequency of exposure to the risk, the characteristics of the work station of each worker and the performance of the personal protective equipment. Personal protective
equipment is, in principle, intended for individual use. Adequate information on each item of PPE shall be provided. Personal protective equipment shall be provided free of charge by the employer, who shall ensure its good working order and satisfactory hygienic condition by means of the necessary maintenance, repair and replacement. The employer shall first inform the worker of the risks against which the wearing of the personal protective equipment protects him. The employer shall arrange for training.

Requirements

Social and technical factors

Health and safety precautions necessitate the use of protective clothing, hand and arm protection and lifejackets in a large number of workplaces and leisure time activities. European accident statistics show that more than 50% of all work accidents are to the hand, arm, leg and body area and necessitate absence from work (of at least one day). More than 40% of work disabilities are caused by injuries to the hand, arm, leg and body area. In the United States studies show that the majority of workplace injuries could be avoided if employees used the proper PPE.

In all developed industries the legal authorities for occupational health and safety regard a high level of safety of PPE as a fundamental social factor. This level of safety can be ensured by specifications contained in modern standards based on technical progress in the world. The definition of improved ergonomic design and comfortable physiological parameters in the standards can increase the acceptance of protective clothing, hand and arm protection and lifejackets. The number of fall accidents and related injuries can be reduced considerably.

The technical factor influencing the elaboration of standards for PPE is based on the technological developments, advances in the materials used, further development of legislation in the field of OSH, and the awareness of the user, that its use can help to ensure his quality of life.
European standardization approach has 4 principles. Only the basic H&S requirements are specified in directives. Bodies responsible for industrial standardization prepare standards to supplement the basic H&S requirements; which remain voluntary. Once the harmonized standard has been announced, products are to be manufactured in accordance with this standard. Manufacturers therefore need to translate these essential requirements into technical solutions.

Standardization in line with these views can be seen as a key component of the market and the workers' safety.

**Basic health and safety requirements**

European standardization has gained increasing importance since 1985 with the resolution on a new approach in the field of technical harmonization and standardization. This new approach includes four general principles. Only the basic health and safety requirements are specified in directives. Bodies responsible for industrial standardization prepare European standards to supplement the basic health and safety requirements, taking account of the state of the art. These European standards remain voluntary. Once the creation of a harmonized European standard has been announced in the *Official Journal of the European Communities*, products manufactured in accordance with this standard can be assumed to conform to the basic health and safety requirements. New approach directives are special in that they do not contain technical detail, they contain broad safety requirements. Manufacturers therefore need to translate these broad, essential requirements into technical solutions. One of the best ways that manufacturers can do this is to use specially developed European standards. These standards are called harmonized standards and they are said to give a 'presumption of conformity' with the directive for which they have been written.

The Council Directive 89/686/EEC (called 'PPE directive' or 'manufacturers directives') lays down the basic safety requirement, which PPE must satisfy in order to ensure the health protection and safety of users. For the purposes of this directive, PPE shall mean any device or appliance designed to be worn or held by an individual for protection against one or more health and safety hazards. The following Table shows the basic health and safety requirements and additional requirements in overview.
## Basic health and safety requirements of PPE

according to European directive 89/686/EEC

<table>
<thead>
<tr>
<th>TYPE OF REQUIREMENTS</th>
<th>SUB-GROUPS</th>
<th>SINGLE SAFETY REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>General requirements applicable to all PPE</td>
<td>Design principles</td>
<td>Ergonomics</td>
</tr>
<tr>
<td></td>
<td>Innocuousness of PPE</td>
<td>Levels and classes of protection</td>
</tr>
<tr>
<td></td>
<td>Comfort and efficiency</td>
<td>Absence of risks and other 'inherent' nuisance factors</td>
</tr>
<tr>
<td></td>
<td>Information supplied by the manufacturer</td>
<td>Adaption of PPE to user morphology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lightness and design strength</td>
</tr>
<tr>
<td>Additional requirements common to several classes of types of PPE</td>
<td>PPE incorporating adjustment systems</td>
<td>Compatibility of different classes or types of PPE</td>
</tr>
<tr>
<td></td>
<td>PPE 'enclosing' the parts of the body to be protected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE for the face, dyes and respiratory tracts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE subject to ageing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE which may be caught up during use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE for use in explosive atmospheres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE intended for emergency use or rapid installation and/or removal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE for use in very dangerous situations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE incorporating components which can be adjusted or removed by the user</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE for connection to another, external complementary device</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE incorporating a fluid circulation system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE bearing one or more identification or recognition marks directly or indirectly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPE in the form of clothing capable of signalling the user's presence visually 'Multi-risk' PPE</td>
<td></td>
</tr>
</tbody>
</table>

Contd.....
Not only will the PPE itself be marked with the specified information, but a significant amount of information will be also shown on the packaging. This will include the names of the manufacture or his representative in the Community, the PPE description, size, CE mark, one or more of the pictograms given below and any other relevant information. The pictogram will be accompanied by a sequence of numbers indicating the product’s performance in the various tests of the particular standard indicated by the program. The pictograms show protection against the different hazards.
Some pictograms for protection equipment

<table>
<thead>
<tr>
<th>Moving parts</th>
<th>Weather protection</th>
<th>Poor visibility risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low temperature</td>
<td>Electric shock</td>
<td>Chainsaw operator risk</td>
</tr>
<tr>
<td>Chemicals</td>
<td>Heat and flames</td>
<td>Ionizing radiation</td>
</tr>
</tbody>
</table>

Items specifically excluded from the scope of the Regulations include:

- PPE manufactured for use in a country outside the Community, or imported into the Community for re-export to a country outside the Community.

- Non-compliant PPE for presentation at trade fairs, exhibitions and the like, provided that an appropriate notice is displayed drawing attention to the fact that:
  - the PPE is not in conformity with the provisions of the Directive; and
  - it may not be acquired or used until it has been brought into conformity by the manufacturer or his authorized representative established in the community.

- PPE designed and manufactured specifically for use by the armed forces or in the maintenance of law and order (helmets, shields etc).

- PPE for self-defence (e.g. aerosol canisters, personal deterrent weapons etc).

- PPE intended for the protection or rescue of persons on vessels or aircraft, not worn all the time.
• Helmets and visors intended for users of two or three-wheeled motor vehicles.
• Second-hand PPE, except for that which, since its last use, has been subjected to further manufacture or refurbished and resold as new PPE.
• PPE covered by another Directive, designed to achieve the same objectives as the PPE Directive with regard to placing on the market, free movement of goods and safety of PPE.

General requirements applicable to all types of PPE concern design principles innocuousness of the PPE, comfort and efficiency, and the information supplied by the manufacturer. A lot (more as 300) of European standards for PPE have been developed as the preferred means of demonstrating equipment conformity with the basic health and safety requirements of Directive 89/686/EEC. Only equipment which meets these requirements is entitled to carry the CE mark (CE: Communauté Européenne = European Community; Figure-1), and can be sold for use in the EC; CE marking is the ‘Passport for free exchange of goods’. The CE mark is not primarily a sign of quality; it is a conformity label to guarantee correspondence to the harmonised requirements.

The CE marking must be affixed to each piece of PPE so as to be visible, legible and indelible throughout the expected life of the PPE; however, if this is not possible in view of the characteristics of the product, the CE marking may be affixed to the packaging. The CE mark must be at least 5mm high and in the font style given in the Regulations.

The CE mark is not primarily a sign of quality; it is a conformity label to guarantee correspondence to the harmonized requirements.
**Addition al requirements**

Besides the basic requirements a manufacturer of PPE has to consider additional requirements common to several classes or types of PPE and requirements specific to particular risks.

For example, all PPE designed to protect the user against several potentially simultaneous risks must be so designed and manufactured as to satisfy, in particular, the basic requirements specific to each of those risks. PPE designed to protect all or part of the body against the effects of heat and/or fire must possess thermal insulation capacity and mechanical strength appropriate to foreseeable conditions of use. Constituent materials and other components suitable for protection against radiant and convective heat must possess an appropriate coefficient of transmission of incident heat flux and be sufficiently incombustible to preclude any risk of spontaneous ignition under the foreseeable conditions of use.

**Basic standards**

Typical groups of European standardised protective clothing and protection textiles are listed in the following Table (The complete and updated list is in Appendix 3)

<table>
<thead>
<tr>
<th>PROTECTIVE FUNCTION</th>
<th>STANDARD CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective clothing against heat and flame</td>
<td>EN 531</td>
</tr>
<tr>
<td>Protective clothing for use in welding and allied processes</td>
<td>EN 470-1</td>
</tr>
<tr>
<td>Protective clothing against mechanical impacts</td>
<td>EN 510</td>
</tr>
<tr>
<td>Protective clothing for users of hand-held chainsaws</td>
<td>EN 381 - series</td>
</tr>
<tr>
<td>Firemen's protective clothing</td>
<td>EN 469</td>
</tr>
<tr>
<td>Protective clothing against cold</td>
<td>EN 342</td>
</tr>
<tr>
<td>Protective clothing against foul weather (moisture, wind, cold)</td>
<td>EN 343</td>
</tr>
<tr>
<td>Protective clothing against radioactive contamination</td>
<td>EN 1073</td>
</tr>
<tr>
<td>Protective clothing against electric hazards/ electrostatic charges</td>
<td>EN 1149</td>
</tr>
<tr>
<td>Protection against thermal hazards of an electric arc</td>
<td>CLC/TS 50354</td>
</tr>
<tr>
<td>High-visibility warning clothing</td>
<td>EN 471</td>
</tr>
</tbody>
</table>
The most important standards for protective clothing which always have to be taken into consideration are:

- EN 340: 12-2003 Personal protective clothing - general requirements, and
- EN 420: 09-2003 General requirements for gloves

At international level the standards correspond (but not identically) e.g., to

- ISO 13688: 1998 Personal protective clothing - general requirements
- AS/NZS 2161.2:1998 General requirements (gloves)
- AS/NZS 4501.2:1999 General requirements (protective clothing)

The European standard EN 340 specifies general performance requirements for ergonomics, innocuousness, size, designation, ageing, compatibility and marking of protective clothing, and the information to be supplied by the manufacturer of the protective clothing. Basic health and ergonomic requirements are stated that are relevant for many types of protective clothing. Protective clothing shall not adversely affect the health or hygiene of the user. Protective clothing shall be made of materials such as textiles, leather, rubbers, plastics that have been shown to be chemically suitable. The materials shall not in the foreseeable conditions of normal use release, or degrade to release, substances generally known to be toxic, carcinogenic, mutagenic, allergic, toxic to reproduction or otherwise harmful. Information claiming that the product is innocuous shall be checked.

Protective clothing should be as light as possible taking into account comfort, water vapour resistance, design, and protection level. Protective clothing should provide users with a level of comfort consistent with the level of protection which is provided against the hazard, the ambient conditions, the level of the user’s activity, and the anticipated duration of use of the protective clothing. Protective clothing that imposes significant ergonomic burdens such as heat
stress, or is inherently uncomfortable because of the need to provide adequate protection, should be accompanied in the information supplied by the manufacturer by specific advice or warnings. Specific advice on the appropriate duration for continuous use of the clothing in the intended application(s) should be given.

**Certification**

**EC type Examination**

In accordance with the European regulation, before placing a PPE model on the market, the manufacturer or his authorized representative established in the Community shall carry out a „EC declaration of production conformity‘. The EC declaration of conformity is the procedure whereby the manufacturer draws up a declaration certifying that the PPE placed on the market is in conformity with the provisions of Directive 89/686/EEC and affixes the EC mark of conformity to each PPE. Affixing the CE mark to a piece of personal protective equipment is equivalent to a graphical declaration of conformity with the relevant health and safety requirements of the PPE directive and other relevant directives.

PPE is categorized into three different types – simple, intermediate and complex, depending on the hazard potential they protect against. The distinction is an important one as it affects the way in which manufacturers and importers are able to demonstrate compliance with the Regulations.

I. ‘Simple’ Design

PPE models of „simple“ design are those where the designer assumes that the user can himself assess the level of protection provided against the minimal risks concerned, the affects of which, when they are gradual, can be safely identified by the user in good time. This type of PPE is intended to protect the wearer exclusively against:
• Mechanical action whose effects are superficial (gardening gloves, thimbles)
• Cleaning materials of weak action and easily reversible effects (gloves affording protection against diluted detergents);
• Risks encountered in the handling of hot components which do not expose the user to a temperature exceeding 50°C, or to dangerous impacts (gloves, aprons for professional use);
• Atmospheric agents of neither exceptional nor extreme nature (headgear, seasonal clothing, footwear);
• Minor impacts and vibrations etc which do not affect vital areas of the body and whose effects cannot cause irreversible lesions (light anti-scalping helmets, gloves, light footwear); and
• Sunlight (sunglasses). However this does not include PPE used for high reflecting environment or in altitude.

II. ‘Intermediate’ Design
This comprises all models of PPE, which are neither covered by the „simple“ design type nor the „complex“ design type.

III. ‘Complex’ Design
PPE models of „complex“ design are intended to protect against mortal danger, or against dangers that may seriously and irreversibly harm health, the immediate effects of which the designer assumes that the user cannot identify in sufficient time. This type of PPE covers exclusively:

• Filtering respiratory devices for protection against solid and liquid aerosols or irritant, dangerous, toxic or radiotoxic gases;
• Respiratory protection devices providing full insulation from the atmosphere including those for use in diving;
• PPE providing only limited protection against chemical attack or against ionizing radiation;
• Emergency equipment for use in high-temperature environments, the effects of which are comparable to those of an air temperature of 100°C or more and which may or may not be characterized by the presence of infra-red radiation, flames or the projection of large amounts of molten materials;
• Emergency equipment for use in low-temperature environments
  the effects of which are comparable to those of an air
  temperature of -50°C or less;
• PPE to protect against falls from a height;
• PPE to protect against electrical risks and dangerous voltages
  or that used as insulation in high-tension work.

This classification is of extraordinary importance for the required set
of tests and certifications (conformity assessment) of a product
(Table). The conformity assessment proceeding from the EC is
modular, and consists of eight basic modules. The modules range from
the manufacturer’s production control up to a comprehensive quality
assurance system. They are identical to a great extent to a quality
management system in accordance with ISO 9001.

For category I (simple protective clothing) a self-conformity statement
by the manufacturer itself is sufficient.

For products of category II (middle hazard potential) the manufacturer
has to apply for an EC type examination to a notified body. EC type
examination is the procedure whereby the approved inspection body
(notified body) establishes and certifies that the PPE model in question
satisfies the relevant provisions of this directive. A notified body is
designated by the Member States, when a series of conditions to be
fulfilled, like independence in carrying out the tests, technical
competence, and professional integrity of personnel and others. Each
member state shall inform the Commission and the other member
states of the approved bodies responsible for the execution of the
certification procedures (EC type examination). For information
purposes, the Commission shall publish in the Official Journal of the
European Communities and keep up to date a list giving the names of
these bodies and the distinguishing numbers it has assigned to them.

The EC type examination alone is not sufficient for PPE of category III
(complex protective clothing with protection against life-threatening or
health-threatening hazards). For these applications additional measures
for quality assurance during the serial manufacturing process of the
product are required. These measures are obligatory and must be controlled by a responsible authority.

Further details of the three categories with respect to EU directives are as under:

**Category I**
Covers the lowest level of PPE. The user is assumed to assess the needs for protection himself, and there is a limited risk of severe consequences of not using appropriate clothing. The products under this category are self declared by the marketer to comply with the standards. Products under this category are waterproof clothing (EN 343) and protecting clothing against cold (EN 342).

**Category II**
Covers products intended to be used in environments with risk for severe, but no fatal consequences. The products must be tested and certified by a notified body. Products under this category are flame retardant clothing (EN 531/533), clothing for high visibility (EN 471) and lifejackets (EN 395, 396 and 399) and buoyancy aids (EN 393).

**Category III**
Covers products and environments where the user can be exposed to mortal danger or to dangers that may seriously and irreversibly harm health.

**EN 340**
General requirements of the protective garments, used only in combination with specific standards such as EN342 etc. General requirements are for ergonomics, aging, sizing, and marking of protective clothing, and for information supplied by the manufacturer.

**Marking (on the product itself or printed on a label fastened to the product)**

- name, commercial brand
- designation of the product type
- designation of the size
- number of the appropriate standard
- pictograms and, if necessary, performance levels
• the “i” marked on a pictogram indicates the need for the user to refer to manufacturer instructions
• maintenance labelling
• instructions for use

PPE Category 1 Standards EN 342, EN 343

**EN 342 : Protection Against Cold**

Products are tested by measuring the insulation for an ensemble (jacket, trouser) worn. Air permeability and breathability are also measured. Figures (1, 2 or 3) are given against X for insulation, Y for air permeability and Z for breathability; higher figures are best.

<table>
<thead>
<tr>
<th>X</th>
<th>Insulations, actual data (higher figure is best)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>Air permeability, level 1, 2 or 3</td>
</tr>
<tr>
<td>Z</td>
<td>Breathability, level 1, 2 or 3</td>
</tr>
</tbody>
</table>

**EN 343 : Protection Against Foul Weather**

These garments are intended to protect against weather conditions with combinations of precipitation, rain, fog, humidity and wind at temperatures down to +5°C. They are tested for waterproofness (X) and breathability (Y); figures (1, 2 or 3) are given and higher figures are best.

<table>
<thead>
<tr>
<th>X</th>
<th>Waterproofness, level 1, 2 or 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>Breathability, level 1, 2 or 3</td>
</tr>
</tbody>
</table>

PPE Category 2 Standards EN 531, EN 533, EN 471

**EN 531 : Protection Against Heat and Flame (for the workers of industry exposed to heat)**

The standard specifies the performance requirements for protective clothing for workers from industry against the brief contacts with a flame and against at least a type of heat. Heat can be presented in the form of convective heat, of radiant heat, significant projections of molten metals or a combination of these risks of heat.
A Limited flame spread
B Convective heat (level B1-B5)
C Radiant heat (level C1-C4)
D Molten aluminium splash (level D1-D3, X= not tested)
E Molten cast iron splash (level E1-E3, X= not tested)

EN 533 : Protection Against Heat and Flame (*Index of resistance of outside shell*)

The standard specifies the performance requirements for the limited flame spread properties of materials and material assemblies used in protective clothing. The material is classified in accordance with an index for limitation of flame spread (X) before and after a standard washing procedure (Y).

- **X** Index of resistance of outside shell flame Index 1, 2 or 3
- **Y** Number of washes at a given temperatures

EN 471 : High Visibility Clothing

The standard specifies requirements for clothing intended to provide visibility of the user in hazardous situations under any light conditions by day and under illumination by vehicle headlights in the dark (24 hours visibility). Effective visibility is to be provided by a fluorescent fabric and reflective stripes. The visibility is measured as a combination of the area and positioning of the reflective materials (X) and the quality of same (Y).

- **X** Area reflex/fluorescent fabric, level 1, 2 or 3
- **Y** Reflex type/quality 1 or 2
**PPE Category 3 Standards EN 1149, EN 470, EN 469, EN 1486, EN 13034, EN 465, EN 466, EN 467, EN 943-1**

**EN 1149 : Antistatic Protective Clothing**

The standard specifies the electrostatic requirements and the test methods for protective clothing dissipating static electricity to avoid sparks which could cause fires. The current European standard does not apply for protection against mains voltage.

- EN 1149-1 Electrical surface resistivity (<5E+10 Ohms on at least one of the sides)
- EN 1149-2 Measuring electrical vertical resistance
- EN 1149-3 Dissipation of electrostatic charge from the surface of the materials for garments

**EN 470 : Welding & Similar Operations Protective Clothing**

The clothing is intended to protect the user against small splashes of molten metal (EN 348), short contact time with flame (EN 532), and ultra violet radiation, and to be worn continuously for up to 8 hours at ambient temperature.

**EN 943-1: Protective Clothing Against Liquid & Gaseous Chemicals, including liquid aerosols and solid particles**

Performance requirements for ventilated and non-ventilated gas-tight (Type 1) and non-gas-tight (Type 2) chemical protective suits including components such as the eyespieces, respiratory apparatuses, gloves and boots.

**EN 465 : Protective Clothing Against Liquid Chemicals**

The standard specifies the performance requirement for chemical protection garments with fogs tight joints between the different parts of the garment.
**EN 466 : Protective Clothing Against Liquid. Chemicals, connections tight with the liquids**

Performance requirements for chemical protective clothing with liquid-tight connections between different parts of the clothing (e.g. gloves, boots) intended to protect their carrier against the liquid chemicals.

**EN 467 : Protective Clothing Against Liquid and Solid Chemicals**

The standard specifies the minimal requirements requested from the garment for a protection against the chemicals with certain parts of the body (e.g. aprons, handles, hoods).

**EN 13034 : Protective Clothing Against Liquid Chemicals**

Performance requirements for the combinations of chemical protection of limited use and reusable. Garment offers a limited protection against the exposure to the liquid aerosols, the fog and the light splashes where the type of potential exposure, for, mist, etc. is defined.

**EN 1486 : Protective Clothing for Firefighters**

Test methods and requirements for reflective clothing for specialised fire fighting.

- Type 1 Hood / shoulder cape / visor and gloves
- Type 2 Floor length coat / hood / visor and gloves
- Type 3 Suit incorporating boots / hood / visor

**EN 469 : Protective Clothing for Fire Fighters**

Minimum performance levels are exceeded for flame spread, heat transfer from flame and radiant heat, residual strength and heat resistance. Additional requirements may be met for tensile strength, tear strength, surface wetting, dimensional change, penetration by liquid chemicals, water resistance and breathability.
# Categorisation of PPE and Requirements for the manufacturer according to Directive 89/686/EEC

<table>
<thead>
<tr>
<th>Step 1: Draw up necessary technical documentation</th>
<th>Simple PPE</th>
<th>Intermediate PPE</th>
<th>Complex PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>This might include:</strong></td>
<td><strong>As for Simple PPE, but documentation must also include a technical file comprising:</strong></td>
<td></td>
<td><strong>As for Intermediate PPE</strong></td>
</tr>
<tr>
<td>o Description of and/or sample of the PPE to which it relates;</td>
<td>a) Overall &amp; detailed plans of the PPE in question, results of testing &amp; the testing facilities used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o List of basic health &amp; safety requirements for the PPE, &amp; the means used to satisfy those requirements, including:</td>
<td>b) A complete list of the basic health and safety requirements, national standards (if any) and other technical specifications taken into account in its design.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Details of any harmonised standards employed in the PPE's manufacture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Details of any other national or other standards, or recognized specifications, employed in the PPE's manufacture;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Any other technical specifications to be taken</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Performance characteristics and details of intended use</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2: Declaration of Conformity</th>
<th>Simple PPE</th>
<th>Intermediate PPE</th>
<th>Complex PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare an EC Declaration of Conformity</td>
<td>Submit an approved body for CE type examination.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3: CE Mark</th>
<th>Simple PPE</th>
<th>Intermediate PPE</th>
<th>Complex PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affix the CE mark to the product</td>
<td>Affix the CE mark to the product</td>
<td>Affix the CE mark to the product (ID No. of Approved Body to be marked adjacent)</td>
<td></td>
</tr>
</tbody>
</table>
Manufacturer's Responsibility

The PPE Directive gives manufacturers the option of complying with its requirements by manufacturing either directly in accordance with the basic health and safety requirements, or to harmonized European standards, which have been developed specifically to allow a presumption of conformity with those requirements.

Figure-2 shows schematically the procedure and the activities between different groups in the chain of certification. The manufacturer of the PPE stands in the centre and must meet all requirements for the CE marking and the conformity declaration. Beside the CE marking the following information must be presented on the PPE product: business name and full address of the manufacturer, type, name or any other identification of the product, size, the harmonized European standard fulfilled, pictogram for the risk which the product should protect against, including performance classes, and care labels.

Manufacturers of PPE must decide in light of all the available information whether their product is covered by the regulations and if so whether it is PPE of a “simple”, “intermediate” or “complex” design. The Regulations require a manufacturer to create and sign a Declaration of Conformity for each type of product and its variants.

Manufacturers must decide in light of all the available information whether their product is covered by the regulations and if so whether it is PPE of a “simple”, “intermediate” or “complex” design. The Regulations require a manufacturer to create and sign a Declaration of Conformity for each type of product and its variants.

Importers of PPE directly into the European Community, with a view to placing it on the Community market should ensure it has been manufactured in accordance with the requirements of the Regulations, and bears the CE mark.

Distributors of PPE (e.g. wholesalers, retailers) have a statutory duty to ensure the PPE satisfies the safety requirements and bears the CE marking.

The Regulations require a manufacturer to create and sign a Declaration of Conformity for each type of product and its variants.
Figure- 3 outlines the content of such a declaration. It should in English. If PPE should be used in an EU country with its own official language, it should also be written in its language. It must also be signed by a representative of the manufacturer. This might be a director of the company. In the event of a false declaration being made, action may be taken against the person who has signed the declaration as well as the manufacturer.

Figure-2 : Schematic procedure of CE-marking according to European Council Directive 89/686/EEC
The manufacturer or his authorized representative in the Community
Company Name/Address etc.

Declarations that the new PPE described below:

Product make and model

Serial number

Category (Simple / Intermediate / Complex)

* Is in conformity with the provisions of Council Directive 89/686/EEC and, where such is the case, the national standard transposing harmonized standard (State which standard used)

* Is identical to the PPE which is the subject of the EC certificate of conformity no..............issued by (State name and address of approved body)

* Is subject to the procedure set out in Article 11 Point A* or Point B* of Directive 89/686/EEC, under the supervision of (State name and address of approved body)

Signed: ............
Position: .....................................
Date: .........................................

*Delete as appropriate

Figure-3 : Example of a Declaration of conformity

Product Quality management and Risk assessment

A manufacturer shall take all steps necessary to ensure that the manufacturing process, including the final inspection of PPE and tests, ensures the homogeneity of production and the conformity of PPE with the type described in the EC type approval certificate and with the relevant basic requirements of the PPE directive. A body to which
notification has been given, chosen by a manufacturer, shall carry out the necessary checks. Those checks shall be carried out at random, normally at intervals of at least one year.

In addition to the EC type examination process, PPE of complex design must also be subject to one of two quality control systems: Final product checks by approved body and Quality system adopted by manufacturer.

In addition to the EC type examination process, PPE of complex design must also be subject to one of two quality control systems. This is to ensure that manufactured PPE does in fact meet the quality and safety of the samples originally submitted for EC type examination. The two types of system are:

- **Final product checks by approved body** ("Point A" in the Directive): The manufacturer appoints an approved body (which may be the same one used for the EC type examination). At least once a year, the approved body makes the necessary checks to ensure that the PPE conforms with the pre-production PPE for which the EC type examination certificate was issued, and that it meets the basic health and safety requirements.

- **Quality system adopted by manufacturer** ("Point B" in the Directive): The manufacturer must check each item of PPE under a quality control system that is approved and audited by a suitably qualified approved body.

The risk assessment procedure should include: identification of the activities to be undertaken by the person(s) who will require to wear PPE, a list of the hazards present, a quantification of the risks that would result from an exposure to the hazards at the foreseeable level, and duration; whether PPE is needed or whether the problem can be solved by other measures; considerations of the protection provided by other control measures; determination of the level and extent of protection required from the PPE (in absolute or relative terms) the environment where the protection has to be worn; additional risks inherent to the use of PPE (ergonomic considerations, heat stress, etc.). Risk assessment should be done by trained personnel. The knowledge and experience of the users of the PPE should be taken into account. A number of risk assessment models may be used to determine the level of risk associated with the activities.
The American Approach

In USA, under a regulation of Occupational Safety and Health Administration (OSHA), an employer must meet specific requirements concerning PPE, analogically to the European regulations.

The regulation also gives employees specific rights concerning PPE. OSHA requires employers to survey the workplace to identify hazards, determine whether any hazard requires PPE, pay special attention to working conditions or processes that can produce the hazards, like falling objects, objects that could puncture the skin, objects that could roll over workers’ feet, toxic chemicals, heat, harmful dust, radiation. Hazards shall be reassessed whenever necessary, especially when new equipment is installed or following accidents. The employer must select appropriate equipment and ensure that all PPE used is the right kind of equipment for the job, and that it is maintained properly, except when workers are using their own equipment. Every employer must ensure that PPE provides a level of protection above the minimum required to protect the worker. All PPE fits properly, no defective or damaged PPE is used, and all PPE is properly cleaned and maintained on a regular basis. The employer must train workers who use PPE.

The OSHA requires that employers protect their employees from workplace hazards that can cause injury:

- Understanding the types of PPE.
- Knowing the basics of conducting a “hazard assessment” of the workplace.
- Selecting appropriate PPE for a variety of circumstances.
- Understanding what kind of training is needed in the proper use and care of PPE.

The information, methods and procedures are based on the OSHA requirements for PPE as set forth in the code of Federal Regulations (CFR) at 29 CFR 1910.132 (General requirements); 29 CFR 1910.133 (Eye and face protection); 29 CFR 1910.135 (Head protection); 29 CFR
For OSHA, a first critical step in developing a comprehensive safety and health program is to identify physical and health hazards in the workplace. The hazard assessment should begin with a walk-through survey of the facility to develop a list of potential hazards

For OSHA, a first critical step in developing a comprehensive safety and health program is to identify physical and health hazards in the workplace. This process is known as a “hazard assessment.” Potential hazards may be physical or health-related and a comprehensive hazard assessment should identify hazards in both categories. Examples of physical hazards include moving objects, fluctuating temperatures, high intensity lighting, rolling or pinching objects, electrical connections and sharp edges. Examples of health hazards include overexposure to harmful dusts, chemicals or radiation.

The hazard assessment should begin with a walk-through survey of the facility to develop a list of potential hazards in the following basic hazard categories:

- Impact,
- Penetration,
- Compression (roll-over),
- Chemical,
- Heat/cold,
- Harmful dust,
- Light (optical) radiation, and
- Biologic.
In addition to noting the basic layout of the facility and reviewing any history of occupational illnesses or injuries, things to look for during the walk-through survey include:

- Sources of electricity,
- Sources of motion such as machines or processes where movement may exist that could result in an impact between personnel and equipment,
- Sources of high temperatures that could result in burns, eye injuries or fire
- Types of chemicals used
- Sources of harmful dusts:
  - Sources of high radiation, such as welding, brazing, cutting, furnaces, heat treating, high intensity lights, etc.,
- The potential for falling or dropping objects,
- Sharp objects that could poke, cut, stab or puncture, and
- Biologic hazards such as blood or other potentially infected material.

When the walk-through is complete, the employer should organize and analyze the data so that it may be efficiently used in determining the proper types of PPE required at the worksite. The employer should become aware of the different types of PPE available and the levels of protection offered. It is definitely a good idea to select PPE that will provide a level of protection greater than the minimum required to protect employees from hazards.

The workplace should be periodically reassessed for any changes in conditions, equipment or operating procedures that could affect occupational hazards. This periodic reassessment should also include a review of injury and illness records to spot any trends or areas of concern and taking appropriate corrective action. The suitability of existing PPE, including an evaluation of its condition and age, should be included in the reassessment.
suitability of existing PPE, including an evaluation of its condition and age, should be included in the reassessment. Documentation of the hazard assessment is required through a written certification that includes the following information:

- Identification of the workplace evaluated,
- Name of the person conducting the assessment,
- Date of the assessment, and
- Identification of the document certifying completion of the hazard assessment.

**The Requirement for PPE**

To ensure the greatest possible protection for employees in the workplace, the cooperative efforts of both employees and employers will help in establishing and maintaining a safe and healthful work environment. In general, all employees are responsible for

- Performing a “hazard assessment” of the workplace to identify and control physical and health hazards,
- Identifying and providing appropriate PPE for employees. Training employees in the use and care of the PPE,
  - Maintaining PPE, including replacing worn or damaged PPE, and
  - Periodically reviewing, updating and evaluating the effectiveness of the PPE program.

In general, employees should:

- Property wear PPE,
- Attend training sessions on PPE,
- Care for, clean and maintain PPE, and
- Inform a supervisor of the need to repair or replace PPE.

**Types of Protection and Standards**

Specific requirements for PPE are presented in many different OSHA standards, published in 29 CFR. Some standards require that employers provide PPE at no cost to the employee while others simply state that the employer must provide PPE.
OSHA’s primary PPE standards (Table) are in Title 29 of the Code of Federal Regulations (CFR), Part 1910 Subpart I, and equivalent regulations in States with OSHA approved State plans. The legal citation for the general PPE standard is 29 CFR 1910.132. There are additional standards that cover different specialised types of PPE. Similar and separate PPE standards cover construction (29 CFR 1926.95-106), shipyard, maritime and long shore workers. Public-sector workers for example in New York State are also covered by the PPE standards under PESH (Public Employees Safety & Health).

The basic standard 29 CFR 1910.132 requires that protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition.

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The basic standard 29 CFR 1910.132 requires that protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition. The standard applies wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a
manner capable of causing injury or impairment to the function of any part of the body through absorption, inhalation or physical contact.

One can find PPE requirements also elsewhere in the General industry Standards (Personal Protective Equipment) divided into six sections:

Section 0 – Intro to 29 CFR 1910, PPE for General Industry.
Section I – Background.
Section II – Workplace hazards involved.
Section III – Summary and explanation of the final rule.
Section IV – Regulatory impact, regulatory flexibility and environmental assessment of revisions to subpart I, personal protective equipment introduction.
Section V - Statutory considerations.

**Quality, Risk Assessment, Safety and Health Programs**

With regard to the quality guarantee, as in Europe, similar regulations are given by the OHSAS 18001. This is a consensus standard developed in 1999 by an independent group of national standards bodies and certification bodies. OHSAS stands for Occupational Health and Safety Assessment Series. OHSAS 18001 is structured the same way as ISO 14001, the environment management system standard and has essentially the same elements. It was specifically developed to be compatible with ISO 9001, the quality management system standard, and ISO 14001 to allow companies to develop and register integrated quality, environmental and occupational safety and health management systems.

OSHA’s general PPE requirements mandate that employers conduct a hazard assessment of their workplaces to determine what hazards are present that require the use of PPE, provide workers with appropriate PPE, and require them to use and maintain it in sanitary and reliable condition. A manual has been designed to help a user to comply with OSHA’s PPE Standard’s 29 CFR 1910 series.

Employees must be trained to know at least the following:
When PPE is necessary,
What PPE is necessary,
How to properly put on, take off, adjust and wear the PPE,
The limitations of the PPE, and
Proper care, maintenance, useful life and disposal of PPE.

Employers should make sure that each employee demonstrates an understanding of the PPE training as well as the ability to properly wear and use PPE before they are allowed to perform work requiring the use of the PPE. Employers should make sure that each employee demonstrates an understanding of the PPE training as well as the ability to properly wear and use PPE before they are allowed to perform work requiring the use of the PPE. If an employer believes that a previously trained employee is not demonstrating the proper understanding and skill level in the use of PPE, that employee should receive retraining. Other situations that require additional or retraining of employees include the following circumstances: changes in the workplace or in the type of required PPE that make prior training obsolete. The employer must document the training of each employee required to wear or use PPE by preparing a certification containing the name of each employee trained, the date of training and a clear identification of the subject of the certification.
LEGISLATIVE APPROACH OF DEVELOPED COUNTRIES

Legislation in most countries requires that employees are provided with suitable PPE. However, employers should first aim to eliminate risks using other methods. An overview of the directives, enforcement mechanisms, PPE standards of USA, EU, UK, Japan, Canada, Australia, South Africa, China and Brazil is given in this section.

Legislation in most of the countries requires that employers provide suitable personal protective equipment (PPE) for their employees wherever there are risks to health and safety which cannot be controlled at source. The first priority of an employer should be to eliminate such risks by ways other than the use of PPE. In other words, PPE should only be considered in situations where it is not possible to achieve the required degree of protection by any other method. PPE is the lowest in the priority of prevention measures because it protects only the person wearing or using it, whereas measures which control the risk at source protect every one in the workplace.

In USA, the implementation of PPE regulations is overseen by the Department of Labor’s Occupational Safety and Health Administration (OSHA). In Europe, PPE is regulated by European directives and standards as well as acts relating to national working conditions such as the UK’s Personal Protective Equipment at Work Regulations 1992. This section briefly describes the legislations (directives), enforcement mechanisms including responsibilities at various levels and standards pertaining to PPE of developed countries – USA, EU, UK, Japan, Canada, Australia, South Africa, China and Brazil.

Hazards exist in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and a myriad of other potentially dangerous situations. Controlling a hazard at its source is the best way to protect employees. Depending on the hazard or workplace conditions, the governmental or private organizations of work personal protection recommend the use of engineering or work practice controls to manage or eliminate hazards to the greatest extent possible. For example, building a barrier between the hazard and the employees is an engineering control; changing the way in which employees perform their work is a work practice control. When engineering, work practice and administrative controls are not feasible or do not provide sufficient protection,
employers must provide Personal Protective Equipment (PPE) to their employees and ensure its use. Personal protective equipment, commonly referred to as “PPE”, is equipment worn to minimize exposure to a variety of hazards.

Textiles are an integral part of most PPE. Protective clothing is now a major part of textiles classified as “technical textiles”. They are used for personal protection in so many occupations and applications and can be further classified according the end-use functions such as thermal (cold) protection, flame protection, chemical protection, mechanical impact protection, radiation protection, electrical protection, biological protection, etc.

In all developed countries they fall under the framework of legal regulations. The standardization of relevant test methods, safety requirements, quality assurance measures, certification procedures and others play an extraordinary role in this context. The demand for further technical developments and elaboration of new standards is continuing to rise. Stricter legal requirements and the increased threat of insurance liability for employers will further the development and application of improved protective clothing. In some cases new technologies require new types of protective clothing. The development of multifunctional garment assemblies with combined protective functions will be increased.

This section presents the state of art of the main legislations for personal protection at work for United States of America, EU countries, UK, Japan, China, South Africa, Brazil and Canada.

**United States of America**

The Occupational Safety and Health (OSHA) Act is the primary federal law which governs occupational health and safety in the private sector and federal government in the United States. It was enacted by Congress in 1970 and was signed by President Richard Nixon on December 29. Its main goal is to ensure that employers provide
The main goal of the OSHA act is to ensure that employers provide employees with an environment free from recognized hazards such as exposure to toxic chemicals, excessive noise levels, mechanical dangers, heat or cold stress, or unsanitary conditions. The Act can be found in the United States Code at title 29, chapter 15 and is known mostly by its familiar acronym, OSHA.

OSHA became a powerful presence in American workplaces. Many businesses deeply resented the government for telling them how to operate, and the act provoked much controversy. Despite this controversy, however, OSHA itself has remained relatively unchanged. It has only been amended once, in 1998, but these amendments were relatively minor.

Administrative rule making, however, has kept OSHA current by responding to changing dangers in the American workplace. After first setting standards for worker safety, OSHA shifted its focus to worker health, setting standards to protect workers from the insidious effects of asbestos, cancer-causing chemicals, beryllium, lead, cotton dust, carbon monoxide, dyes, radiation, pesticides, exotic fluids, and other toxins. In setting such standards, OSHA’s jurisdiction has steadily expanded. The nature of workplace injuries has also changed, and OSHA has responded, for example, by setting new standards to alleviate repetitive stress disorders like carpal tunnel syndrome.

Under the administration of President Bill Clinton, OSHA attempted to shift from a top-down, command and control system in which the government tells industry what it should do or else, to a partnership between regulators and private businesses. Under a partnership system, businesses that proactively implement comprehensive safety and health programs obtain flexibility and leniency in meeting OSHA standards.

OSHA slowly shifted its focus to worker health and then from a top-down approach to a more collaborative one between the government and private businesses.

The Act defines an employer to be any "person engaged in a business affecting commerce who has employees, but does not include the United States or any state or political subdivision of a State." The Act applies to employers as diverse as manufacturers,
construction companies, law firms, hospitals, charities, labour unions and private schools. Churches and other religious organizations are covered if they employ workers for secular purposes. The Act excludes the self-employed, family farms, workplaces covered by other federal laws (such as mining, nuclear weapons, etc.).

Due to difficulty of the rule making process (which is governed by the Administrative Procedures Act), OSHA has focused on basic mechanical and chemical hazards rather than procedures. Major areas which its standards currently cover are: toxic substances, harmful physical agents, electrical hazards, fall hazards, hazards associated with trenches and digging, hazardous waste, infectious disease, fire and explosion dangers, dangerous atmospheres, machine hazards, and confined spaces.

According to Section 5 of OSHA,

(a) Each employer -
   (i) shall furnish to each of his employees employment and a place of employment which are free from recognizing hazards that are causing or are likely to cause death or serious physical harm to this employees;
   (ii) shall comply with occupational safety and health standards promulgated under this Act.

(b) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own action and conduct.

USA Government placed before the US Congress the proposal on occupational safety in 1970. Congress Senate members discussed the same in detail and cutting across party lines, the Senate members gave their approval of stamp. It is explained in Section 2 under the heading “Congressional findings and purpose”. Clause (a) of Section 2 supra explains that the Congress finds that personal injuries and illnesses arising out of work situations impose a substantial burden upon, and are a hindrance to, interstate commerce in terms of lost production, wage loss, medical expenses and disability compensation payments.
USA Congress has further explains the purpose for which the enactment has been made. In clause (b) of Section 2 of Occupational Safety and Health Act, 1970 Congress declares it to be its purpose and policy through the exercise of its powers to regulate interstate trade and commerce to provide for general welfare to assure so far as possible every workman and woman in the nation safe and healthful working conditions and to prevent human resources to –

(a) encourage employers and employees to reduce the number of occupational safety and health hazards at their places of employment;
(b) to cast upon employers and employees have separate but independent responsibilities to achieve safe working conditions;
(c) to undertake research activities in the field of occupational safety and health by developing innovative methods, techniques and approaches for dealing with occupational safety and health problems;
(d) providing training avenues in industries to achieve the main purpose for which the legislation was intended;
(e) to create an effective enforcement programme;
(f) appropriate reporting procedures;
(g) by encour labour management efforts to reduce injuries and disease arising out of employment.

**Inspections and Investigations**

Occupational Health and Safety Act, 1970 has given adequate teeth to the prosecution agency. Powers to inspects and investigate the lapses have been provided under Section 8 (a) of the Act, supra in detail.

The inspectors designated are empowered –

(a) to enter the premises of the owner alleged to have been committed; and
(b) to inspect and investigate during regular working hours and interrogate any employer, owner or any like person who has direct involvement with the business undertaken.
In terms of Section 8 (b), the inspector may secure the attendance of the employee, employer or owner or any other person who have direct involvement with the business by issuing summons.

**OSHA Standards**

OSHA, 1970 has prescribed certain standards pertaining to occupational safety. In terms of Section 5 (a) (i) of OSHA Act, 1970 which states that—

“Each Employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to this employees”.

Employers have been addressed the issue of expose heated surfaces and based on this a standard titled “Standard guide for Heated System conditions that produce contact burn injuries (c-1055-92).”

In terms of rule 1910 132 (a) –

“Protective equipment, including personal protective equipment for eyes, head, face and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reasons of hazards or processes or environment, chemical hazards, radiological hazards, or mechanical instants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact”. 
Heat stress hazards and use of PPE

Occupational Safety and Health Administration of USA has been interpreting the Legislation in detailed and understandable manner. This is done by them while disposing off complaints and suggestions about PPE received from time to time.

On 18.05.2010, the said Administration issued a clarifying note to a workman in response to a suggestion gave a clarification. The querist is an electrician with about thirty years of experience. He has been using wearing light fitting, light coloured and light weight clothes while working in the heat and humidity. In view of directions from OSHA, the employer had asked him to wear heavy flame resistant uniforms at all times in spite of the fact that he was not required to work in front of an open hot electrical circuit.

The question is why can’t the employees wear regular loose fitting, light weight clothing when the employee is not engaged in activity creating flames and heat. Especially when 90% of the work done by the employee relates to relamping is there any need to wear flame resistant clothing?

In response to this, OSHA gave a clarification in this regard. OSHA’s standards require employers to provide appropriate PPE to protect employees exposed to electrical hazards encountered during the course of their duties. They have been explained in 29 CFR 1910.132, 29 CFR 1910.137 and 29 CFR 1910.335(a) under OSHA. In case the conditions under which the employees are working pose heat stress hazards, the employer needs to evaluate such hazards and determine what appropriate action needs to be taken while still protecting the employees from electrical hazards. In view of this, the employer could provide light weight flame resistant clothing.

In view of this we can conclude that the rules framed by Occupational Safety & Health Administration is quite flexible and tilted towards employees. At times of need, the OSHA changes its directives to suit to the peculiar characteristic of employment.
Occupational Safety & Health Administration has provided additional methods to abate heat stress hazards in work places. They include, but are not limited to:-

(a) Permitting workers to drink plenty of water and cold liquids at liberty;

(b) Establishing provisions for work/rest regimen so that exposure time to high temperature and/or the work rate is decreased;

(c) Developing a heat stress programme which incorporates the following:

- A comprehensive training programme;
- Screening programme to identify health conditions aggravated by different environmental conditions;
- An orientation programme for new employees;
- Reorientation programme for employees returning after a sell of long leave;
- Specific procedures to be followed for heat-related emergency situations; and
- Provisions that first aid be administered immediately to employees displaying symptoms of heat related illness.

OSHA requirements are set by statute, standards, and regulations. OSHA’s clarifications explain these requirements and how they apply to particular circumstances. However, they can not create additional obligations on the part of the employer. The OSHA’s explanations are clarificatory in nature and not obligatory. Only the directives are obligatory.

US Fish and Wildlife Service is a department that has made an attempt to further clarify on the use of Personal Protective Equipment. A detailed clarification on the use of PPE vide release No. 442 dated 19.03.2004 explaining the use of PPE at work places. It has established policy and procedures for providing clothing and equipment that protects employees from hazards that may be encountered while performing their jobs.
Under OSHA, a Personal Protective Equipment programme has been created which applies to all employees, volunteers job corporations, youth conservation corpus members, students and seasonal workers who need PEE to protect them from hazards.

That the Law further has cited the following authorities for implementation of the purpose for which the Act has been enacted.

a) Executive Order 12196 – Occupational Safety and Health Programmes for federal employees;
b) Public Law 91-596, Section 19, Federal Agency Safety Programmes and responsibilities;
c) 29 CFR 1910, 132-133 and 135-138, Occupational Safety & Health Administration’s General Industry PPE Standards;
d) 29 CFR 1960, Basic Programme Elements for Federal Employee Occupational Safety & Health Programmes and related matters;
e) American National Standards Institute (ANSI) standards incorporated in the Occupational Safety & Health Act, (29 CFR 1910);
f) National Institute for Occupational Safety and Health (NIOSH) Personal Protective Equipment Guidance.

**Multilayer responsibility for the implementation of safety work wear**

The responsibility for the use of PPE has been ensured through the effective control on the part of the following multilayered responsible officers.
Duties of officers involved in PPE programme

(A) The Chief, Division of Safety and Health:-
   (i) Revise and update circulars regarding use of PPE;
   (ii) Provide interpretation of the PPE requirements and serve as a consultant to resolve service wide question or issues.

(B) Regional Directors and Manager in States:-
   (i) Provide sufficient support and resources to effectively implement the PPE programme in their areas of responsibility.

(C) Regional/CNO Managers:-
   (i) Provide interpretation of the PPE programme requirements and serve as an advisor to resolve Region wide/CNO wide questions and issues;
(ii) Evaluate implementation of the Personal Protective Equipment programme during Regional/CNO field station safety programme evaluations;

(iii) Assist project leaders/supervisors with developing job hazard assessments.

(D) Project Leaders:-

(i) Project Leaders/Supervisors must make sure that all aspects of the PPE programme are implemented in their facilities and work places;

(ii) Conducting through job hazard assessments;

(iii) Taking appropriate action to reduce and eliminate such hazards;

(iv) Verification of assessments in consultation with Regional/CNO Safety Manager;

(v) Ensuring the employees are provided with appropriate personal protective equipment;

(vi) To ensure that employees are adequately trained;

(vii) Consulting Regional/CNO Safety Manager for assistance in detecting appropriate PPE;

(viii) Attend PPE training;

(ix) Make sure that employees properly select use, maintain and clean their PPE;

(x) Take appropriate disciplinary action in case employees do not wear and properly maintain and clean their PPE;

(xi) Immediately repair or replace defective or damaged PPE;

(xii) Maintain records on PPE assignments and training.

(E) Employees:-

(i) Employees must comply with all PPE programme requirements;
PPE will be used only when equipment engineering controls or management controls do not adequately protect the employees when the employer may not be able to absolutely eliminate all known hazards that have been identified.

In terms of service policy, action will be taken by the employer to ensure that the employees would be protected from known hazards in the workplace. PPE will be used only when equipment engineering control or management controls do not adequately protect the employees when the employer may not be able to absolutely eliminate all known hazards that have been identified. However, PPE supplied shall meet ANSI standards or equivalent industry standards. The service policy shall provides for training the employees when to use PPE, its limitations, maintenance and cleanliness.

As already indicated PPE refers to any clothing or equipment that is designed to protect any part of human body from workplace hazards that the employee is expected to absorb, inhale or that can physically touch him. The employers are expected to protect the employees from potentially hazardous conditions in their workplace by Occupational Safety and Health Administration. The nature of PPE is that when they are unable to eliminate all identified hazards in their workplace the PPE provided to the employees by employer at free of cost would act as a barrier against injury to the employee and his health. OSHA requires the use of PPE to reduce employee’s exposure to hazards in their workplace. There is an acceptable level of heat that is emitted out of manufacturing and other kinds of processes when engineering and administrative controls are not found to be adequate or feasible to reduce these exposures like heat to acceptable level, employers are required to provide personal protective equipment.

The following diagram would explain the steps involved in use of PPE.

(ii) Wear PPE as and when required;
(iii) Complete all PPE training;
(iv) Clean and keep all PPE in good and serviceable condition;
(v) Tell supervisors when PPE needs to be repaired or replaced.
European Union

The European Union is composed of 27 sovereign Member States: Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Republic of Ireland, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. It is an economic and political union of above states which are primarily located in Europe. The union was established by a Treaty signed in Maastricht in the year 1993. It is called Treaty of Maastricht. It has about 500 million population in which 51% of them speak English followed by 31% German and 26% French. The work population of European Union is 7.3% of the total work population of the world. The workforce joined together to generate 21% of the total gross world product.

Law or Enforcements

Law or Enforcements become binding on all member countries through the system of European Union. European Union has developed a single market through a standardized system of Laws. These laws apply in all member countries and ensure free movement of people, goods, services, and capital. It maintains common policies on trade, agriculture, fisheries, regional development and mutual cooperation.

As a legal personality, European Union is able to enter into agreements or treaties with all or most of the member countries. European Union
European Union has developed a single market, a common foreign and security policy and operates through a hybrid system of intergovernmentalism. European Union enacts legislations in Justice and Home Affairs. The legislations enacted by European Union are forwarded to various member countries. European Union has devised a common Foreign and Security Policy. European Union operates through a hybrid system of supra nationalism and intergovernmentalism. In some cases the decisions are taken by independent supranational institutions, while in others, they are made through negotiation between member states.

European Economic Community on 21st December 1989 proposed a treaty on the basis of recommendation of European Commission and on the basis of Economic and Social Committee of Europe adopted measures with the aim of progressively establishing the internal market for free movement of goods and services that are made taking into account personal protection of employees working in industries.

The Directive on Personal Protective Equipment (PPE) 89/686/EEC belongs to the family of directives under Article 114 of the Treaty on the functioning of the European Union. They harmonize products ensuring a high level of protection for citizens and free circulation throughout Europe. Safety and health are basic values for this particular directive.

It is a must for PPE, the products having the unique feature to provide for protection against specific hazards, to meet this challenge: to ensure the user’s safety and health in specific circumstances. The manufacturer informs about the type of hazards against which his product protects.

The European Union initiated Directive 89/686/EEC in order to ensure equally safe products throughout the European Union.

The Directive has been applied its text has to be “transposed” into national legislation. Each Member State has integrated the provisions into its legislation in respect of that particular country, and it is the transposed text that is applied at the national level. Through this directive, EU has made an attempt to consolidate the existing provisions available in various European countries in relation to safeguarding of industrial worker during the course of his/her employment. It has further streamlined design, manufacture, quality level, testing and certification of PPE available to their staff in the absence or inadequacy of priority public protection.
methods. In view of this directive, national provisions relating to safety at work make the use of PPE compulsory. Many requirements oblige the employers to make appropriate PPE available to their staff.

Council of European Communities has defined requirements to be satisfied by PPE. However, in order to facilitate proof of conformity with those of basic requirements, European standards have been made available relating to the design, manufacture and specification of test methods applicable to PPE. EU has nominated European Committee for Standardization and European Committee for Electro technical standardization to adopt harmonized standards in accordance with the general guidelines. Such guidelines have been made in place in accordance with the Council Directive ref. 83 / 189 / EEC dated 28.03.1983 laying down a procedure for the provision of information pertaining to standards.

In terms of Sections 2 and 3 of the above directive, PPE refers to:

“2. for the purposes of this Directive, PPE shall mean any device or appliance designed to be worn or held by an individual for protection against one or more health and safety hazards.

PPE shall also cover:

(a) a unit constituted by several devices or appliances which have been integrally combined by the manufacturer for the protection of an individual against one or more potentially simultaneous risks;

(b) a protective device or appliance combined, separably or inseparably, with personal non-protective equipment worn or held by an individual for the execution of a specific activity;

(c) interchangeable PPE components which are essential to its satisfactory functioning and used exclusively for such equipment.

3. Any system placed on the market in conjunction with PPE for its connection to another external, additional device shall be regarded as an integral part of that equipment even if the system is not intended to be worn or held permanently by the user for the entire period of risk exposure.”
Thus, EU has made it mandatory to provide PPE to all workers, whoever is required to be provided, at the cost of employer. Quality of the product manufactured has a direct relationship with the environment in which the product is manufactured. When the worker is making the product with adequate safety measure in his/her mind, the product developed by him/her is made in accordance with the international standards.

There is a provision in the legislation in relation to monitoring aspect. Legislative framework has been improved so that both the sides of industry will make an effective and appropriate contribution to the process of Standardization

**Directive 89/686/EEC on PPE**

The Directive on Personal Protective Equipment (PPE) 89/686/EEC belongs to the family of directives under Article 114 of the Treaty on the functioning of European Union. Personal health and safety are fundamental rights and people expect and require a high level protection, at work, home and leisure. EU has been active in the pursuit of this ideal initiating a series of directives improving health and safety at work and providing high quality PPE.

European Union’s Council pronounced the Directive No. 89/686/EEC on 21.12.1989 on the approximation of laws of the Member States relating to Personal Protective Equipment. PPE, in terms of this directive refers to any device or appliance designed to be worn or held by an individual for protection against one or more health safety hazards. It shall also cover (a) a unit constituted by several devices or appliances which have been integrally combined by the manufacturer for the protection of an individual against one or more potentially simultaneous risks; (b) a protective device or appliance combined, separably or inseparably with personal non-protective equipment. Section 3.6 of the directive specifically provides that PPE should be able to protect all or part of body against the effects of heat and/or fire, must possesses thermal insulation capacity and mechanical strength appropriate to forcible conditions of use.
In all member states of the European Community (EC) this directive is transferred at national law level. For example, in Germany this directive has been converted into national law through the 8th Ordinance Regulating the Equipment Safety Act or it was implemented into UK law by the PPE (EC Directive) Regulations 1992 (SI 1992/3139) made on 10 December 1992 and came into effect on 1 January 1993.


In 2002, the Principal Regulations and the three amendments were consolidated into one document in the interests of providing clearer legislation and at the same time additional enforcement powers were extended to the Trading Standards Departments. The consolidated regulations called the Personal Protective Equipment Regulations 2002 (SI 2002 No.1144) came into effect on 15 May 2002. These Regulations revoke the Principal Regulations and subsequent three amendments.

**United Kingdom**

Employers have basic duties concerning the provision and use of personal protective equipment (PPE) at work and this document, explains what is needed to meet the requirements of the Personal Protective Equipment at Work Regulations 1992.

PPE is defined in the Regulations as ‘all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects him against one or more risks to his health or safety’. **Examples are safety helmets, gloves, eye protection, high visibility clothing, safety footwear and safety harnesses.**
Hearing protection and respiratory protective equipment provided for most work situations are not covered by these Regulations because other regulations apply to them. However, these items need to be compatible with any other PPE provided.

However, cycle helmets or crash helmets worn by employees on the roads are not covered by the Regulations. Motorcycle helmets are legally required for motorcyclists under road traffic legislation.

**What do the Regulations require?**

The main requirement of the PPE at Work Regulations 1992 is that personal protective equipment is to be supplied and used at work wherever there are risks to health and safety that cannot be adequately controlled in other ways.

The Regulations also require that PPE:

- is properly assessed before use to ensure its suitability;
- is maintained and stored properly;
- is provided with instructions on how to use it safely; and
- is used correctly by employees.

An employer cannot ask for money from an employee for PPE, whether it is returnable or not. This includes agency workers if they are legally regarded as the employees. If employment has been terminated and the employee keeps the PPE without the employer's permission, then, as long as it has been made clear in the contract of employment, the employer may be able to deduct the cost of the replacement from the wages owed.

To allow the right type of PPE to be chosen, the employers carefully considers the different hazards in the workplace. This will enable him to assess which types of PPE are suitable to protect against the hazard and for the job to be done.

The employers may seek supplier's advice on the different types of PPE available and how suitable they are for different tasks. It may be necessary
in a few particularly difficult cases to obtain advice from specialist sources and from the PPE manufacturer. Another useful source of information is the British Safety Industry Federation (www.bsif.co.uk).

The following while be considered while assessing whether PPE is suitable or not:

- Is it appropriate for the risks involved and the conditions at the place where exposure to the risk may occur? For example, eye protection designed for providing protection against agricultural pesticides will not offer adequate face protection for someone using an angle grinder to cut steel or stone.
- Does it prevent or adequately control the risks involved without increasing the overall level of risk?
- Can it be adjusted to fit the wearer correctly?
- Has the state of health of those who will be wearing it been taken into account?
- What are the needs of the job and the demands it places on the wearer? For example, the length of time the PPE needs to be worn, the physical effort required to do the job and the requirements for visibility and communication.

If more than one item of PPE is being worn, are they compatible? For example, does a particular type of respirator make it difficult to get eye protection to fit properly?

**The hazards and types of PPE**

*Eyes*

Hazards: chemical or metal splash, dust, projectiles, gas and vapour, radiation. Options: safety spectacles, goggles, face shields, visors.

*Head*

Hazards: impact from falling or flying objects, risk of head bumping, hair entanglement. Options: a range of helmets and bump caps.

*Breathing*

Hazards: dust, vapour, gas, oxygen deficient atmospheres.
Options: disposable filtering face piece or respirator, half or full face respirators, air fed helmets, breathing apparatus.

**Protecting the body**
Hazards: temperature extremes, adverse weather, chemical or metal splash, spray from pressure leaks or spray guns, impact or penetration, contaminated dust, excessive wear or entanglement of own clothing.
Options: conventional or disposable overalls, boiler suits, specialist protective clothing, e.g. chain mail aprons, high visibility clothing.

Personal Protective Equipment at Work Regulations

**Hands and arms**
Hazards: abrasion, temperature extremes, cuts and punctures, impact, chemicals, electric shock, skin infection, disease or contamination.
Options: gloves, gauntlets, mitts, wrist cuffs, armlets.

**Feet and legs**
Hazards: wet, electrostatic buildup, slipping, cuts and punctures, falling objects, metal and chemical splash, abrasion.
Options: safety boots and shoes with protective toe caps and penetration resistant midsole, gaiters, leggings, spats.

**Training**
Make sure anyone using PPE is aware of why it is needed, when it is to be used, repaired or replaced and its limitations.

Train and instruct people how to use it properly and make sure they are doing this. Because PPE is the last resort after other methods of protection have been considered, it is important that users wear it all the time they are exposed to the risk. Never allow exemptions for those jobs which take 'just a few minutes'.

Check regularly that PPE is being used and investigate fully any reasons why it is not. Safety signs can be useful reminders to wear PPE.
**Maintenance**

Make sure equipment is well looked after and properly stored when it is not being used, for example in a dry, clean cupboard, or in the case of smaller items, such as eye protection, in a box or case; kept clean and in good repair follow the manufacturer’s maintenance schedule (including recommended replacement periods and shelf lives). Simple maintenance can be carried out by the trained wearer, but more intricate repairs should only be done by specialists.

Make sure suitable replacement PPE is always readily available.

**CE marking**

Ensure any PPE bought is ‘CE’ marked and complies with the requirements of the Personal Protective Equipment Regulations 2002. The CE marking signifies that the PPE satisfies certain basic safety requirements and in some cases will have been tested and certified by an independent body.

The PPE at Work Regulations do not apply where the following six sets of regulations require the provision and use of PPE against these hazards. For example, gloves used to prevent dangerous chemicals penetrating the skin would be covered by the Control of Substances Hazardous to Health Regulations 2002 (as amended). The regulations are:

- The Control of Lead at Work Regulations 2002.
- The Ionizing Radiations Regulations 1999.
- The Control of Asbestos at Work Regulations 2002.
- The Control of Substances Hazardous to Health Regulations 2002
- The Noise at Work Regulations 1989.

**Enforcement of Occupational Safety**

In United Kingdom, occupational safety is controlled and administered by Health and Safety Executive.
HSE lays down lot of emphasis on prevention rather than prosecution. However, it has teeth to come down heavily on wrong doers. HSE ensures the stakeholders to take care of the following:

a) dealing with serious risks immediately;
b) comply with the directives; and
c) holding them responsible in case fail in their duty.

HSE is guided by a policy framed by the crown. This is called HSE’s Enforcement Policy Statement. This statement is based on Enforcement concordat which is the guideline principle behind the Enforcement Policy Statement. Crown has again formulated a general principled guideline called Code for Crown Prosecutors. In the case of violation that deserve prosecutions, HSE refers to this code – Code for Crown Prosecutions.

Therefore, it can be said that the enforcement mechanism is strictly based on

(a) Enforcement Concordat; and
(b) Code for Crown Prosecutors.

**Enforcement Concordat**

Enforcement Concordat is based on six sets of principles framed by Crown. They are as under:

(a) Standards
(b) Openness
### Standards
Clear standards setting out the level of service and performance benchmark.

### Openness
Transparency in clarity in expression.

### Helpfulness
Helping business by advising on and assisting with compliance.

### Complaints
A clear and flawless complaint redressal system.

### Proportionality
Enforcement action is directly proportionate to risks involved.

### Consistency
Ensuring consistent enforcement practice

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**Code for Crown Prosecutors**

There is a Public Office constituted by the Crown titled Director of Public Prosecutions. It sets out general principles which are required to be followed by the Crown Prosecutors. The code is again based on the underlying principles. They are as under:

a) **Is there enough evidence against the defendant?**; and

b) **Is it the public interest for the code to bring the case to the judiciary?**

A prosecution will usually take place unless the prosecutor is sure that the public interest factors tending against prosecution outweigh those tending in favour.
This document has to be understood by all sorts of workman including no matter whether they are literate or otherwise; again no matter whether they are educated or otherwise. For easy understanding the same has been published in the website http://www.cps.gov.uk in various languages including Bengali, Punjabi and Tamil.

Crown has desired the prosecutors through this code the following:

a) Fair and effective prosecution.
b) Decision to prosecute or out of court settlement should be taken up with ease and care.
c) The offender should be given opportunity to defend his matter before prosecuting authority with confidence.
d) In case of non major violations, opportunity should be given to the offender to opt for out of court settlement.
e) Prosecutors should be fair, impartial and independent without heeding to external force.
f) Prosecution service is the public authority for the purposes of current, relevant equality legislation.
g) Prosecutors must apply the principles of Human Rights Act, 1988 and respect human rights without any kind of discrimination.

In view of the foregoing paragraphs explained, it may be concluded that Health and Safety Executive ensures adequate enforcement mechanism. At the same time, Crown has given powers with directions to use them with care and respect.

**Corporate plan for health in work place**

Health and Safety Executive of UK is certainly committed to providing its employees with good conditions of work. The aim is multiple fold like effective management arrangements to ensure well being of staff, reduction of impact on employees from ill health and injury. Everyone working for HSE has a proportionate responsibility to think how they can contribute to delivery the plan’s outcomes.
Three year framework period has been devised by HSE. In order to accomplish this HSE has devised three themes which are as under:

- Providing strong leadership, active management and collective ownership;
- Tracking risk priorities; and
- Developing measurements and improving monitoring.

Senior Management Team of HSE is responsible for ensuring delivery of the plan.

Corporate Health and Safety Committee will monitor progress with the plan at each of the three meetings that will take place in the year and alert Senior Management Team as necessary.

**HSE’s recommendations on safe environment**

HSE website makes recommendations on thermal control in the workplace. It makes it clear that individuals both employees and employers should take certain precautions at workstations to prevent heat and fire. HSE has issued advisory in respect of this to improve thermal comfort in workplace to reduce heat and resultant fire. These things have been published in their website [www.hse.govt.uk/ temperature/thermal](http://www.hse.govt.uk/ temperature/thermal).

They are enumerated below:

- Addition and removal of layers of clothing depending on as to the factory temperature;
- Usage of a pedestal and a table fan to reduce heat;
- Using window binds and Venetian binds to reduce heat of direct sunlight;
- Employees should be provided with refrigerated water to reduce body heat;
Employees should be advised to work away from direct sunlight;

Employers should provide periodic intervals to employees working in warm conditions to cool down and cold conditions to warm up.

Insulation of hot plant and pipes;

Upgradation of air conditioning and air cooling.

Inclusion of thermal comfort as part of workplace risk assessments;

Introduction of work systems to limit exposure such as flexible hours;

Relaxation of forma dress codes;

Moving work stations away from hot plant or out of direct sunlight.

**South Africa**

Not only in Europe, in South Africa the procedure adopted for providing safety work wear is stringent. Department of Labour vide Government Notice R: 1031 Dated 30 May 1986 has promulgated General Safety Regulations, 1986. In terms of these, the Government has, in terms of section 35 of the Machinery and Occupational Safety Act, 1983 made the regulations in place.

Pursuant to this, personal safety equipment and facilities refers to:

"2. (1) Subject to the provisions of paragraphs (f), (g), (h) and (i) of regulation 5 of the General Administrative Regulations published under Government Notice R. 2206 of 5 October 1984, every employer and every user of machinery shall make an evaluation of the risk attached to any condition or situation which may arise from the activities of such employer or user, as the case may be, and to which persons at a workplace or in the course of their employment or in connection with the use of machinery are exposed, and he shall take such steps as may under the circumstances be necessary to make such condition or situation safe."
(2) Where it is not practicable to safeguard the condition or situation contemplated in sub regulation (1), the employer or user of machinery, as the case may be, shall take steps to reduce the risk as much as is practicable, and shall provide free of charge and maintain in a good and clean condition such safety equipment and facilities as may be necessary to ensure that any person exposed to any such condition or situation at a workplace or in the course of his employment or on premises where machinery is used is rendered safe.

(3) Taking into account the nature of the hazard that is to be countered, and without derogating from the general duties imposed on employers and users of machinery by sub regulations (1) and (2), the safety equipment and facilities contemplated in sub regulation (2) shall include, as may be necessary —

(a) suitable goggles, spectacles, face shields, welding shields, visors, hard hats, protective helmets, caps, gloves, gauntlets, aprons, jackets, capes, sleeves, leggings, spats, gaiters, protective footwear, protective overalls, or any similar safety equipment or facility of a type that will effectively prevent bodily injury;

(b) waterproof clothing, high-visibility clothing, chemical-resistant clothing, low temperature clothing, chain mail garments, waders, fire retardant or flame-proof clothing, ice-jackets, or any similar safety equipment of a type that will effectively protect the wearer thereof against harm;

(c) belts, harnesses, nets, fall arresters, life lines, safety hooks, or any similar equipment of a type that will effectively protect persons against falls;

(d) mats, barriers, locking-out devices, safety signs, or any similar facility that will effectively prevent slipping, unsafe entry or unsafe conditions;

(e) protective ointments, ear-muffs, ear-plugs, respirators, breathing apparatus, masks; air lines, hoods, helmets, or any
similar safety equipment or facility of a type that will effectively protect against harm;

(f) suitable insulating material underfoot where persons work on a floor made of metal, stone, concrete or other similar material; and

(g) generally, such safety equipment or facilities as may be necessary to render the persons concerned safe.

(4) An employer or a user of machinery, as the case may be, shall take steps to ensure that no safety equipment or facility provided as required by this or any other regulation is removed from a workplace or from premises where machinery is used, except for purposes of cleaning, repair, maintenance, modification, mending or replacement, and no person shall remove any such safety equipment or facility from a workplace or premises where machinery is used, except for the aforesaid purposes.

(5) An employer shall instruct his employees in the proper use, maintenance and limitations of the safety equipment and facilities provided.

(6) An employer shall not require or permit any employee to work unless such an employee uses the required safety equipment or facility provided in terms of this or any other regulation.

(7) The provisions of this regulation shall not be construed as derogating from the provisions of any specific regulation prescribing specific safety equipment or facilities.

The above regulations have been provided in South Africa are similar to that of Europe in so far as safety work’s wear.

Japan

Work related accidents in industries and construction sites in Japan resulted in 1001 fatalities and 44886 injuries in 1996. However, with the finding intervention of the Japanese Government in arrest work related
Intervention by the Japanese government has caused a reduction of 60.58% in the total number of accidents that have happened. Fatal accidents in various firms, in the year 2005 the number had fallen down rapidly. The same has reduced by 48.65%. In 2005, work related fatal accidents stood at 487 and injuries reduced to 27193 which is equivalent to reduction of 60.58% accidents. Thus considerable reduction in fatal injuries and grievous injuries could have been possible only because of timely intervention of the Government through legislations.

On the traffic and transports front, the Japanese Government made it mandatory through the Ministry of Land, Infrastructure and Transport to protect the workers by mandating comprehensive uniforms of traffic control personnel, replacement of traffic control personnel with robots, more appropriate positioning of traffic control personnel and placement of delta cushions.

Extensive research has been done at various sites.

**Industrial safety in Japan**

Japanese Government had established an organisation called The Japan Industrial Safety and Health Association in the year 1964. It was established pursuant to Industrial Accidents Prevention Organisation Act, 1964 which was enacted and enforced in the year for the purpose of preventing industrial accidents by means of encouraging employers to make autonomous efforts to ensure safety and health at workplaces.

Prior to enactment of the legislation, supra, industrial accidents had been steadily increasing. As many as 540,000 workers encountered accidents annually at their workplaces. At the same time tragic accidents in which lot of workers encounter at workplaces posed a grave concern to the government.

Secondly, health related issues assured significant place in such discussions. Health related issues arising from the advancement of the aging society and increased stress at work were required to be addressed seriously. Further, employers were required to protect the employees from accidents by paying more attention to workers’ safety and health. Government through JISHA tried to emphasize that workers’ safety should be the prime motive behind a successful entrepreneur.
In order to accomplish the objective of the Japanese Government, constituted The Japan Industrial Safety and Health Association in Tokyo, Japan.

**JISHA’s activities**

JISHA’s activities centres around the following which attribute workers’ safety:

(a) Organising seminars for managers, foremen and operators;
(b) Risk assessments, zero accidents campaign or measures for mental health;
(c) Providing education to workers on industrial accident measures and to take preventive measures;
(d) Publication of books, distribution of organizational safety health goods and videos, establishment of internet websites, organisation of national conventions other events and campaigns;
(e) Improving organizational safety health conditions at workplaces by promoting O&H diagnosis, working environment and measurement, or consulting service. Beside the above, JISHA’s other activities include:

(i) Support for the introduction of risk assessment and establishment of occupational safety and health management systems (OSHMS);
(ii) Based on requests from organisations, JISHA also deputes experts to the workplace to give employers certain advice necessary for introducing or establishing an OSHMS appropriately;
(iii) Conducting and awarding OSHMS standards certification in accordance with the guidelines of the Japanese Ministry of Health, Labour and Welfare (MHLW) and International Labour Organisation (ILO);
(iv) Physical and mental health promotion and mental health measures;
(v) Promotion of Occupational Safety Health Education;
(vi) Assistance in the introduction of and operation of Zero Accident campaigns;
JISHA’s on demand technical services;
International cooperation;
Assistance to small and medium sized enterprises;
Dissemination of publications and provision of latest information;
Investigation of chemical substances for toxicity and safety testing.

**JISHA’S Concern on Work Related Accidents**

JISHA is very much concerned on work related accidents. Dangers and hazards in workplace have diversified as production processes have become more varied and complex; with the introduction of new machinery, equipment and chemical substances have been introduced.

Apart from the above, employment of untrained and unskilled workers in dangerous machines and process attribute to work related dangers. Heavy use of chemicals, highly inflammable gas and petroleum substances account for work related dangers.
Risk assessment is the practice of identifying dangers to people or potential sources of harmful effects, estimating such effects to people and eliminating or reducing unacceptable risks.

An occupational safety and health management system (OSHMS) is a system for achieving specific organizational goals setout in an OSH policy made by top management; creating a concrete plan for achieving those goals, and envisaging that the entire organisation works together toward the goals with each individual playing his or her part. OSHMS recognizes PDCA check. PDCA refers to plan – PDCA – Check – act cycle and the same is regarded as an effective tool for implementing the system.

JISHA trains entrepreneurs to initiate KYT pattern of safety. Where efforts are made to heighten workers sensitivity to danger, foster their powers of concentration, problem solving abilities and increase eagerness of workers to put them in practice. This service is called Kiken Yochi or hazard prediction.

The ‘KYT’ Scheme

In Japan, JISHA trains entrepreneurs to initiate KYT pattern of safety. Preventing accidents due to human error and ensuring safety and health on-site requires that workplace leaders take the initiative to identify hidden dangers. A zero accident campaign is definitely a culture oriented activity. It places priority on OSH and a lively workplace. Based on the philosophy of respect for human beings, all managers and employees participate as a whole in industrial accident-prevention activities at workplaces. It strives to find solutions to problems and to realize “zero accident” as their ultimate goal.

Japanese Government started advocating the Total Participation Zero Accident in workplaces campaign in 1973. It envisages a spirit of respect for human beings that holds that

(A) “Each person is an indispensable being”, which is again expressed on three basic principles as under:

– ascertaining all kinds of danger in every person’s daily life;
not limited to dangers lurking at workplaces and jobs be detected, comprehended and resolved;

aiming at stamping out all accidents including industrial accidents, occupational diseases and traffic disasters.

(B) “Principle of participation” refers to the stage in which with top management, supervisors, staff members, workers discuss and deliberate problems to find out a solution.

In order to spread the campaign pertains to Total Participation Zero Accident campaign, JISHA followed the principle of campaign techniques for putting such principles on tracks. JISHA, therefore, evaluated a scheme called KYT for line managers and supervisors. KYT refers to (kiken yochi in Japanese) hazard prediction and training. Again it has been subdivided, according to requirements as under:

(a) KYT training for medical care safety primarily for safety supervisors, at medical institutions; and

(b) KYT traffic refers to training for drivers primarily.

Japanese Government has understood that prevention of occupational accidents is vital to ensure safety and health of employees working in any industry. In order to achieve this end, JISHA conducts frequent training programmes keeping Zero Accident campaign in mind.

**KYT and Accident Prevention**

Preventing accidents due to human error and ensuring safety and health in workstations require that entrepreneurs should take initiative to identify hidden dangers and resolve the same immediately.

With the purpose in mind, efforts are made to heighten workers' sensitivity to danger, foster their powers of concentration problem solving abilities and increase eagerness of workers to put them in practice. This service is called kiken yochi, or hazard prediction.
Predicting of hazards and practice of resolution of hazards is called as a process of carrying out work tasks is called KYT.

KYT is an effective management tool. It is effective for implementing risk assessment in workers safety as well as health management system.

**Steps in KYT**

The following are the four steps that have been universally accepted steps in KYT.

### Steps of KYT

**Step 1 – Understanding situation**
In Step 1, the entrepreneur understands the hazard that may outbreak at a later date. Work place members are allowed to discuss amongst themselves about the hidden hazards.

**Step 2 – Investigating the nature of hazard**
The entrepreneur thoroughly examines the nature of hazard, its origin and quantum of hazard.

**Step 3 – Establishing counter measures**
The entrepreneur is required to allow the employees of all cadres to talk to each other clearly with the main object of understanding the problems, exchange of ideas in relation to problems faced and identification of hazards.
Step 4 – Setting targets
Counter measures are defined in terms of specified actions to be taken. In this process the actions required to be taken to counter the hazards are streamlined and adopted through separate teams.

Preventive Measures

Preventive measures for heat environment in industries have been notified by Japanese Government in the year 1996. In record making heat waves in 1994-95, lot of industrial accidents took place resulting in fatal accidents which made the Japanese Government to enact a legislation whereby certain regulations were imposed.

The prime cause of occurrence of heat related illness is the lack of award of degree of ignorance concerning dangers of working hot environment. When investigated, many causes were found. They were

(a) insufficient time breaks;
(b) insufficient amount of fluids and salt replacement;
(c) lack of information on worker’s state of health;

Occurrence of heat related illness is preventable through providing both industrial management and workers with the essential knowledge to prevent heat-related illness by appropriate measures.

Japanese Government has suggested the following trouble shooting measures to combat heat related industrial accidents:

(1) Work Environment Management:

- To block heat source and working place;
- Providing adequate ventilation;
- Providing goods or facilities to cool down body temperature;
- To provide cool rest station;
- To provide fluids and glucose at work stations at frequent intervals;
- To install a thermometer in the immediate vicinity of work station.
(2) **Work Management:**

- To provide recess or break time during working hours;
- To avoid clothing which tends to absorb or keep heat and choose material that absorbs moisture well and is highly porous;
- To ensure that workers wear porous headgear under the direct rays of sun.

(3) **Health Care Management:**

- To get the workers medically examined at intermittent intervals;
- To give workers education in daily health care regarding proper hours of health and nutrition;
- To ascertain health condition of worker before the start of the day;
- To install a thermometer at rest station to encourage workers to check their own body temperature.

(4) **Industrial Health Education:**

Before engaging a worker in extreme weather condition, the worker should be given training in health education on the following items to management personnel and workers. They are required to be checked up for –

- Symptoms of heat related illness;
- Measure for the prevention of heat related illness;
- Measures to take in emergencies;
- Case examples of heat related illness.

(5) **Emergency Measures:**

- To coordinate with all emergency network like hospitals, clinics and related contact information;
- To move the patient to a cool place, immediately summon medical care, and arrangement provide water and glucose.
Enforcement

Industrial Safety and Health Act, 1972 was promulgated in 1972. Through this enactment, Japanese Government has ensured strict mechanism for enforcement of safety measures in industries.

Article 2 requires industries to appoint General Safety and Health Manager, when one hundred or more workers are employed.

Article 3 & 4 requires to appoint Safety Officer and Welfare Officer when fifty or more workers are employed.

Article 5 requires to appoint an Industrial Physician when fifty or more workers are employed.

Providing Safety Equipment

Article 342 of Ordnance on Industrial Safety and Health passed by Ministry of Labour in 1972 require that Safety Standards are required to be provided by the employer. For example, when a worker is required to work close to live wire high voltage line, he is required to be provided personal insulating protective equipment by the employer and instruct the worker to wear appropriately.

Article 255 of the Ordnance, supra, requires that the employer shall provide appropriate personal protective equipment to workers engaged in the immediate vicinity of blast furnace, a cupola, glass melting furnace and other places where work handling a large quantity of higher temperature substances is carried out, in order to prevent burns or other danger due to the scattering, outflow etc. of the said high temperature substances, take appropriate measures.

Further in terms of Clause 2 of Article 255 of the Ordnance, supra, provides that the employer shall give at the above work places appropriate personal protective equipment so that the worker can avoid burn and other dangers.
In 2006, China witnessed a lot of work related industrial accidents. On 30.05.2006, a 35 year old migrant woman, Gam Hongying, who worked in a cloth factory in Guangzhou died of severe heat and sunstroke; on 02.07.2006, an industrial worker, Liu Yuanfang, who worked in a textile company called Changlong Textile Co. Ltd. of Fujian Province died at his workplace due to heat exhaustion. On 15.07.2006, Zhu Longmei suddenly died at her workplace. Again on 08.08.2006, A Feng, fainted after overnight work in Guangzhou. She was working in a textile mill, she was declared dead at hospital.

Tragedies listed above are only few instances made known to the outside world. Problems in safeguarding legitimate interests of the workers has become a great challenge and also it became a social issue for the nation as a whole. In accordance with surveys conducted by the Chinese Government as well as independent surveys, in industry or service sectors such as textiles, clothing, toys, electronics, chemicals, construction, restaurants, catering, manufacturing it is not uncommon for workers to work intensively and overwork for little pay. Some private enterprises have high rates of accidents due to their outdated equipment and poor working conditions. Therefore, workers in such industries work in manufacturing areas are directly exposed to pollution, noise, high temperature etc. which greatly endanger their personal safety and health. Surveys have shown that occupational safety and health conditions of industrial workers are extremely bad.

Private enterprises are reluctant to invest in safety and health facilities; over supply of manpower in labour market provide a bigger room for small enterprises are reluctant to invest in safety and health facilities; over supply of manpower in labour market provide a bigger room for small

Reason for industrial accidents can be viewed from various aspects. First of all, industries lack legal knowledge. Therefore, they neglect the rights and privileges of workers. On the other hand, they seek more and more profits. Secondly, private enterprises are reluctant to invest in safety and health facilities; whereas over supply of manpower in China’s labour market and fierce competition for jobs provide a bigger room for small employers to manipulate the situation to their advantages. Some entrepreneurs in rural areas and undeveloped areas do not know about the existence of legislations to protect industrial workers. To take an
employers to manipulate the situation to their advantages. Some entrepreneurs in rural areas and undeveloped areas do not know about the existence of legislations to protect industrial workers.

example, there is a legislation titled Protection of Rights and interests of women, when a survey was conducted in 169 coalmines, only 87 employers were aware of the fact that they cannot employ female workers in mines. Only 12 employers were aware of the fact that women require special protection but were not clear about the details. As many as 70 entrepreneurs were not even aware of national laws.

Industrial Workers’ Safety

Safety regulations and rules of some companies are incomplete and safety and health rules are not widely known. To quote an example, many private enterprises do not provide their employees with necessary information on safety nor with labour protection facilities. Even industrial workers themselves were not aware of their rights relating to industrial safety.

Present situation of labour safety

Presently the situation has been improving. Even though there was a legislation enacted in 1995 by the Chinese Government envisaging Safety, Health and Labour Welfare many industrialists were unaware of it. However, the situation is improving.

In terms of Chapter 6 of the Labour Law 1995, Labour Safety and Sanitation assume greater important position; the employer shall establish and perfect its system for labour safety and sanitation, strictly abide by State rules and standards on labour safety and sanitation, educate labourers in labour safety, prevent accidents and reduce occupational hazards. Article 53 of the Ordnance provide that the labour safety and sanitation facilities shall meet State fixed standards. The regulation further provide that labour safety and sanitation facilities of new projects and projects of renovation and expansion shall be designed, constructed and put into operation and use at the same time as the main projects. Article 54 of the regulation further provide that the employer shall provide labourers with safety and sanitation conditions meeting State stipulations and
necessary articles of labour protection, and carryout regular health examination for labourers engaged in work with occupational hazards. In this particular Article, the directive requires the employer to provide safety work wear or personal protective equipment to the industrial workers. Article 55 expects that the industrialists should train the employees working in hazardous operations are required to be trained appropriately. Safe operation in the process of labour is the keynote addressed here. In case the line supervisors direct them to work disregarding safety and security of the worker concerned or any other or group of workers, the workers have inherent right to refuse the unsafe work. The Govt. shall establish a system for the statistical report and treatment of accidents of injuries or deaths and cases of occupational diseases.

Canada

In Canada all states and territories have Occupational Health and Safety (OHS) legislation that must be followed by all workplaces. This legislation covers:

- Material safety management systems.
- Hazardous substances and dangerous goods codes.
- Manual handling.
- Personal Protective Equipment (PPE).
- Material Safety Data Sheets (MSDS).

The Occupational Health and Safety Authority in each state are responsible for ensuring that the regulations are followed. Their responsibilities include the following:
• Ensure that safe practices are followed in work place

• Check machines and equipment to ensure compliance with safety requirements

• Prosecute employers and employees where clear breaches of regulations can be shown to have existed.

The need to provide Personal Protective Equipment (PPE) shall be determined from the process of hazard identification, risk assessment and development of risk control measures using the Forms OHSW Procedures to ensure that the provision of PPE is an appropriate control option.

In Australia, PPE items should be purchased from suppliers who ensure that only approved (Australian Standard or equivalent marking) PPE will be provided.

**Australia**

In Australia, PPE shall conform to any legislative, Australian Standard and/or Industry Standard requirements or guidelines. PPE items should be purchased from suppliers who ensure that only approved (Australian Standard or equivalent marking) PPE will be provided and include the following services:

- Advice on PPE,
- Information relating to any test results,
- Advice on personal fitting, use, cleaning, maintenance and storage of PPE,
- A range of sizes (where appropriate),
- Information on the availability and need for replacement parts,
- Demonstration of the PPE, and
- Immediate replacement of any defective PPE
Brazil

In the Brazilian legislation, PPE is defined as all equipment of personal use designed to protect the physical integrity during the work activity. It is mandatory that all PPE commercialized in Brazil have the certificate of approval from the ministry.

The usage of PPE is mandatory in many industrial sectors, and the Brazilian Ministry of Work and Employment (Ministério do Trabalho e Emprego) certifies products and companies that are currently in the market.

It is mandatory that all the PPE commercialized in Brazil have the Certificate of Approval from the Ministry, since this testify the product origin and quality, through mechanical and chemical tests achieved by Brazilian qualified technical institutes.

The PPE market is divided into:

- Above-the-neck PPE, including hearing protection, eye protection, face protection and head protection
- Protective clothing
- Respiratory protection equipment (facial or semi-facial masks with air supplier, respirators or air purification system)
- Protective gloves
- Protective footwear.
All advanced countries in the world have reinforced Occupational Health and Safety Act (OSHA). They have done this by implementing directives which necessitate entrepreneurs to implement safety measures in industries. Since advanced countries have adequate number of directives to ensure workers’ safety, industries provide adequate number of safety devices including safety work wear to their workmen. Workers are able to concentrate on production without taking much botheration on safety aspects.

Workers working in heat generating industries and hazardous industries work whilst their bodies are totally covered with protective work wear. They are found to be wearing goggles, helmets, long coats and pants made of fire retardant fabrics and gloves to protect themselves. Their whole body is covered with PPE. Contrary to that in Indian industries it is not in practice ab initio. A typical Indian worker working in heat generating industries and hazardous industries work with no protective work wear. Except in a few organized factories, in rest, workers wear ordinary clothes and some times only inner wear or bare body and barefooted. Even in organized factories, the type of protective work wear used is of an inferior quality made of coated cotton fabric which does not provide the required degree of protection. Very high temperature molten metals are handled by the workers in country made equipments thereby sacrificing workers’ safety.

Industrial accidents

In India though the number of industrial accidents is very high, often many of them are not reported. Accidents in work places take place in an alarming proportion due to lack of enforcement. When there is no adequate enforcement, whatever be the stringent law, it would be remain ineffective. It is relevant to note that the number of Health and Factory Inspectors in India is far too small. For example, for the NCT of Delhi, there were only three Factory Inspectors in 1999. They were in charge
of 6496 factories covered by the Factories Act (cciindia.org). That is not even one Inspector per 2000 factories, whereas a reasonable ratio would be one per 250, i.e. 24 Inspectors in all. Due to this scarcity of staff, regular visits to companies are virtually impossible, and inspectors react only when complaints are lodged or accidents are reported.

The other reason for lack of enforcement could be the unsuitability of the centrally drafted regulations to the local situation in the factories. Legislations are either unrelated to the danger or do not take into account distinctive work situations. Obviously, workplaces differ from each other. Legislation, which neglects these differences, imposes very high costs on some workplaces, while others still remain unsafe, despite complying with the requirements. For example, the Factories Act requires minimum space for each worker to prevent overcrowding - 14.2 cubic metres for factories built after the commencement of this Act and 9.9 cubic metres for older ones. The actual checking of this requirement is carried out by the Health Inspector based on the building plan of the facility. The total available space is divided by the number of workers, so that violations for single workplaces cannot be found out.

Furthermore, the levied penalties are insignificant. In view of inadequate number of enforcement mechanism, conditions of work places are not inspected properly. In any case, only eight percent of the Indian workforce is employed in the organised sector; therefore the law necessarily will not reach the bigger part of it - the unorganised medium, small and tiny and micro industries.

Is it profitable for the industry to provide sufficient safety and health measures without regulations by the state?

There are two reasons for the industry to adopt voluntary safety and health measures. They are the cost of accidents or diseases Vs the cost of OSH and easy access to international markets especially to developed countries.
The costs of accidents or diseases

It is obvious that hazardous and unhealthy workplaces result in costs for the employer. The treatment of the injured or sick worker has to be paid for. If the worker is not able to resume work after his recovery, a substitute has to be trained and it will take some time before the new worker reaches the productivity levels of the old one. Indemnification for injured workers or those who have died and their families can cause considerable expenses; and the burden would be especially high for small and medium scale firms. In most cases the damage to workers is accompanied by damages to instalments which have to be repaired.

All these expenses can be easily assigned to the incident that causes them. Therefore they are direct costs. Workers who cannot work amount to a loss of production for the company. Other employees could be substitutes for them, but then the substitute would have to work overtime, which would be more expensive. If however, the substitution were to take place within the routine of a workday, it means that there has to have been an inefficiency before, for the aim of normal production should be a capacity utilisation close to 100%. This spare capacity causes overhead costs and contradicts the assumption of profit maximisation. Furthermore, equipment involved in an accident would have a shorter lifespan and would have to be replaced earlier.

Most companies could profit by publicising the production conditions in their factories/workplaces. Customers in developed countries often set a high value to the conditions under which products are fabricated. Moreover, a plant is not a closed system. Workers are part of the public, and with their incomes, they are more or less direct customers of the company. Companies, which do not maintain well co-ordinated safety measures, would therefore not only endanger their own employees but also others that co-ordinate their activities with the company. For these reasons hazardous workplaces would amount to a loss of image and finally, of sales.
All these costs are indirect and usually not registered as emerging from particular incidents, but they are the main part of costs arising due to unsafe working conditions. Estimates of the proportion between direct and indirect costs of accidents range from 1:1 to 1:20, depending on the considered sector and the methodology of recording. That means that the indirect costs are at least as high as the direct ones and, though more difficult to measure, it would be a criminal mistake to neglect them.

**The costs of OSH**

Estimates of costs of OSH measures tend to overestimate the actual costs. Examinations of the used methodologies of cost projection show that they are frequently overstated. Only the direct costs obvious to prevention of accidents and diseases are taken into account. This way usually consists of installing additional devices to separate the workers from the hazards. This not only impedes the flow of work but is also uneconomic. In most cases slight changes in the construction of installations would be more effective, cheaper, and they would involve the worker and his knowledge in the process of finding a better solution. Furthermore, the installation of automatic machines would not only enhance safety but also increase the productivity.

**Easy access to free markets through OSH**

To enter into international markets, it is essential that all manufacturing activities are carried out in a manner by which the environment is protected and product is manufactured by adopting all safety measures at work place. Internationally accepted products can be achieved by adopting OSH measures like in the developed countries.

**Standards on OSH**

The standards are consensus agreements between delegations representing all stakeholders concerned - suppliers, users, employees and, often, governments. They agree on specifications and criteria to be
applied consistently in the classification of materials, the manufacture of products and the provision of services.

Standards are one way to set a certain level without fixing minimum requirements. Such standards are required to be updated keeping in view of the present trends. The best known standards across the world are ISO 9000 for quality management, and ISO 14000 for environmental protection, both by ISO. These can be used for voluntary certification of implemented management systems in order to distinguish one company among its competitors.

OSH is another realm where standards could be applied. The widespread adoption of standards for OSH means that the workplace conditions in companies, which satisfy these standards, would be more attractive for workers and employees and the company would get a greater variety to choose the best from.

The above mentioned ISO 9000 and ISO 14000 comprise aspects of OSH only on the margin. ISO 9001 obliges the employers to communicate to the organisation the importance of meeting statutory and regulatory requirements, and environmental issues only go along with the safety of plants and machinery. A particular ISO standard on OSH does not exist and is not being planned, for differences in local values, culture, and requirements do not allow one sole standard suitable for all.

Therefore some countries have developed standards on Occupational Health and Safety Management Systems (OHSMS) according to their needs. In India also there is a dire need to develop such standards. A management system does not mean a specified set of restrictions or rules, which have to be followed. What is important is continual improvement of the working conditions. Improvements are not to be made isolated from other measures. With an OHSMS, OSH interests are considered to be equal to production, sales, or other fields of operation.

Currently the most discussed approach has been developed by a group of 13 European certification companies and the British Standardisation
Institute (BSI). The Occupational Health and Safety Assessment Series (OHSAS) 18000 correspond to the structure of ISO 14000 and thus can be implemented without conflicts where this is already being used. India has published IS 15001: 2000 Indian Standard on Occupational Health and Safety Management Systems - Specification and Guidance for Use, which is based on OHSAS 18000 and adapted to the Indian needs. However, this standard is not popular and is not obligatory on the part of the industry to implement because there is no Indian legislation on OSH IS 15001, similar to the other standards, names four phases of the improvement process: planning, implementation and operation, measurement and evaluation (checking and corrective action in OHSAS 18001), and management review.

Essential is the risk assessment process, which is described comprehensively in Annex C of IS 15001. It comprises of six steps: Classifying work activities, identifying hazards, determining risks, deciding if risk is tolerable, preparing risk control action plan, and reviewing adequacy of action plan.

National Safety Council

National Safety Council an autonomous organisation under Ministry of Labour, Government of India is engaged in giving training to employees of industries in relation to safety in work place. According to the said Council, developing a strong safety culture as an integral part of the work culture and lifestyle in the people is a big challenge. Appropriate training is one of the several approaches to meet the challenge successfully. National Safety Council, whose mission is to create, develop and sustain awareness about safety, health and environment at the national level, has been conducting training courses on since its inception in 1966. What started off as a national initiative on March 4, 1966 has become synonymous with safety training today in not only Government and public sectors but also in private companies.
According to the said Council, protection of employees is involved in multiple steps which are explained in the following diagram.

Ministry of Labour and Employment describes safety measurements of workers that are required to be taken by industries. Legally speaking Occupational Health and Safety is discussed in Constitution of India. Articles 24, 39 (a) to (f), 42 and 43 as under:

**Article – 24:** Prohibition of employment of children in factories, etc. – No child below the age of fourteen years shall be employed to work in any factory or mine or engaged in any other hazardous employment.

**Article – 39:** Certain principles of policy to be followed by the State – The State shall, in particular, direct its policy towards securing -

(a) that the citizens, men and women equally, have the right to an adequate means of livelihood;

**Legal provision on safety of workers**
(b) that the ownership and control of the material resources of the community are so distributed as best to subserve the common good;

(c) that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment;

(d) that there is equal pay for equal work for both men and women;

(e) that the health and strength of workers, men and women, and the tender age of children are not abused and that citizens are not forced by economic necessity to enter avocations unsuited to their age or strength;

(f) the children are given opportunities and facilities to develop in a healthy manner and in conditions of freedom and dignity and that childhood and youth are protected against exploitation and against moral and material abandonment.

**Article – 42: Provision for just and humane conditions of work and maternity relief** – The State shall make provision for securing just and humane conditions of work and for maternity relief.

**Article – 43: Living wage, etc., for workers** – The State shall endeavour to secure, by suitable legislation or economic organisation or in any other way, to all workers agricultural, industrial or otherwise, work, a living wage, conditions of work ensuring a decent standard of life and full enjoyment of leisure and social and cultural opportunities and, in particular, the State shall endeavour to promote cottage industries on an individual or co-operative basis in rural areas.

It is also relevant to peruse directive principles of State policy.

In order to achieve this objective and to give effect to the intention of legislations, Ministry of Labour and Employment called Directorate General, Factory Advice Service and Labour Institutes, Mumbai are taking lead role in their supervision and administration.
DGFASLI functions under the administrative control of Ministry of Labour and Employment and it is considered to be its technical arm. It gives advice to Ministry as regards to maintenance of safety, health and welfare of workers in factories. Besides the same, it also assists the Central Government in formulation and review of policy and legislation on occupational health and safety of workers.

**National Policy on Safety of workers**

The Ministry has drafted a National Policy on Safety of workers. Salient features of the entire policy are as under:

The Constitution of India provide detailed provisions for the rights of the citizens and also lays down the Directive Principles of State Policy which set an aim to which the activities of the state are to be guided.

These Directive Principles provide

(a) for securing the health and strength of employees, men and women;

(b) that the tender age of children are not abused;

c) that citizens are not forced by economic necessity to enter avocations unsuited to their age or strength;

d) just and humane conditions of work and maternity relief are provided; and

e) that the Government shall take steps, by suitable legislation or in any other way, to secure the participation of employee in the management of undertakings, establishments or other organisations engaged in any industry.

On the basis of these Directive Principles as well as international instruments, Government is committed to regulate all economic activities for management of safety and health risks at workplaces and to provide measures so as to ensure safe and healthy working conditions for every working man and woman in the nation.
Government recognizes that safety and health of workers has a positive impact on productivity and economic and social development. Prevention is an integral part of economic activities as high safety and health standard at work is as important as good business performance for new as well as existing industries.

The formulation of policy, priorities and strategies in occupational safety, health and environment at work places, is undertaken by national authorities in consultation with social partners for fulfilling such objectives. A critical role is played by the Government and the social partners, professional safety and health organizations in ensuring prevention and in also providing treatment, support and rehabilitation services.

Government of India firmly believes that without safe, clean environment as well as healthy working conditions, social justice and economic growth cannot be achieved and that safe and healthy working environment is recognized as a fundamental human right. Education, training, consultation and exchange of information and good practices are essential for prevention and promotion of such measures.

The changing job patterns and working relationships, the rise in self employment, greater sub-contracting, outsourcing of work, homework and the increasing number of employees working away from their establishment, pose problems to management of occupational safety and health risks at workplaces. New safety hazards and health risks will be appearing along with the transfer and adoption of new technologies. In addition, many of the well known conventional hazards will continue to be present at the workplace till the risks arising from exposure to these hazards are brought under adequate control. While advancements in technology have minimized or eliminated some hazards at workplace, new risks can emerge in their place which needs to be addressed.

Particular attention needs to be paid to the hazardous operations and of employees in risk prone conditions such as migrant employees and
various vulnerable groups of employees arising out of greater mobility in the workforce with more people working for a number of employers, either consecutively or simultaneously.

The increasing use of chemicals, exposure to physical, chemical and biological agents with hazard potential unknown to people; the indiscriminate use of agro-chemicals including pesticides, agricultural machineries and equipment; industries with major accident risks; effects of computer controlled technologies and alarming influence of stress at work in many modern jobs pose serious safety, health and environmental risks.

The fundamental purpose of this National Policy on Safety, Health and Environment at workplace, is not only to eliminate the incidence of work related injuries, diseases, fatalities, disaster and loss of national assets and ensuring achievement of a high level of occupational safety, health and environment performance through proactive approaches but also to enhance the well-being of the employee and society, at large. The necessary changes in this area will be based on a co-ordinated national effort focused on clear national goals and objectives.

Every Ministry or Department may work out their detailed policy relevant to their working environment as per the guidelines on the National Policy.

**Goals**

The Government firmly believes that building and maintaining national preventive safety and health culture is the need of the hour. With a view to develop such a culture and to improve the safety, health and environment at work place, it is essential to meet the following requirements:-

- providing a statutory framework on Occupational Safety and Health in respect of all sectors of industrial activities including the construction sector, designing suitable control systems of compliance, enforcement and incentives for better compliance.
- providing administrative and technical support services.
• providing a system of incentives to employers and employees to achieve higher health and safety standards.

• providing for a system of non-financial incentives for improvement in safety and health.

• establishing and developing the research and development capability in emerging areas of risk and providing for effective control measures.

• Focusing on prevention strategies and monitoring performance through improved data collection system on work related injuries and diseases.

• Developing and providing required technical manpower and knowledge in the areas of safety, health and environment at workplaces in different sectors.

• Promoting inclusion of safety, health and environment, improvement at workplaces as an important component in other relevant national policy documents.

• Including safety and occupational health as an integral part of every operation.

**Objectives**

The policy seeks to bring the national objectives into focus as a step towards improvement in safety, health and environment at workplace. The objectives are to achieve:-

a) Continuous reduction in the incidence of work related injuries, fatalities, diseases, disasters and loss of national assets.

b) Improved coverage of work related injuries, fatalities and diseases and provide for a more comprehensive data base for facilitating better performance and monitoring.

c) Continuous enhancement of community awareness regarding safety, health and environment at workplace related areas.
d) Continually increasing community expectation of workplace health and safety standards.

e) Improving safety, health and environment at workplace by creation of “green jobs” contributing to sustainable enterprise development.

**Action Programme**

For the purpose of achieving the goals and objectives mentioned above, the following action programme is drawn up and where necessary time bound action programme would be initiated, namely:-

**Enforcement**

- by providing an effective enforcement machinery as well as suitable provisions for compensation and rehabilitation of affected persons;

- by effectively enforcing all applicable laws and regulations concerning safety, health and environment at workplaces in all economic activities through an adequate and effective labour inspection system;

- by establishing suitable schemes for subsidy and provision of loans to enable effective implementation of the policy;

- by ensuring that employers, employees and others have separate but complementary responsibilities and rights with respect to achieving safe and healthy working conditions;

- by amending expeditiously existing laws relating to safety, health and environment and bring them in line with the relevant international instruments;

- by monitoring the adoption of national standards through regulatory authorities;

- by facilitating the sharing of best practices and experiences between national and international regulatory authorities;
• by developing new and innovative enforcement methods including financial incentives that encourage and ensure improved workplace performance;

• by making an enabling legislation on Safety, Health and Environment at Workplaces;

• by setting up safety and health committees wherever deemed appropriate;

National Standards

• by developing appropriate standards, codes of practices and manuals on safety, health and environment for uniformity at the national level in all economic activities consistent with international standards and implementation by the stake holders in true spirit;

• by ensuring stakeholders awareness of and accessibility to applicable policy, documents, codes, regulations and standards;

Compliance

• by encouraging the appropriate Government to assume the fullest responsibility for the administration and enforcement of occupational safety, health and environment at workplace, provide assistance in identifying their needs and responsibilities in the area of safety, health and environment at workplace, to develop plans and programmes in accordance with the provisions of the applicable Acts and to conduct experimental and demonstration projects in connection therewith;

• by calling upon the co-operation of social partners in the supervision of application of legislations and regulations relating to safety, health and environment at workplace;

• by continuous improvement of Occupational Safety and Health by systems approach to the management of Occupational
Safety and Health including developing guidance on Occupational Safety and Health management systems, strengthening voluntary actions, including mechanisms for self-regulatory concept and establishing auditing mechanisms which can test and authenticate occupational safety and health management systems;

- by providing specific measures to prevent catastrophes, and to co-ordinate and specify the actions to be taken at different levels, particularly in the industrial zones with high potential risks;

- by recognising the best safety and health practices and providing facilitation for their adoption.

- by providing adequate penal provisions as deterrent for violation of laws for the time being in force;

- by encouraging all concerned to adopt and commit to “Responsible Care” and/or “Corporate Social Responsibility” to improve safety, health and environment at workplace performance;

- by ensuring a suitable accreditation machinery to recognise institutions, professionals and services relating to safety, health and environment at workplace for uniformity and greater coverage as also authenticating safe management system;

- by encouraging employers to ensure occupational safety and health management systems, establish them in efficient manner to improve workplace safety and health;

- by specifically focusing on such occupational diseases like pneumoconiosis and silicosis; developing a framework for its prevention and control as well as develop technical standards and guidelines for the same;

- by promoting safe and clean technology and progressively replacing materials hazardous to human health and environment;
**Awareness**

- by increasing awareness on safety, health and environment at workplace through appropriate means;

- by providing forums for consultations with employers’ representatives, employees representatives and community on matters of national concern relating to safety, health and environment at workplace with the overall objective of creating awareness and enhancing national productivity;

- by encouraging joint labour-management efforts to preserve, protect and promote national assets and to eliminate injuries and diseases arising out of employment;

- by raising community awareness through structured, audience specific approach;

- by continuously evaluating the impact of such awareness and information initiatives;

- by maximizing gains from the substantial investment in awareness campaigns by sharing experience and learning;

- by suitably incorporating teaching inputs on safety, health and environment at workplace in schools, technical, medical, professional and vocational courses and distance education programme;

- by securing good liaison arrangements with the International organisations;

- by providing medical criteria wherever necessary which will assure insofar as practicable that no employee will suffer diminished health, functional capacity, or life expectancy as a result of his workplace activities and that in the event of such occupational diseases having been contracted, is suitably compensated;

- by providing practical guidance and encouraging employers and employees in their efforts to reduce the incidence of occupational
safety and health risks at their places of employment and to impress upon employers and employees to institute new programmes and to improve existing programmes for providing safe and healthful working conditions, requiring employers to ensure that workers and their representatives are consulted, trained, informed and involved in all measures related to their safety and health at work;

Research and Development

• by providing for research in the field of safety, health and environment at workplace, including the social and psychological factors involved, and by developing innovative methods, techniques including computer aided Risk Assessment Tools, and approaches for dealing with safety, health and environment at workplace problems which will help in establishing standards;

• by exploring ways to discover latent diseases, establishing causal connections between diseases and work environmental conditions, updating list of occupational diseases and conducting other research relating to safety, health and environmental problems at workplace;

• by establishing research priorities as per national requirements; exploring partnerships and improving communications with various national and international research bodies;

• by ensuring a coordinated research approach and an optimal allocation of resources in Occupational Safety and Health sector for such purposes;

Occupational safety and health skills development

• by building upon advances already made through employer and employee initiative for providing safe and healthy working conditions;

• by providing for training programmes to increase the number and competence of personnel engaged in the field of occupational safety, health and environment at workplace;
by providing information and advice, in an appropriate manner, to employers and employees organisations, with a view to eliminating hazards or reducing them as far as practicable;

by establishing occupational health services aimed at protection and promotion of health of employee and improvement of working conditions and by providing employee access to these services in different sectors of economic activities;

by integrating health and safety into vocational, professional and labour related training programmes as also management training including small business practices;

by adopting Occupational Safety and Health training curricula in workplace and industry programmes;

Data collection

by compiling statistics relating to safety, health and environment at work places, prioritising key issues for action, conducting national studies or surveys or projects through governmental and non-governmental organisations;

by reinforcing and sharing of information and data on national occupational safety, health and environment at work place information amongst different stake holders through a national network system on Occupational Safety and Health;

by extending data coverage relevant to work-related injury and disease, including measures of exposure, and occupational groups that are currently excluded, such as self-employed people;

by extending data systems to allow timely reporting and provision of information;

by developing the means for improved access to information.
**Review**

- An initial review and analysis shall be carried out to ascertain the current status of safety, health and environment at workplace and building a national Occupational Safety and Health profile.

- National Policy and the action programme shall be reviewed at least once in five years or earlier if felt necessary to assess relevance of the national goals and objectives.

**Conclusion**

- There is a need to develop close involvement of social partners to meet the challenges ahead in the assessment and control of workplace risks by mobilising local resources and extending protection to such working population and vulnerable groups where social protection is not adequate.

- Government stands committed to review the National Policy on Safety, Health and Environment at Workplace and legislations through tripartite consultation, improve enforcement, compilation and analysis of statistics, develop special programmes for hazardous operations and other focus sectors, set up training mechanisms, create nation-wide awareness, arrange for the mobilisation of available resources and expertise.

- The National Policy and programme envisages total commitment and demonstration by all concerned stake holders such as Government and social partners. Our goals and objectives will be that through dedicated and concerted efforts consistent with the requirements of safety, health and environment at work place and thereby improving the quality of work and working life.

In view of the Directive Principles of State Policy as enshrined in Indian Constitution, National Policy on Safety of Workers has been drafted by the Ministry of Labour and Employment, Government of India keeping in mind safety of workers in industries in accordance with international standards. In line with this policy, now it has become essential to suggest appropriate amendments in various labour welfare statutes. For this purpose, the following legislations are studied to begin with:

4.19
1. Boilers Act, 1923

2. Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996

3. Contract Labour (Regulation and Abolition) Act, 1970

4. Dangerous Machines (Regulation) Act, 1983


6. Factories Act, 1948

7. Industrial Employment (Standing Orders) Act, 1946


10. Mines Act, 1952

11. Plantation Labour Act, 1951


13. Fatal Accidents Act, 1855


In the above legislations the following amendments are suggested:

1. **Boilers Act, 1923**

   a) Sub Section (j) may be inserted defining safety work wear;

   b) An additional Section 21A may be inserted to read as under:

   “21A. The technical person who is expected to attend to and operate the boiler in normal course of time or any one who is required to attend to and operate the boiler shall wear

   4.20
safety work wear while attending to such duties and such safety work wear shall be provided by the owner of the boiler to such operator. The owner shall ensure to display sign boards in the immediate vicinity of the boiler persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one every year by the owner at free of cost.

Provided further that such safety work wear should meet the requirement of ISO 11612 excluding code D and code E.

2. Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996

a) New Sections 37A and 37B may be inserted to read as under:

b) 37A will explain about safety work wear for different classes of persons;

c) 37B may read as under:

“37B. In every place where fifty or more building construction workers are employed, the contractor shall provide free of cost safety work wear to such building workers. In case the building is constructed by the owner, then the owner shall provide such safety work wear. Safety work wear shall commensurate with the nature of work undertaken by the building workers.

Provided further that such safety work wear should meet the requirement of ISO 11611.

3. Contract Labour (Regulation and Abolition) Act, 1970

a) New sub section 16 (c) and (d) may be inserted to read as under:

b) 16 (c) will explain about safety work wear for different classes of persons;

c) 16 (d) may read as under:
4. **Dangerous Machines (Regulation) Act, 1983**

a) New sub section 3 (q) and Section 21A may be inserted to read as under:

b) Sub section 3(q) will explain about safety work wear for different classes of persons;

c) 21A may read as under:

> “21A. In every place where dangerous machine is engaged, the contractor shall provide free of cost safety work wear to such persons operating dangerous machines. 
*Provided further that such safety work wear should meet the requirement of ISO 14116 for heat and flame and ISO 11611 for welding operation.*

5. **Dock Workers (Safety, Health and Welfare) Act, 1986**

a) New sub section 2 (i) and Section 21A may be inserted to read as under:

b) Sub section 2 (i) will explain about safety work wear for different classes of persons;

c) 21A may read as under:

> “21A. In every dock, the contractor shall provide free of cost safety work wear to such persons operating in the dock. 
*Provided further that such safety work wear should meet the requirement of ISO 14116 for heat and flame protection.*
6. **Factories Act, 1948**

a) In Section 2, Safety work wear may be defined.

b) A new Section 15A may be added to provide as under:

"The technical person who is expected to attend to and operate the heating equipment, high voltage electrical installation or furnace in normal course of time or any one who is required to attend to and operate the heating equipment, high voltage electrical installation or furnace shall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.

In every place where fifty or more building construction workers are employed, the contractor shall provide free of cost safety work wear to such building workers. In case the building is constructed by the owner, then the employer shall provide such safety work wear. Safety work wear shall commensurate with the nature of work undertaken by the building workers.

In every place where contract labour is engaged exceeding twenty persons, the contractor shall provide free of cost safety work wear to such contract labourers.

In every place where dangerous machine is engaged, the contractor shall provide free of cost safety work wear to such persons operating dangerous machines."
In every dock, the contractor shall provide free of cost safety work wear to such persons operating in the dock. This regulation is mandatory depending on the nature of work carried out by the worker."

*Provided further that such safety work wear should meet the requirement of ISO 11612 and BS EN 61482-1-2.*

*Provided further that such safety work wear should meet the requirement of ISO 11611 in case the worker is handling welding equipment.*

7. **Industrial Employment (Standing Orders) Act, 1946**

a) A separate clause 10A may be added to define Safety Work Wear;

b) A separate clause may be added to provide as under:

“The technical person who is expected to attend to and operate the heating equipment, high voltage electrical installation or furnace in normal course of time or any one who is required to attend to and operate the heating equipment, high voltage electrical installation or furnace shall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.

In every place where fifty or more building construction workers are employed, the contractor shall provide free of cost safety work wear to such building workers. In case the building is constructed by the owner, then the employer shall provide
such safety work wear. Safety work wear shall commensurate with the nature of work undertaken by the building workers.

In every place where contract labour is engaged exceeding twenty persons, the contractor shall provide free of cost safety work wear to such contract labourers.

In every place where dangerous machine is engaged, the contractor shall provide free of cost safety work wear to such persons operating dangerous machines.

In every dock, the contractor shall provide free of cost safety work wear to such persons operating in the dock. This regulation is mandatory depending on the nature of work carried out by the worker.”

Provided further that whenever workers are engaged in heat and flame then the safety work wear should meet the requirement of ISO 11612 and for high voltage electrical work, the safety work wear should meet the requirement of BS EN-61482-1-2.

Provided further that whenever workers are engaged in welding work, then the safety work wear should meet the requirement of ISO 11611.

Provided further that workers are engaged in chemical plants, then the safety work wear shall meet the requirement of ISO 17491.


a) A new sub section 10 A may be added to define Safety Work wear;

b) A new sub section 10AB may be added to provide Safety Work Wear.

“The technical person who is expected to attend to the mines operations in mines in normal course of time or any one who
is required to attend to and operate the equipment in mine area hall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.

*Provided further that such safety work wear should meet the requirement of ISO 11612 and BS EN 61482-1-2.*


a) A new sub section 10 A may be added to define Safety Work wear;

b) A new sub section 10AB may be added to provide Safety Work Wear.

“The technical person who is expected to attend to the mines operations in mines in normal course of time or any one who is required to attend to and operate the equipment in mine area hall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.
Provided further that such safety work wear should meet the requirement of ISO 11612 and BS EN 61482-1-2.

10. Mines Act, 1952

a) A new sub section 10 A may be added to define Safety Work wear;

b) A new sub section 10AB may be added to provide Safety Work Wear.

“The technical person who is expected to attend to the mines operations in mines in normal course of time or any one who is required to attend to and operate the equipment in mine area hall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.

Provided further that such safety work wear should meet the requirement of ISO 11612 and BS EN 61482-1-2.

11. Plantation Labour Act, 1951

a) New Sections 12A and 12B may be inserted to read as under:

b) 12A will explain about safety work wear for different classes of persons;

c) 12B may read as under:

“12B. In every place where fifty or more plantation workers are employed, the owner or contractor as the case may be shall provide free of cost safety work wear to such plantation workers. In case of plantation, such safety work wear should
withstand torrential rain that may affect such plantation area. Safety work wear shall commensurate with the nature of work undertaken by the plantation workers. 

*Provided further that such safety work wear to be used at the time of spraying of pesticides should meet the requirement of ISO 17491.*


a) A new sub section 14 A may be added to define Safety Work wear;

b) A new sub section 14AB may be added to provide Safety Work Wear.

“The technical person who is expected to attend to the mines operations in mines in normal course of time or any one who is required to attend to and operate the equipment in mine area shall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards. 

*Provided further that such safety work wear should meet the requirement of ISO 11612 and BS EN 61482-1-2.*

**13. Fatal Accidents Act, 1855**

a) In Section 2, Safety work wear may be defined.

b) A new Section 9A may be added to provide as under:

“The technical person who is expected to attend to and operate the heating equipment, high voltage electrical installation or furnace in normal course of time or any one
who is required to attend to and operate the heating equipment, high voltage electrical installation or furnace shall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.

In every place where fifty or more building construction workers are employed, the contractor shall provide free of cost safety work wear to such building workers. In case the building is constructed by the owner, then the employer shall provide such safety work wear. Safety work wear shall commensurate with the nature of work undertaken by the building workers.

In every place where contract labour is engaged exceeding twenty persons, the contractor shall provide free of cost safety work wear to such contract labourers.

In every place where dangerous machine is engaged, the contractor shall provide free of cost safety work wear to such persons operating dangerous machines.

In every dock, the contractor shall provide free of cost safety work wear to such persons operating in the dock. This regulation is mandatory depending on the nature of work carried out by the worker."

*Provided further that such safety work wear should meet the requirement of ISO 11612 and BS EN 61482-1-2.*
14. **Manufacture, Storage and Impose of Hazardous Chemicals Rules, 1989**

   a) A new sub section 8A may be added to define Safety Work wear;
   
   b) A new sub section 8AB may be added to provide Safety Work Wear.

   “The technical person who is expected to attend to the storage area operations where chemicals and hazardous substances [chemicals and hazardous substances defined elsewhere in this Act] in normal course of time or any one who is required to attend to and operate the equipment in such area shall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.

   *Provided further that such safety work wear should meet the requirement of ISO 17491, ISO 11612 and BS EN 61482-1-2.*

15. **Biomedical Waste (Management & Handling) Rules, 1998**

   a) A new sub section 12A may be added to define Safety Work wear;
   
   b) A new sub section 12AB may be added to provide Safety Work Wear.

   “The technical person who is expected to attend to the bio medical waste treatment plant in normal course of time or any one who is required to attend to and operate the equipment in such treatment plant area shall wear safety
work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.

*Provided further that such safety work wear should meet the requirement of ISO 11612 and BS EN 61482-1-2.*


a) A new sub section 14A may be added to define Safety Work wear;

b) A new sub section 14AB may be added to provide Safety Work Wear.

“The technical person who is expected to attend to the chemical storage and manufacturing operations in normal course of time or any one who is required to attend to and operate the equipment in such area hall wear safety work wear while attending to such duties and such safety work wear shall be provided by the employer of the heating equipment, high voltage electrical installation or furnace to such operator. The employer shall ensure to display sign boards in the immediate vicinity of the heating equipment, high voltage electrical installation or furnace persuading such attendants to wear safety work wear. Such safety work wear shall be replaced with a new one if and when the earlier one by the employer at free of cost as and when the work wear does not fulfil minimum standards.
Provided further that such safety work wear worn at the time of handling chemicals should meet the requirement of ISO 17491.

Provided further that such safety work wear should meet the requirement of ISO 14116 in case the chemicals are inflammable and heat emission in nature.

Definition of safety work wear

Safety work wear means and include protective personal clothing to protect human body from heat, dust, fire and resultant natural and manmade disasters that cannot be controlled easily and in the event of such natural and manmade disasters affecting human being would result in fatal accident including death.

Such safety work wear shall be manufactured, tested, marketed and used after thorough laboratory testing. The administrative ministry shall cause to issue appropriate notification in the gazette as to laboratory that can test such safety work wear including fixing up of standards in accordance with technical regulations explained in detail hereunder.

Technical Regulations

In developed countries legislations require that employers provide suitable PPE for their employers wherever there are risks to health and safety which can not be controlled at source. The first priority of an employer should be to eliminate such risks by way of other than the use of PPE. In other words, PPE should only be considered in situations where it is not possible to achieve the required degree of protection by any other method. PPE is considered to be the lowest in the hierarchy of risk prevention measures because

- it protects only the person wearing or using it, where as measures which control risk at source protect every one in the work place
- maximum levels of protection are difficult to achieve and level of protection is difficult to assess
• it may restrict the wearer or user by limiting mobility or visibility, thereby creating additional hazards.

The above facts have been considered while suggesting the following PPE technical regulations.

The PPE technical regulations are divided into three categories according to the level of risk which a PPE item is designed to protect against - the higher the risk, the more stringent the performance requirements of the PPE item. The three categories are simple, intermediate and complex.

The simple category comprises products which are designed to protect only against low level hazards and minimum risks. The intermediate category comprises products designed to protect against risks of severe injury. Products in the complex category claim to provide against risks of mortal dangers or hazards which may seriously harm the user’s health.

The technical regulations require that PPE is:

• properly assessed before use to ensure that it provides the protection needed
• maintained and stored properly
• provided with instructions on how to use it safely
• used correctly by employees and
• worn the whole time the wearer is exposed to a particular risk

In addition to setting minimum health and safety requirements for PPE users, the regulations places obligations on employers to

• conduct risk assessment of hazards in their work places
• define the characteristics of equipment necessary to protect their employees
• ensure that all PPE in their workplace conforms to IS standards
• ensure that PPE is appropriate for the risks it is designed to minimize
• keep records of assessment and reasons for selecting particular types of PPE
• ensure that the PPE items prevent or control risks involved in a particular activity without increasing overall level of risk

• ensure that the PPE items worn or used by an employee are compatible with other PPE items worn or used by the employee.

The PPE product sold in the market should have BIS mark for which it must be tested by an independent body. The testing should be done in accordance to relevant IS/ISO performance standards for a particular item of PPE.

BIS-marked PPE must be supplied with user guidance notes, which should provide the following information:

• the name of the manufacturer

• the category of hazard for which the PPE is designed

• the level of performance achieved by PPE item

• instruction for use, if relevant and

• instructions for care and storage

As stated earlier, Technical Textile committee - TX 32, BIS has so far developed 27 standards and test methods out of which one standard is on protective clothing for industrial workers exposed to heat (which excludes firefighter’s and welder’s clothing). The standards for other thermal hazards which are likely to occur in industries during electrical (electrical arc) and welding operations are not yet developed. Hence it is proposed here, to adopt ISO/EN standards till the time BIS develops its own standards. The following Table shows the present status of IS and ISO/EN standards and test methods.
## Present Status of IS and ISO/BS EN Standards

<table>
<thead>
<tr>
<th>S. No.</th>
<th>ISO/BN EN Standard</th>
<th>IS Standard</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ISO 11611 (Supersedes EN 470-1) : Protective clothing for use in welding and allied processes</td>
<td>IS standard not available</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>ISO 11612:2008 Clothing for protection against heat and flame - Test methods and performance requirements for heat-protective clothing</td>
<td>IS 15748 : 2007, Textiles - Protective clothing for industrial workers exposed to heat (excluding firefighters' and welders' clothing)</td>
<td>ISO 11612:2008 includes ISO 15025 Procedure B and ISO 12127 test methods but IS 15748:2007 does not include these methods</td>
</tr>
<tr>
<td>3.</td>
<td>ISO 14116:2008 Protective clothing - Protection against heat and flame - Limited flame spread materials, material assemblies and clothing</td>
<td>IS 15742:2007 - Requirements for clothing made of limited flame spread materials and material assemblies affording protection against heat and flame specification</td>
<td>-</td>
</tr>
</tbody>
</table>

### ISO 11611 (Supersedes EN 470-1): Protective clothing for use in welding and allied processes

#### 1. Pretreatment

a) Cleaning: As per customer instruction. If no instruction then five cleaning cycles shall be performed.

b) Ageing: As per customer instruction max. nos. of washes (i.e wash and dry cycles)

#### 2. Conditioning: Test condition

Samples shall be conditions at (20±2) °C and (65±5) % RH at least 24 hours (leather specimen for 48 hours). Sample shall immediately test within 5 minutes from removing conditioning chamber. Samples for electrical resistance testing shall be conditioned and tested in an atmosphere having RH (85±5) % and temperature (20±2)°C.
### Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class-1</td>
<td>Class-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile strength</td>
<td>Class-1</td>
<td>Class-2</td>
</tr>
<tr>
<td></td>
<td>- Woven material</td>
<td>400N</td>
</tr>
<tr>
<td></td>
<td>- Leather</td>
<td>80N</td>
</tr>
<tr>
<td>Tear strength</td>
<td>Class-1</td>
<td>Class-2</td>
</tr>
<tr>
<td></td>
<td>- Woven material</td>
<td>20N</td>
</tr>
<tr>
<td></td>
<td>- Leather</td>
<td>20N</td>
</tr>
<tr>
<td>Burst strength of</td>
<td>ISO 13938-1</td>
<td>200 kPa</td>
</tr>
<tr>
<td>knitted fabric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seam strength</td>
<td>Class-1</td>
<td>Class-2</td>
</tr>
<tr>
<td></td>
<td>- Woven outer textile material</td>
<td>225N</td>
</tr>
<tr>
<td></td>
<td>- Leather</td>
<td>110N</td>
</tr>
<tr>
<td>Dimensional change</td>
<td>Class-1</td>
<td>Class-2</td>
</tr>
<tr>
<td></td>
<td>- Woven</td>
<td>≤ ±3%</td>
</tr>
<tr>
<td></td>
<td>- Knitted</td>
<td>≤ ±5%</td>
</tr>
<tr>
<td>Fat content in leather</td>
<td>ISO 4048</td>
<td>≤15%</td>
</tr>
<tr>
<td>Flame spread (any one procedure or both as per requirement)</td>
<td>ISO 15025 Procedure A and Procedure B (Code letter A1) and Procedure B (Code letter A2)</td>
<td>- No flaming to the top or either side edge - No hole formation (Only procedure A) - No flaming or molten debris - Mean after flame ≤ 2S - Mean afterglows ≤ 2S</td>
</tr>
<tr>
<td>Effect of flame on seam (specimen shall be oriented with the seam running up the centerline of the test specimen so that the burner impinges directly upon it)</td>
<td>ISO 15025 Procedure A and Procedure B</td>
<td>Seams shall remain intact</td>
</tr>
<tr>
<td>Impact of spatter</td>
<td>ISO 9150</td>
<td>- Min. 15 drops of molten metal to raise the temperature behind the test specimen by 40K - Material shall not ignite</td>
</tr>
</tbody>
</table>

### 3. General Safety Requirements
### UV Radiation Hazards

A simple check for continued UV protection for this type of clothing (e.g. carried out weekly) is to hold the garment up to light of a 100 W tungsten bulb approximately 1 m away; if light can be seen through the fabric, UV will penetrate too.

<table>
<thead>
<tr>
<th>Heat transfer (radiation)</th>
<th>ISO 6942 at a heat flux 20kW/m²</th>
<th>RHTI ≥ 7</th>
<th>RHTI ≥ 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical resistance</td>
<td>EN1149-2, Applied potential (100+5)V</td>
<td>≥10⁻⁵Ω</td>
<td>&gt;10⁻⁵Ω</td>
</tr>
<tr>
<td>Innocuousness</td>
<td>Technical safety sheets of individual material &amp; components</td>
<td>No component of the clothing shall produce any harmful effect on the wearer</td>
<td>No component of the clothing shall produce any harmful effect on the wearer</td>
</tr>
<tr>
<td>- pH value</td>
<td>ISO 3071 for textile &amp; ISO 4045 for leather</td>
<td>3.5 to 9.5</td>
<td>3.5 to 9.5</td>
</tr>
<tr>
<td>- Cr (VI) content</td>
<td>ISO 17075</td>
<td>Less than detection limit</td>
<td>Less than detection limit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of welder clothing</th>
<th>Selection criteria relating to the process</th>
<th>Selection criteria relating to the environmental conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-1</td>
<td>Manual welding techniques with light formation of spatters and drops e.g.</td>
<td>Operation of machines, e.g.</td>
</tr>
<tr>
<td></td>
<td>- gas welding</td>
<td>- oxygen cutting machines</td>
</tr>
<tr>
<td></td>
<td>- TIG welding</td>
<td>- plasma cutting machines</td>
</tr>
<tr>
<td></td>
<td>- micro plasma welding</td>
<td>- resistance welding machines</td>
</tr>
<tr>
<td></td>
<td>- brazing</td>
<td>- machines of thermal spraying</td>
</tr>
<tr>
<td></td>
<td>- spot welding</td>
<td>- bench welding</td>
</tr>
<tr>
<td></td>
<td>- MMA welding</td>
<td></td>
</tr>
<tr>
<td>Class-2</td>
<td>Manual welding techniques with heavy formation of spatters and drops e.g.</td>
<td>Operation of machines, e.g. of :</td>
</tr>
<tr>
<td></td>
<td>- MMA welding</td>
<td>- in confined spaces</td>
</tr>
<tr>
<td></td>
<td>- (with basic or cellulose-covered electrode)</td>
<td>- at overheat welding/cutting or in comparable constrained position</td>
</tr>
<tr>
<td></td>
<td>- MAG welding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- (with CO₂ or mixed gases)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- MIG welding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- (with high current)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Self-shielded flux cored arc welding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Plasma cutting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Gouging</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Oxygen cutting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Thermal spraying</td>
<td></td>
</tr>
</tbody>
</table>

**General requirement**: When tested in accordance with ISO 13688, the dimensions of the material shall not exceed ±3% in either length or width direction after a pretreatment with five cycles of washing (ISO 6330-2A) according to the manufacture’s instruction. Metallized material shall be pretreated as per Annex A given in ISO 11612:2008 for radiant heat testing.

**Performance requirements:**

1. **Heat resistance at a temperature of (180±5)°C**
   - When tested in accordance with ISO 17493 at a temperature of (180±5)°C, all fabric and hardware used in the garment and/or clothing assembly shall not ignite or melt and shall not shrink by more than 5%.

2. **Limited flame spread (code letter A1 and/or A2)**
   - Pre-treat cloth five times in front loading machine using 1 g/l ECE in soft water and finally dried once- ISO 6330-2A at 60°C and drying by E (tumble).
   - If dry clean only, it shall be dry clean five times in accordance with ISO 3175.

**As per ISO 15025, Procedure A (Code letter A1):**

Test in accordance of ISO 15025, procedure A before and after pretreatment, all outer materials or clothing assemblies shall meet the following:

- No specimen shall give flaming to the top or either side edge
- No specimen shall give hole formation;
- No specimen shall give flaming or molten debris
• The mean value of after flame time shall be < 2 S
• The mean value of afterglow time shall be < 2 S

As per ISO 15025, Procedure B (Code letter A2):

Test in accordance of ISO 15025, procedure B before and after pretreatment, all outer materials or clothing assemblies shall meet the following:

• No specimen shall give flaming to the top or either side edge
• No specimen shall melt or suffer flaming or molten debris
• The mean value of afterflame time shall be < 2 S
• The mean value of afterglow time shall be < 2 S

For seams, standard method as given in the ISO 11612 should be followed.

3. Dimensional change due to cleaning:

After pre treatment (after 5 wash or as per the requirement), the change in dimension shall be measured in accordance with ISO 5077 and shall not exceed 3% in either length or width direction. In the case of knitted fabric shrinkage shall not exceed 5%.

4. Physical requirement:

i) Tensile strength (ISO 13934-1): The tensile strength of the outer material or clothing assembly shall be minimum 300 N for machine and cross direction. For leather (ISO 3376), the tensile strength shall be 60N in two direction at right angle.

ii) Tear strength (ISO 13937-2): The tear strength of the outer material or clothing assembly shall be minimum 15 N. For leather (ISO 3377-1), the tear strength shall be 20N in two direction at right angle.

iii) Burst strength of knitted material (ISO 13938-1): The burst strength of the knitted material shall be a minimum 200 kPa.

iii) Seam Strength (ISO 13935-2): It shall be minimum 225 N for woven and 110N for leather.
5. **Optional requirement-Resistance to water penetration (Code letter W)**

i) Resistance to water penetration shall be tested and classified in accordance with EN 343.

ii) Water-vapour resistance shall be tested and classified in accordance with EN 343.

6. **Ergonomic requirement**

Sample shall be tested for practical performance as per guideline of Annex D given in ISO 11612.

7. **Fat content of leather**

When tested in accordance with ISO 4048 the fat content shall not exceed 15%.

8. **Innocuousness**

i) Possible harmful effect: No component of clothing must be known to produce any harmful effect on the wearer. This shall be checked by technical safety sheets of the individual material and components.

ii) pH value (ISO 3071 for textiles and ISO 4045 for leather): It shall be >3.5 and <9.5 for textiles and leather respectively.

iii) Chromium (VI) content of leather (ISO 17075): It shall be less than the detection limit.

9. **Convective heat (code letter B)**

When tested in accordance with ISO 9151, the protection against convective heat shall meet at least the performance level B1 in the Table.

<table>
<thead>
<tr>
<th>Performance levels</th>
<th>Range of HTI 24 values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>B1</td>
<td>4.0</td>
</tr>
<tr>
<td>B2</td>
<td>10.0</td>
</tr>
<tr>
<td>B3</td>
<td>20.0</td>
</tr>
</tbody>
</table>
10. Radiant heat (code letter C)

When tested in accordance with ISO 6942, Method B, at heat flux density 20 kW/m², the protection against radiant heat shall meet at least the performance level C1 in the Table. For metallized material pretreatment as per annex A shall be performed before test.

<table>
<thead>
<tr>
<th>Performance levels</th>
<th>Radiant heat transfer index (RHI 24), Second</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>C1</td>
<td>7.0</td>
</tr>
<tr>
<td>C2</td>
<td>20.0</td>
</tr>
<tr>
<td>C3</td>
<td>50.0</td>
</tr>
<tr>
<td>C4</td>
<td>95.0</td>
</tr>
</tbody>
</table>

11. Molten aluminium splash (code letter D)

When tested in accordance with ISO 9185, using molten aluminium, the protection against molten aluminium splash shall meet at least the performance level D1 in the Table.

<table>
<thead>
<tr>
<th>Performance levels</th>
<th>Molten aluminium splash index, g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>D1</td>
<td>100</td>
</tr>
<tr>
<td>D2</td>
<td>200</td>
</tr>
<tr>
<td>D3</td>
<td>350</td>
</tr>
</tbody>
</table>

12. Molten iron splash (code letter E)

When tested in accordance with ISO 9185, using molten iron, the protection against molten iron splash shall meet at least the performance level E1 in the Table.

<table>
<thead>
<tr>
<th>Performance levels</th>
<th>Molten iron splash index, g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>E1</td>
<td>60</td>
</tr>
<tr>
<td>E2</td>
<td>120</td>
</tr>
<tr>
<td>E3</td>
<td>200</td>
</tr>
</tbody>
</table>
13. Contact heat (Code letter F)

When tested in accordance with ISO 12127 at a temperature $250^\circ$C, shall meet at least the performance level F1 in the Table.

<table>
<thead>
<tr>
<th>Performance levels</th>
<th>Threshold time, second</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>F1</td>
<td>5.0</td>
</tr>
<tr>
<td>F2</td>
<td>10.0</td>
</tr>
<tr>
<td>F3</td>
<td>15.0</td>
</tr>
</tbody>
</table>

14. Optional requirement-Protection against the thermal effect of an electric arc event

Annex F of ISO 11612 can be referred as guideline

15. Optional test-Whole garment testing for prediction of injury by burn

Material shall be tested in accordance to ISO 13506 for prediction of burn using instrumented manikin.

ISO 14116 (Supersedes EN 533): Protective clothing- Protection against heat and flame-Limited flame spread materials, material assemblies and clothing

1. Pretreatment:

   a) Cleaning: As per customer instruction. If no instruction then five cleaning cycles shall be performed.
   b) Ageing: As per customer instruction max. nos. of washes (i.e wash and dry cycles)

2. Cleaning Index:

   i) If domestic washing then- No. of washes with letter H/washing temperature
ii) If Industrial washing then- No. of washes with letter I/washing temperature

iii) If dry-cleaned then- No. of cleansing with letter C/International symbol for dry-cleaning

iv) If neither washed nor dry cleaned, the cleaning index shall be in the form: 0/0

3. Final Index: Limited flame spread index/cleaning index

4. Performance requirements:

   a) Thermal performance:

   • Fabric shall be tested in accordance with ISO 15025, Procedure A (Surface ignition) and results shall be reported in flame spread index of 1, 2 or 3. Highest index number is the best one. (before and after pretreatments)

   • Single layer or assembly of cloth may be tested.

   • Sample size: 200±2 mm x 160±2 mm, 2 sets of three specimen each side

   • Test flame time: 10 seconds

   • Test condition: Samples shall be conditioned at (20±2) °C and (65±5) % RH at least 24 hours. Sample shall immediately test within 2 minutes from removing conditioning chamber. Test shall performed in an atmosphere having temperature 10°C and 30°C, a relative humidity between 15 and 80% and air movement less than 0.2 m/s.

   • Type of gas used shall be mentioned in the report.

   • Assembly cloth: i) Index shall be 1, 2 or 3 when flame is applied to the outer face and 2 or 3 with the flame applied to the inner face of the assembly, ii) Each layer of an assembly shall comply with index 1, 2 or 3 when flame applied on outer face, except the innermost layer shall comply with index 2 or 3.

   • In the case of garment, seam shall be tested with ISO 15025, placed in a vertical position through the centerline of the specimen. Seams shall not separate.
Classification:

<table>
<thead>
<tr>
<th>Properties</th>
<th>Requirement</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame spread</td>
<td>No specimen shall permit any part of the lowest boundary of any flame to reach the upper or vertical edge</td>
<td>/</td>
</tr>
<tr>
<td>Flaming debris</td>
<td>No specimen shall give off flaming debris</td>
<td></td>
</tr>
<tr>
<td>After glow</td>
<td>No afterglow shall spread the carbonized area to the undamaged area after the cessation of flaming</td>
<td></td>
</tr>
<tr>
<td>Hole formation</td>
<td>No specimen shall show hole formation</td>
<td>NR</td>
</tr>
<tr>
<td>After flame</td>
<td>The after flame time of each individual specimen shall not exceed 2 seconds</td>
<td>NR</td>
</tr>
</tbody>
</table>

NR : Not required

Protective clothing having Index 1 material shall not be worn next to the skin.

5. Mechanical performance:

i) Tensile strength (ISO 13934-1): The tensile strength of the outer material or clothing assembly shall be minimum 150 N for machine and cross direction.

ii) Tear strength (ISO 13937-2): The tear strength of the outer material or clothing assembly shall be minimum 7.5 N.

iii) Seam Strength (ISO 13935-2): It shall be minimum 30 N.

BS EN 61482-1-2: 2007 (Test Methods): Live working – Protective clothing against the thermal hazards of an electric arc tester and accessories

The test methods specified in this document are aimed at rendering a decision whether arc thermal protection is met under defined conditions.

Two protection classes are tested. Protection class 1 and protection class 2 are safety requirements covering actual risk potentials due to electric fault arcs. For the tests a low voltage procedure is used. The tests can optionally be carried out in two fixed test classes, selected by the amount of prospective short circuit current:

Class 1 : 4 kA;
Class 2 : 7 kA
Material and clothing will be tested with two methods: the material box test method and the garment box test method. The standard determine the behaviour of materials and garments when exposed to heat energy from electric arc with specific characteristics.

**Test parameters:**

The test parameters are shown in the Table:

<table>
<thead>
<tr>
<th>Test class</th>
<th>Test current kA</th>
<th>Test voltage V ac</th>
<th>Arc duration ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-1</td>
<td>4±5 %</td>
<td>400±5 %</td>
<td>500±5 %</td>
</tr>
<tr>
<td>Class-2</td>
<td>7±5 %</td>
<td>400±5 %</td>
<td>500±5 %</td>
</tr>
</tbody>
</table>

**Number of tests**: A series of four specimens shall be tested with material box test method while in the case of garment box test method; one test specimen of garment at minimum shall be tested.

**Test condition**: The test shall be carried out as an indoor or an outdoor test at an ambient temperature between 15°C and 35°C and a relative humidity of 25% to 75%.

**Test result**:

i) **Acceptance criteria of material box test method**: The test corresponding to a certain classification of arc conditions shall be considered as passed, if all of the criteria defined in the following table are met:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burning time</td>
<td>≤5 s</td>
</tr>
<tr>
<td>Melting</td>
<td>No melting through to the inner side</td>
</tr>
<tr>
<td>Hole formation</td>
<td>No hole bigger than max. 5mm in every direction (in the innermost layer)</td>
</tr>
<tr>
<td>Heat flux</td>
<td>All eight value pairs ((E_{it} - t_{max})) are below corresponding stoll values</td>
</tr>
</tbody>
</table>
ii) **Acceptance criteria of garment box test method:** The test shall be considered as passed if

- the material of the garment has passed successfully the material box test according to the above table
- the garment submitted to the garment test method fulfill the criteria given in the following table:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burning time</td>
<td>$\leq 5$ S</td>
</tr>
<tr>
<td>Melting</td>
<td>No melting through to the inner side</td>
</tr>
<tr>
<td>Hole formation</td>
<td>No hole bigger than max. 5mm in every direction (in the innermost layer)</td>
</tr>
</tbody>
</table>

After exposure, fastners shall be functional. Accessories shall have no negative influence on the results of the burning time, melting and hole formation.
The final recommendations emerging out of this report are required to be implemented by the administrative ministry by issuing a notification in the official gazette. Such notification would become valid only after it gets approval of the Parliament. To give effect to the recommendations, the following actions are suggested:

**Task 1** Vetting the report by stake holders

i. policy makers (central and state governments);
ii. industry (manufacturers, end users);
iii. BIS,
iv. Legal experts,
v. Trade Unions,
vi. Test Houses,
vii. Insurance companies
viii. others such as R&D institutions, universities

- At the outset MoT is required to make this draft report public by uploading it in the official website. The Ministry should invite comments from all the above referred stake holders and any other interest groups. One month time may be given to respond.
- A notice may be published in the news papers and trade journals indicating the intention of the Ministry to proceed further.
- Chief Secretaries of States and Union Territories may be intimated about the proposal and seek their comments.
- A copy of the notice may be sent to Chambers of Commerce, industry trade associations and All India recognised trade unions.
- Advocates practicing in labour legislations may be invited for discussions. Such discussions may be arranged by MoT in association with other ministries such as Ministry of Labour & Employment and Ministry of Law & Justice, Ministry of Consumer Affairs, Food and Public Distribution. Such discussions should take place in metropolitan cities and industry dominated State capitals like Jharkhand, Bihar, Orissa, Uttar Pradesh, Maharashtra, Punjab, Tamil Nadu and Andhra Pradesh.
**Task 2** Report finalization and submission by MoT to GoI for necessary action and follow up for early adoption of the recommendations and follow up with BIS to prepare necessary standards & through Ministry of Consumer Affairs, Food and Public Distribution to get ISI mark for *Protective work wear*.

The final recommendations should be forwarded to Ministry of Labour and Employment, which is the Administrative Ministry for taking appropriate decision; which in turn will refer to Ministry of Law and Justice. All the three ministries should join together to push the proposal to the Parliament Secretariat for necessary action for tabling before the august houses. Ministry of Labour and Employment should make appropriate notification in the official gazette for making the bill effective.

MoT should follow up the matter with BIS to give top priority to prepare standards and test procedure for industrial work wear to protect against heat and flame and then request Ministry of Consumer Affairs, Food and Public Distribution to bring the protective work wear under ISI label.

**Task 3** Work shops & Seminars

i. to sensitize the user industry for voluntary adoption of the recommendations

ii. to promote manufacture of the state of art safety work wear

**Task 4** Training Programs

i. on quality evaluation as per IS and international standards to personnel working in the industry and test houses

ii. on latest technology to industry personnel and students of textile institutes and others.

Tasks 3 & 4 shall be carried out by CoE (Protech), NITRA in association with MoT and all stakeholders.
APPENDIX-1 : List of International ISO Standards, relevant test methods for protective textiles, ISO/TC 38 textiles

<table>
<thead>
<tr>
<th>STANDARD CODE</th>
<th>STANDARD TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 105-series A, B, C, D, E, F, G, N, P, S, X, Z</td>
<td>Textiles - Tests for colour fastness (daylight, Xenonlight, etc.)</td>
</tr>
<tr>
<td>ISO 139:1973</td>
<td>Textiles - Standard atmospheres for conditioning and testing</td>
</tr>
<tr>
<td>ISO 675:1979 ISO 675:1979/Cor 1: 1990</td>
<td>Textiles - Woven fabrics - determination of dimensional change on commercial laundering near boiling point</td>
</tr>
<tr>
<td>ISO 811:1981</td>
<td>Textile fabrics - Determination of resistance to water penetration - hydrostatic pressure test</td>
</tr>
<tr>
<td>ISO 3175-11998 Cor 1:2002</td>
<td>Textiles - Professional care, dry cleaning and wet cleaning of fabrics and garments - Part 1: assessment of performance after cleaning and finishing</td>
</tr>
<tr>
<td>ISO 3175-3:2003</td>
<td>Textiles - Professional care, dry cleaning and wet cleaning of fabrics and garments - Part 3: procedure for testing performance when cleaning and finishing using hydrocarbon solvents</td>
</tr>
<tr>
<td>ISO 3175-4:2003</td>
<td>Textiles - Professional care, dry cleaning and wet cleaning of fabrics and garments - Part 4: procedure for testing performance when cleaning and finishing using simulated wet cleaning</td>
</tr>
<tr>
<td>ISO 3759:1994 Cor 1:1999</td>
<td>Textiles - Preparation, marking and measuring of fabrics specimens and garments in tests for determination of dimensional change</td>
</tr>
<tr>
<td>ISO 4880:1997</td>
<td>Burning behaviour of textiles and textile products vocabulary</td>
</tr>
<tr>
<td>ISO 4920:1981</td>
<td>Textiles - Determination of resistance to surface wetting (spray test) of fabrics</td>
</tr>
<tr>
<td>ISO 5077:1984</td>
<td>Textiles - Determination of dimensional change in washing and drying</td>
</tr>
<tr>
<td>ISO 5079:1995</td>
<td>Textile Fibres - determination of breaking force and elongation at break of individual fibres</td>
</tr>
<tr>
<td>ISO 5084:1996</td>
<td>Textiles - Determination of thickness of textiles and textile products</td>
</tr>
<tr>
<td>ISO 5085-2: 1990</td>
<td>Textiles - Determination of thermal resistance - Part 2: high thermal resistance</td>
</tr>
<tr>
<td>ISO 6330:2000</td>
<td>Textiles - Domestic washing and drying procedures for textile testing</td>
</tr>
<tr>
<td>ISO 6940:2004</td>
<td>Textile fabrics - Burning behavior - Determination of ease of ignition of vertically oriented specimens</td>
</tr>
<tr>
<td>ISO 7772-1998</td>
<td>Assessment of industrial laundry machinery by its effect on textiles - Part 1: washing machines</td>
</tr>
<tr>
<td>ISO 9237:1995</td>
<td>Textiles - Determination of the permeability of fabrics to air</td>
</tr>
<tr>
<td>ISO 9865:1991</td>
<td>Textiles - Determination of water repellency of fabrics by the Bundesmann rain-showertest</td>
</tr>
<tr>
<td>ISO 10047:1993</td>
<td>Textiles - Determination of surface burning time of fabrics</td>
</tr>
<tr>
<td>ISO 10528:1995</td>
<td>Textiles - Commercial laundering procedure for textile fabrics prior to flammability testing</td>
</tr>
<tr>
<td>ISO 11092:1993</td>
<td>Textiles - Physiological effects - measurement of thermal and water vapour resistance under steady-state conditions (sweating guarded-hotplate test)</td>
</tr>
<tr>
<td>ISO 12138:1996</td>
<td>Textiles - Domestic laundering procedures for textile fabrics prior to flammability testing</td>
</tr>
<tr>
<td>ISO 12947-21998 Cor1:2002</td>
<td>Textiles - Determination of the abrasion resistance of fabrics by the Martindale method - Part 2: determination of specimen breakdown</td>
</tr>
<tr>
<td><strong>ISO</strong></td>
<td><strong>Title</strong></td>
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<tr>
<td>---------</td>
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<tr>
<td>12947-4</td>
<td>Textiles- Determination of the abrasion resistance of fabrics by the Martindale method - Part 4: assessment of appearance change</td>
</tr>
<tr>
<td>13934-1</td>
<td>Textiles.. Tensile properties of fabrics .. Part 1: determination of maximum force and elongation at maximum force using the strip method</td>
</tr>
<tr>
<td>13934-2</td>
<td>Textiles.. Tensile properties of fabrics .. Part 2: determination of maximum force using the grab method</td>
</tr>
<tr>
<td>13935-1</td>
<td>Textiles.. Seam tensile properties of fabrics and made .. up textile articles Part 1: determination of maximum force to seam rupture using the strip method</td>
</tr>
<tr>
<td>13935-2</td>
<td>Textiles.. Seam tensile properties of fabrics and made .. up textile articles Part 2: determination of maximum force to seam rupture using the grab method</td>
</tr>
<tr>
<td>13936-1</td>
<td>Textiles.. Determination of the slippage resistance of yarns at a seam in woven fabrics .. Part 1: fixed seam opening method</td>
</tr>
<tr>
<td>13936-2</td>
<td>Textiles- Determination of the slippage resistance of yarns at a seam in woven fabrics- Part 2: fixed load method</td>
</tr>
<tr>
<td>13937-1</td>
<td>Textiles- Tear properties of fabrics- Part 1 : determination of tear force using ballistic pendulum method (Elmendorf)</td>
</tr>
<tr>
<td>13937-4</td>
<td>Textiles - Tear properties of fabrics- Part 4: determination of tear force of tongue-shaped test specimens (double tear test)</td>
</tr>
<tr>
<td>13938-1</td>
<td>Textiles - Bursting properties of fabrics- Part 1: hydraulic method for determination of bursting strength and bursting distension</td>
</tr>
<tr>
<td>13938-2</td>
<td>Textiles- Bursting properties of fabrics- Part 2: pneumatic method for determination of bursting strength and bursting distension</td>
</tr>
<tr>
<td>14184-1</td>
<td>Textiles -Determination of formaldehyde- Part 1: free and hydrolyzed formaldehyde (water extraction method)</td>
</tr>
<tr>
<td>14184-2</td>
<td>Textiles- Determination of formaldehyde- Part 2: released formaldehyde (vapour absorption method)</td>
</tr>
<tr>
<td>14419</td>
<td>Textiles- Oil repellency-hydrocarbon resistance test</td>
</tr>
<tr>
<td>15496</td>
<td>Textiles- Measurement of water vapour permeability of textiles for the purpose of quality control</td>
</tr>
<tr>
<td>15797</td>
<td>Textiles- Industrial washing and finishing proceduresfor testing of workwear</td>
</tr>
<tr>
<td>15831</td>
<td>Clothing- Physiological effects-measurement of thermal insulation by means of a thermal manikin</td>
</tr>
<tr>
<td>ISO Standard</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>ISO 2801:1998</td>
<td>Clothing for protection against heat and flame—recommendations for selection, care and use of protective clothing</td>
</tr>
<tr>
<td>ISO 6529:2001</td>
<td>Protective clothing—protection against chemicals determination of resistance of protective clothing materials to permeation by liquids and gases</td>
</tr>
<tr>
<td>ISO 6530:1990</td>
<td>Protective clothing—protection against liquid chemicals determination of resistance of materials to penetration by liquids</td>
</tr>
<tr>
<td>ISO 6942:2002</td>
<td>Protective clothing—protection against heat and fire method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat</td>
</tr>
<tr>
<td>ISO 9150:1988</td>
<td>Protective clothing—determination of behavior of materials on impact of small splashes of molten metal</td>
</tr>
<tr>
<td>ISO 9151:1995</td>
<td>Protective clothing against heat and flame—determination of heat transmission on exposure to flame</td>
</tr>
<tr>
<td>ISO 9185:1990</td>
<td>Protective clothing—assessment of resistance of materials to molten metal splash</td>
</tr>
<tr>
<td>ISO 11393-1:1998</td>
<td>Protective clothing for users of hand-held chain-saws. Part 1: test rig driven by a flywheel for testing resistance to cutting by a chain-saw</td>
</tr>
<tr>
<td>ISO 11393-2:1999</td>
<td>Protective clothing for users of hand-held chain-saws. Part 2: test methods and performance requirements for leg protectors</td>
</tr>
<tr>
<td>ISO 11393-4:2003</td>
<td>Protective clothing for users of hand-held chain-saws. Part 4: test methods and performance requirements for protective gloves</td>
</tr>
<tr>
<td>ISO 11393-5:2001</td>
<td>Protective clothing for users of hand-held chain-saws. Part 5: test methods and performance requirements for protective gaiters</td>
</tr>
<tr>
<td>ISO/TR 11610:2004</td>
<td>Protective clothing - vocabulary</td>
</tr>
<tr>
<td>ISO 11612:1998</td>
<td>Clothing for protection against heat and flame test methods and performance requirements for heat-protective clothing</td>
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<tr>
<td>ISO 12127:1996</td>
<td>Clothing for protection against heat and flame—of. Contact heat transmission through protective clothing or constituent materials</td>
</tr>
<tr>
<td>ISO 13688:1998</td>
<td>Protective clothing—General requirements</td>
</tr>
<tr>
<td>ISO 13994:1998</td>
<td>Clothing for protection against liquid chemicals. Determination of the resistance of protective clothing materials to penetration by liquids under pressure</td>
</tr>
<tr>
<td>Standard</td>
<td>Description</td>
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<tr>
<td>ISO 13995:2000</td>
<td>Protective clothing .. Mechanical properties .. Test method for the determination of the resistance to puncture and dynamic tearing of materials</td>
</tr>
<tr>
<td>ISO 13996:1999</td>
<td>Protective clothing .. Mechanical properties .. Determination of resistance to puncture</td>
</tr>
<tr>
<td>ISO 13997:1999</td>
<td>Protective clothing .. Mechanical properties- Determination of resistance to cutting by sharp objects</td>
</tr>
<tr>
<td>ISO 13998:2003</td>
<td>Protective clothing-aprons, trousers and vests protecting against cuts and stabs by hand knives</td>
</tr>
<tr>
<td>ISO 13999-1:1999</td>
<td>Protective clothing-gloves and arm guards protecting against cuts and stabs by hand knives. Part 1: chain-mail gloves and arm guards</td>
</tr>
<tr>
<td>ISO 13999-2:2003</td>
<td>Protective clothing-gloves and arm guards protecting against cuts and stabs by hand knives. Part 2: gloves and arm guards made of material other than chain</td>
</tr>
<tr>
<td>ISO 14460:1999</td>
<td>Protective clothing for automobile racing drivers- protection against heat and flame- performance requirements and test methods</td>
</tr>
<tr>
<td>Amd 1:2002</td>
<td>Modified flexion test</td>
</tr>
<tr>
<td>ISO 14877:2002</td>
<td>Protective clothing for abrasive blasting operations using granular abrasives</td>
</tr>
<tr>
<td>ISO 15025:2000</td>
<td>Protective clothing-protection against heat and flame-method of test for limited flame spread</td>
</tr>
<tr>
<td>ISO 16603:2004</td>
<td>Clothing for protection against contact with blood and body fluids-determination of the resistance of protective clothing materials to penetration by blood and body fluids-test method using synthetic blood (available in English only)</td>
</tr>
<tr>
<td>ISO 16604:2004</td>
<td>Clothing for protection against contact with blood and body fluids-determination of resistance of protective clothing materials to penetration by blood-borne pathogens-test method using Phi-X 174 bacteriophage.</td>
</tr>
<tr>
<td>ISO 17491:2002</td>
<td>Protective clothing - Protection against gaseous and liquid chemicals determination of resistance of protective clothing to penetration by liquids and gases</td>
</tr>
<tr>
<td>ISO 17492:2003 Cor 1:2004</td>
<td>Clothing for protection against heat and flame-determination of heat transmission on exposure to both flame and radiant heat</td>
</tr>
<tr>
<td>ISO 17493:2000</td>
<td>transmision on exposure to both flame and radiant heat resistance using a hot-air circulating oven</td>
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<tr>
<td>ISO 22608:2004</td>
<td>Protective clothing .. Protection against liquid chemicals .. Measurement of repellency, retention, and penetration of liquid pesticide formulations through protective clothing materials</td>
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<td>REFERENCE AND TITLE OF THE EUROPEAN HARMONISED STANDARD</td>
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<td>EN 133:2001 . Respiratory protective devices - Classification</td>
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<tr>
<td>EN 135:1998 : Respiratory protective devices - List of equivalent terms</td>
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</tr>
<tr>
<td>EN 136:1998 : Respiratory protective devices - Full face masks - Requirements, testing, marking</td>
<td></td>
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<tr>
<td>EN 137:2006: Respiratory protective devices - Self-contained open-circuit compressed air breathing apparatus with full face mask - Requirements, testing, marking</td>
<td></td>
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<tr>
<td>EN 138:1994: Respiratory protective devices - Fresh air hose breathing apparatus for use with full face mask, half mask or mouthpiece assembly - Requirements, testing, marking</td>
<td></td>
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<tr>
<td>EN 140:1998: Respiratory protective devices - Half masks and quarter masks - Requirements, testing, marking</td>
<td></td>
</tr>
<tr>
<td>EN 142:2002: Respiratory protective devices - Mouthpiece assemblies - Requirements, testing, marking</td>
<td></td>
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<tr>
<td>EN 143:2000: Respiratory protective devices - Particle filters - Requirements, testing, marking</td>
<td></td>
</tr>
<tr>
<td>EN 144-1:2000: Respiratory protective devices - Gas cylinder valves - Part 1: Thread connections for insert connector</td>
<td></td>
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<tr>
<td>EN 144-3:2003: Respiratory protective devices - Gas cylinder valves - Part 3: Outlet connections for diving gases Nitrox and oxygen</td>
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<tr>
<td>EN 145:1997 Respiratory protective devices - Self-contained closed-circuit breathing apparatus compressed oxygen or compressed oxygen-nitrogen type - Requirements, testing, marking</td>
<td></td>
</tr>
<tr>
<td>Standard Number</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
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<tr>
<td>EN 148-3:1999</td>
<td>Respiratory protective devices - Threads for facepieces - Part 3: Tread connection M 45 x 3</td>
</tr>
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<td>Respiratory protective devices - Filtering half masks to protect against particles - Requirements, testing, marking</td>
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<td>EN 166:2001</td>
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<td>EN 167:2001</td>
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<td>EN 168:2001</td>
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<td>Personal eye-protection - Filters for welding and related techniques - Transmittance requirements and recommended use</td>
</tr>
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<tr>
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<tr>
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<td>Personal eye protection - Sunglare filters for industrial use</td>
</tr>
<tr>
<td>EN 174:2001</td>
<td>Personal eye-protection - Ski goggles for downhill skiing</td>
</tr>
<tr>
<td>EN 175:1997</td>
<td>Personal protection - Equipment for eye and face protection during welding and allied processes</td>
</tr>
<tr>
<td>EN 207:2009</td>
<td>Personal eye-protection equipment - Filters and eye-protectors against laser radiation (laser eyeprotectors)</td>
</tr>
<tr>
<td>EN 208:2009</td>
<td>Personal eye-protection - Eye-protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors)</td>
</tr>
<tr>
<td>EN 250:2000</td>
<td>Respiratory equipment - Open-circuit self-contained compressed air diving apparatus - Requirements, testing, marking</td>
</tr>
<tr>
<td>EN 269:1994</td>
<td>Respiratory protective devices - Powered fresh air hose breathing apparatus incorporating a hood - Requirements, testing, marking</td>
</tr>
<tr>
<td>EN 340:2003</td>
<td>Protective clothing - General requirements</td>
</tr>
<tr>
<td>EN 341:1992</td>
<td>Personal protective equipment against falls from a height - Descender devices</td>
</tr>
<tr>
<td>Standard</td>
<td>Description</td>
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</tr>
<tr>
<td>EN 342:2004/ AC 2008</td>
<td>Protective clothing - Ensembles and garments for protection against cold</td>
</tr>
<tr>
<td>EN 343:2003+A1:2007</td>
<td>Protective clothing - Protection against rain</td>
</tr>
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<td>EN ISO 13982-2:2004</td>
<td>Protective clothing for use against solid particulates - Part 2: Test</td>
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<tr>
<td></td>
<td>method of determination of inward leakage of aerosols of fine particles into</td>
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<td></td>
<td>suits (ISO 13982-2:2004)</td>
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<tr>
<td>EN ISO 13995:2000</td>
<td>Protective clothing - Test method for the determination of the resistance</td>
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<tr>
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<td>to puncture and dynamic tearing of materials (ISO 13995:2000)</td>
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<tr>
<td>EN ISO 13997:1999</td>
<td>Protective clothing - Mechanical properties - Determination of resistance to</td>
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<td>cutting by sharp objects (ISO 13997:1999)</td>
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<td>EN ISO 13998:2003</td>
<td>Protective clothing - Aprons, trousers and vests protecting against cuts and</td>
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<td>stabs by hand knives (ISO 13998:2003)</td>
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<td>EN 14021:2003</td>
<td>Stone shields for off-road motorcycling suited to protect riders against</td>
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<td>stones and debris - Requirements and test methods</td>
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<tr>
<td>EN 14052:2005</td>
<td>High performance industrial helmets</td>
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<td>EN 14058:2004</td>
<td>Protective clothing - Garments for protection against cool environments</td>
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<tr>
<td>EN ISO 14116:2008</td>
<td>Protective clothing - Protection against heat and flame - Limited flame</td>
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<td>spread materials, material assemblies and clothing (ISO 14116:2008)</td>
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<td>Standard Number</td>
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<tr>
<td>EN 14126:2003</td>
<td>Protective clothing - Performance requirements and tests methods for protective clothing against infective agents</td>
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<tr>
<td>EN 14143:2003</td>
<td>Respiratory equipment - Self-contained re-breathing diving apparatus</td>
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<tr>
<td>EN 14225-1:2005</td>
<td>Diving suits - Part 1: Wet suits - Requirements and test methods</td>
</tr>
<tr>
<td>EN 14225-2:2005</td>
<td>Diving suits - Part 2: Dry suits - Requirements and test methods</td>
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<td>EN 14225-3:2005</td>
<td>Diving suits - Part 3: Actively heated or cooled suits (systems) - Requirements and test methods</td>
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<tr>
<td>EN 14225-4:2005</td>
<td>Diving suits - Part 4: One atmosphere suits (ADS) - Human factors requirements and test methods</td>
</tr>
<tr>
<td>EN 14325:2004</td>
<td>Protective clothing against chemicals - Test methods and performance classification of chemical protective clothing materials, seams, joins and assemblages</td>
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<tr>
<td>EN 14328:2005</td>
<td>Protective clothing - Gloves and armguards protecting against cuts by powered knives - Requirements and test methods</td>
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<tr>
<td>EN 14360:2004</td>
<td>Protective clothing against rain - Test method for ready made garments - Impact from above with high energy droplets</td>
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<tr>
<td>EN 14387:2004+A1:2008</td>
<td>Respiratory protective devices - Gas filter(s) and combined filter(s) - Requirements, testing, marking</td>
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<tr>
<td>EN 14404:2004+A1:2010</td>
<td>Personal protective equipment - Knee protectors for work in the kneeling position</td>
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<tr>
<td>EN 14435:2004</td>
<td>Respiratory protective devices - Self-contained open-circuit compressed air breathing apparatus with half mask designed to be used with positive pressure only - Requirements, testing, marking</td>
</tr>
<tr>
<td>EN 14458:2004</td>
<td>Personal eye-equipment - Faceshields and visors for use with firefighters’ and high performance industrial safety helmets used by firefighters, ambulance and emergency services</td>
</tr>
<tr>
<td>EN 14529:2005</td>
<td>Respiratory protective devices - Self-contained open-circuit compressed air breathing apparatus with half mask designed to include a positive pressure lung governed demand valve for escape purposes only</td>
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<tr>
<td>EN 14572:2005</td>
<td>High Performance Helmets for Equestrian Activities</td>
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<tr>
<td>EN 14593-1:2005</td>
<td>Respiratory protective devices - Compressed air line breathing apparatus with demand valve - Part 1: Apparatus with a full face mask - Requirements, testing, marking</td>
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<tr>
<td>EN 14593-2:2005</td>
<td>Respiratory protective devices - Compressed air line breathing apparatus with demand valve - Part 2: Apparatus with a half mask at positive pressure - Requirements, testing, marking</td>
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<td>Standard</td>
<td>Description</td>
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<tr>
<td>EN 14594:2005</td>
<td>Respiratory protective devices - Continuous flow compressed air line breathing apparatus - Requirements, testing, marking</td>
</tr>
<tr>
<td>EN 14605:2005+A1:2009</td>
<td>Protective clothing against liquid chemicals - Performance requirements for clothing with liquid-tight (Type 3) or spray-tight (Type 4) connections, including items providing protection to parts of the body only (Type PB [3] and PB [4])</td>
</tr>
<tr>
<td>EN 14786:2006</td>
<td>Protective clothing - Determination of resistance to penetration by sprayed liquid chemicals, emulsions and dispersions - Atomizer test</td>
</tr>
<tr>
<td>EN 15090:2006</td>
<td>Footwear for firefighters</td>
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<tr>
<td>EN 15333-1:2008</td>
<td>Respiratory equipment - Open-circuit umbilical supplied compressed gas diving apparatus - Part 1: Demand apparatus</td>
</tr>
<tr>
<td>EN 15613:2008</td>
<td>Knee and elbow protectors for indoor sports - Safety requirements and test methods</td>
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<tr>
<td>EN 15614:2007</td>
<td>Protective clothing for firefighters - Laboratory test methods and performance requirements for wildland clothing</td>
</tr>
<tr>
<td>Standard Code</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
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<td>EN 24869-1:1992</td>
<td>Acoustics - Hearing protectors - Subjective method for the measurement of sound attenuation (ISO 4869-1:1990)</td>
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<tr>
<td>EN 50286:1999</td>
<td>Electrical insulating protective clothing for low-voltage installations</td>
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<tr>
<td>EN 50321:1999</td>
<td>Electrically insulating footwear for working on low voltage installations</td>
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<tr>
<td>EN 50365:2002</td>
<td>Electrically insulating helmets for use on low voltage installations</td>
</tr>
<tr>
<td>EN 60895:2003</td>
<td>Live working - Conductive clothing for use at nominal voltage up to 800 kV a.c. and ± 600 kV d.c. IEC 60895:2002 (Modified)</td>
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<tr>
<td>EN 60903:2003</td>
<td>Live working - Gloves of insulating material IEC 60903:2002 (Modified)</td>
</tr>
<tr>
<td>EN 60984:1992</td>
<td>Sleeves of insulating material for live working IEC 60984:1990 (Modified)</td>
</tr>
</tbody>
</table>
### APPENDIX-4 : Non-exhaustive guide list of American standards for textiles and protective clothing

<table>
<thead>
<tr>
<th>REFERENCE AND TITLE OF THE AMERICAN STANDARDS</th>
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</thead>
<tbody>
<tr>
<td>CPSC CS 191 .. 53 16 CFR 1610.4 Flammability of Clothing Textiles</td>
</tr>
<tr>
<td>ASTM D 1230: Flammability of Clothing Textiles</td>
</tr>
<tr>
<td>GSA FTMS 191: Method 5903.1 Flame Resistance of Clothing Vertical</td>
</tr>
<tr>
<td>GSA FTMS 191 Method 5905.1 Flame Resistance of Clothing Vertical</td>
</tr>
<tr>
<td>GSA FTMS 191 Method 5908: Burning Rate of Cloth, 45°, Angle</td>
</tr>
<tr>
<td>GSA FTMS 191 Method 5910 Burning Rate of Cloth, 30°, Angle</td>
</tr>
<tr>
<td>NFPA 701: Large scale Fire Test for Flame Resistant Textiles and Films</td>
</tr>
<tr>
<td>NFPA 701: Small scale Fire Test for Flame Resistant Textiles and Films</td>
</tr>
<tr>
<td>NFPA 1971: Protective Clothing</td>
</tr>
<tr>
<td>NFPA 1975: Station Work Uniforms</td>
</tr>
<tr>
<td>ASTM F 903: Test Method for Resistance of Protective Clothing Materials to Penetration by Liquids</td>
</tr>
<tr>
<td>ASTM F 0955: Test Method for Evaluating Heat Transfer Through Materials for Protective Clothing upon Contact with Molten Substances</td>
</tr>
<tr>
<td>ASTM F 1001: Guide for Selection of Chemicals to Evaluate Protective Clothing Materials</td>
</tr>
<tr>
<td>ASTM F 1002: Performance Specification for Protective Clothing for Use by Workers Exposed to Specific Molten Substances and Related Thermal Hazards</td>
</tr>
<tr>
<td>ASTM F 1052: Practice for Pressure Testing of Gas Tight Totally Encapsulating Chemical Protective Suits</td>
</tr>
<tr>
<td>ASTM F 1060: Test Method for Thermal Protective Performance of Materials for Protective Clothing for Hot Surface Contact</td>
</tr>
<tr>
<td>ASTM F 1154 Practice for Qualitatively Evaluating the Comfort, Fit, Function, and Integrity of Chemical Protective Suit Ensembles</td>
</tr>
<tr>
<td>ASTM F 1291: Test Method for Measuring the Thermal Insulation of clothing Using a Heated Mannequin</td>
</tr>
<tr>
<td>ASTM F 1194: Guide for Documenting the Results of Chemical Permeation Testing</td>
</tr>
<tr>
<td>ASTM F 1296: Guide for Evaluating Chemical Protective Clothing</td>
</tr>
<tr>
<td>ASTM F 1301: Practice for Labeling Chemical Protective Clothing</td>
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<tr>
<td>ASTM F 1359: Practice for Determining the Liquid-Tight Integrity of Chemical Protective Suits or Ensembles under Static Conditions</td>
</tr>
<tr>
<td>ASTM F 1383: Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids or Gases under Conditions of Intermittent Contact</td>
</tr>
<tr>
<td>ASTM F 1407: Test Method for Resistance of Chemical Protective Clothing Materials to Liquid Permeation- Permeation Cup method</td>
</tr>
<tr>
<td>Standard</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ASTM F 1461</td>
</tr>
<tr>
<td>ASTM F 1494</td>
</tr>
<tr>
<td>ASTM Test Methods for Measuring the Performance Characteristics of Exhaust Valves Used in Chemical Protective Suits (New Standard)</td>
</tr>
<tr>
<td>ASTM Practice for Determining the Resistance of Chemical Protective Coveralls, Suite or Ensembles to Inward Leakage to Liquids under Dynamic Conditions (New Standard)</td>
</tr>
<tr>
<td>ASTM Practice for Evaluating Resistance of Protective Clothing Materials to Permeation by Liquid Chemical Warfare Agent (New Standard)</td>
</tr>
<tr>
<td>NFPA 1991</td>
</tr>
<tr>
<td>NFPA 1992</td>
</tr>
<tr>
<td>NFPA 1993</td>
</tr>
</tbody>
</table>
Industrial Accidents are a common occurrence in India. Industrial accidents can take place due to a variety of reasons such as poor quality and maintenance of the equipment, negligence and carelessness by the operators, inadequate training by the company, and improper handling and disposal of the hazardous waste materials.

Accidents can cause fatal and non-fatal injuries and in many instances can even lead to human deaths.

**Cause: Electrocution**

During the year 2009, a total of 8,683 cases were reported in all the states and Union Territories. The number of persons killed was maximum in case of Andhra Pradesh closely followed by Maharashtra and Madhya Pradesh.

### No. of persons injured and killed due to Electrocution -2009

- **453** Injured
- **8539** Killed

*Source: Ministry of home affairs, GoI (ON134)*
Cause: Fire Accidents

Accidents due to fire are one of the most common causes in India. In the year 2009 alone, 24,884 cases were reported in which 23,268 persons lost their lives while 3,034 were injured.

Maharashtra, Madhya Pradesh, Tamil Nadu and Gujarat were the states that observed maximum number of death cases due to fire.

Source: Ministry of home affairs, GoI (ON134)
Cause: Railways

The number of fatal injuries in railways between the period 1988 and 2009 were 3823 while non-fatal injuries were 1,65,378. An important point to observe is the considerable reduction in the incidence of both the fatal and non-fatal injuries during this period. The highest no. of non-fatal cases reported were 17,633 in the year 1988 which came down to just 2015 in 2009. Similarly, the highest no of fatal injuries were reported in the year 1993(510) which came down to 87 in 2009.

Source: Ministry of labour and Employment, GoI (ON94 and ON125)
**Factory/Machine Accidents**

![Bar chart showing the number of accidents and fires in oil refineries in India from 2007 to 2009.](chart)

Source: Ministry of Home Affairs, GoI (ON134)

**No. of Accidents/Fires occurred in Oil Refineries in India**

![Bar chart showing the number of accidents and fires in oil refineries in India from 2005 to 2007.](chart)

Source: Question No. 3090 dt 20.11.2008
Laborers work on an under-construction pillar after it collapsed partially at a metro rail construction site in Bangalore

Rajya Sabha Starred Question No 59 dt 18.2.2009
No. of Non-Fatal Injuries in Factories

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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<td></td>
<td>44200</td>
<td>32763</td>
<td>33135</td>
<td>30909</td>
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Source: Lok Sabha Unstarred Question No. 1295 dt 2.8.2010; Rajya Sabha Unstarred Question No 1275 dt 15.7.2009

Industry- wise Fatal Injuries

<table>
<thead>
<tr>
<th>Industries</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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</thead>
<tbody>
<tr>
<td>Food Products &amp; Beverages</td>
<td>126</td>
<td>68</td>
<td>60</td>
<td>88</td>
</tr>
<tr>
<td>Textiles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper &amp; Paper Products</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Chemical &amp; Chemical Products</td>
<td>122</td>
<td>88</td>
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<td></td>
</tr>
<tr>
<td>Non Metallic Mineral Products</td>
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<td></td>
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<td>206</td>
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<tr>
<td>Basic Metals</td>
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<td>55</td>
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<tr>
<td>Fabricated Metal Products</td>
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<td></td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Rubber &amp; Plastic Products</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Lok Sabha Unstarred Q.NO. 1295, dated 2/8/10
Industry-wise Non-Fatal Injuries

<table>
<thead>
<tr>
<th>Industry</th>
<th>Non-Fatal Injuries</th>
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</thead>
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<tr>
<td>Food Products &amp; Beverages</td>
<td>720</td>
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<tr>
<td>Textiles</td>
<td>18,859</td>
</tr>
<tr>
<td>Paper &amp; Paper Products</td>
<td>616</td>
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<tr>
<td>Chemical &amp; Chemical Products</td>
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<tr>
<td>Non Metallic Mineral Products</td>
<td>1,387</td>
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<tr>
<td>Basic Metals</td>
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<tr>
<td>Fabricated Metal Products</td>
<td>2,575</td>
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<tr>
<td>Rubber &amp; Plastic Products</td>
<td>1,896</td>
</tr>
</tbody>
</table>

Source: Lok Sabha Unstarred Q.NO. 1295, dated 2/8/10
NORTHERN INDIA TEXTILE RESEARCH ASSOCIATION
Sector-23, Raj Nagar, Ghaziabad (U.P.)
Email: mail@nitratextile.org    Fax: 0120-2783596