UNIT IV

Safety in plant design and layout – Safety provisions in the factory act 1948 – Indian explosive act 1884 – ESI act 1948 – Advantages of adopting safety laws.
Safety measures in handling and storage of chemicals – Fire chemistry and its control – Personnel protection – Safety color codes of chemicals.

SAFETY IN PLANT DESIGN AND LAYOUT

PLANT LAYOUT

Plant layout refers to the arrangement of physical facilities such as machinary, equipment,furnitures within the factory building in such a manner so as to have quickest flow of material at the lowest cost and with the least amount of handling in processing the product from the receipt of material to the shipment of the finished product.

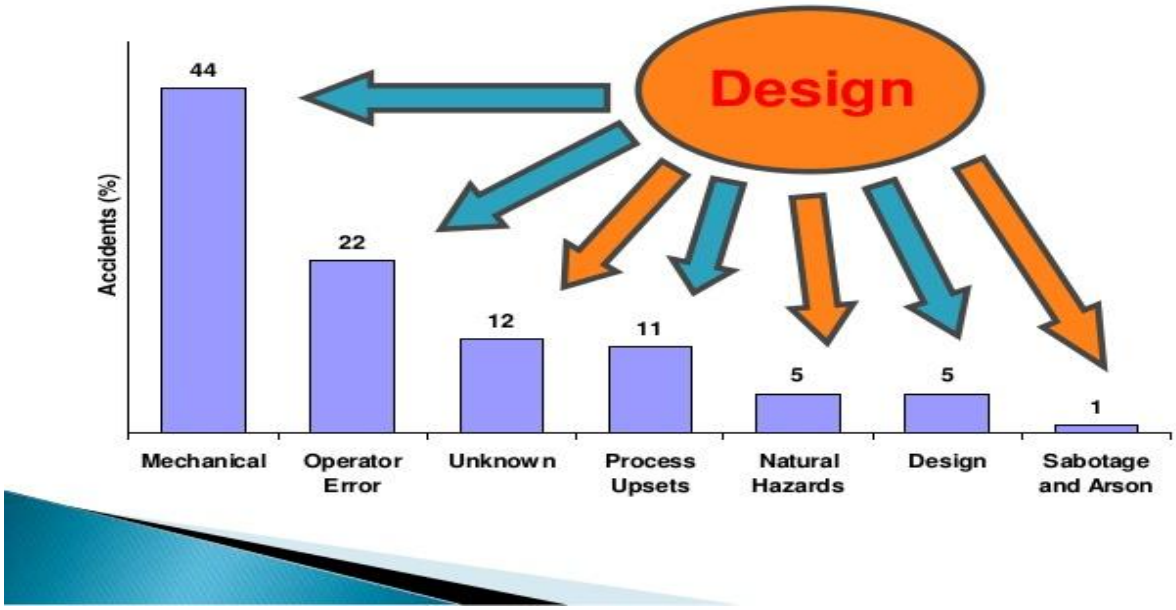
GOALS OF PLANT LAYOUT DESIGN

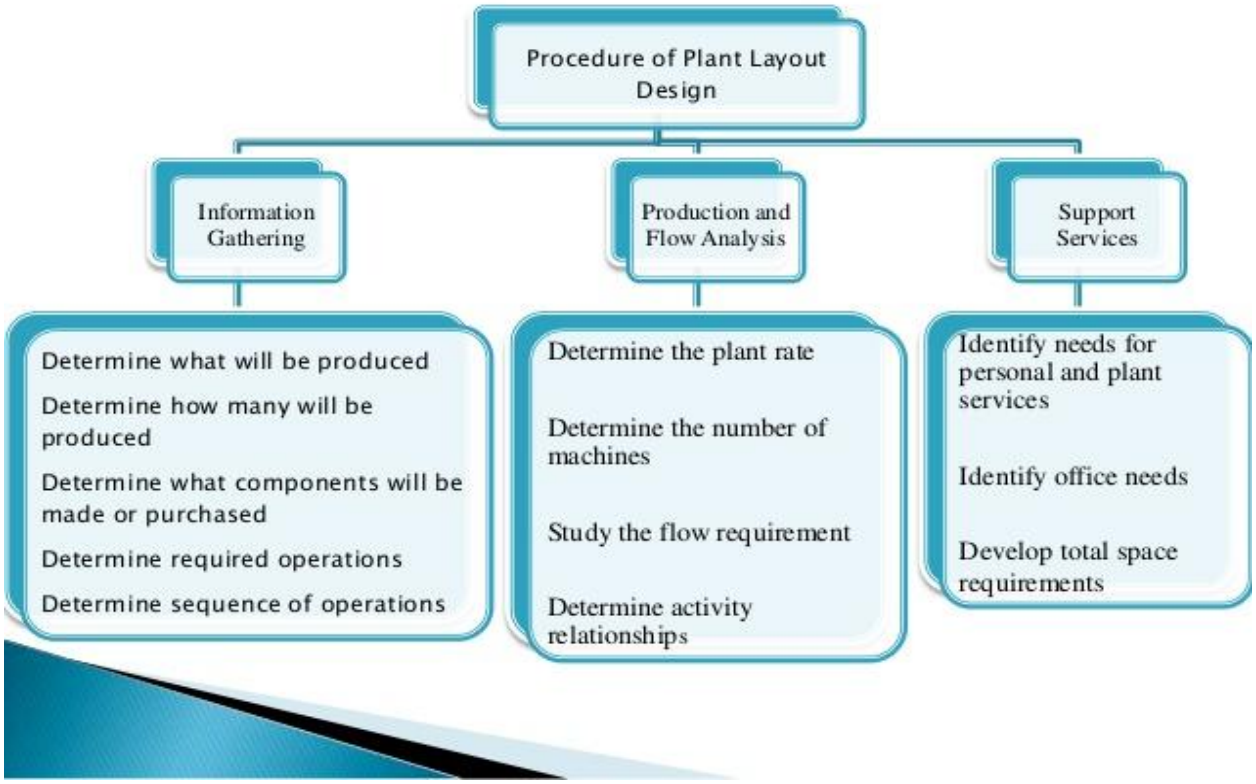
- Meet quality and capacity requirement in the most economical manner.
- Minimize unit cost and optimize quality.
- Promote effective use of people, equipment, space and energy.
- Provide for employee safety and comfort.
- Control project costs
- Achieve production deadlines.

PLANT LAYOUT BASED ON

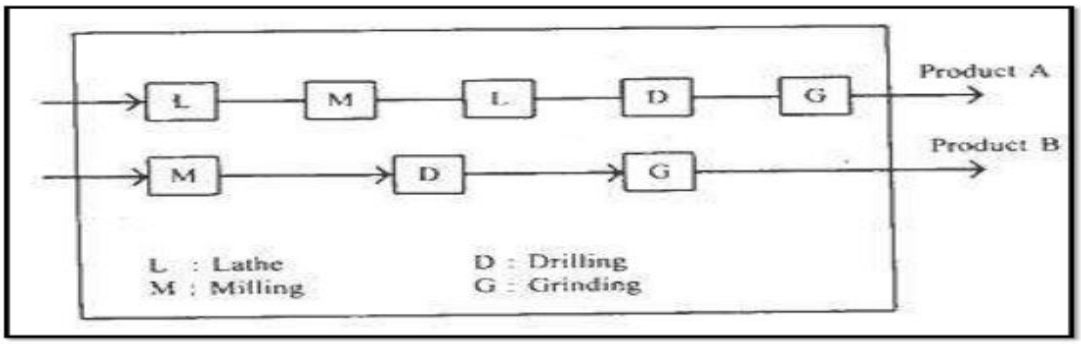
- New site development or addition to previously developed site.
- Type and quantity of product to be produced.
- Possible further expansion.
- Operational convenience and accessibility.
- Type of process and product control.
- Economics distribution of utilities and services.
- Type of building and building code requirement.
- Guidelines related to health and safety.
- Waste disposal problems.
- Space available and space requirement.
- Auxiliary equipment and
- Roads and railroads.

CAUSES OF LOSSES IN LARGE PLANT ACCIDENTS

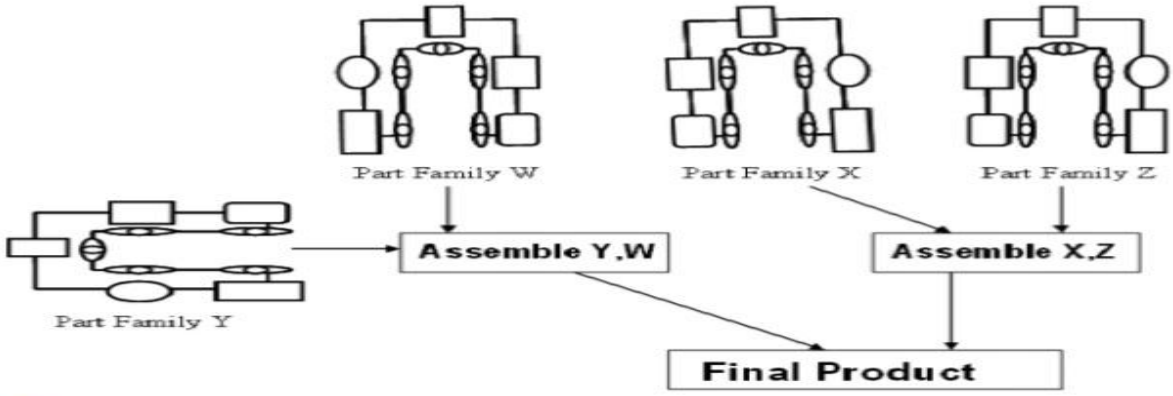


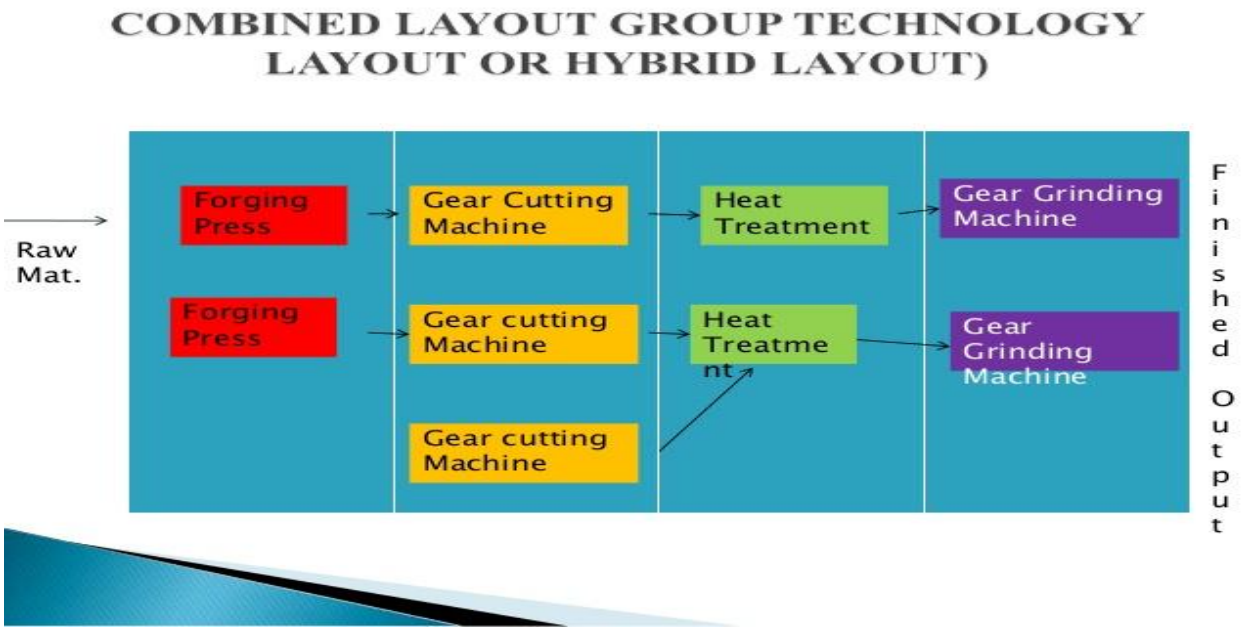


FLOW CHART OF LINE LAYOUT



FIXED POSITION LAYOUT





IMPORTANT FACTORS OF PLANT LAYOUT AS FAR AS SAFETY ASPECTS

- Prevent limit and mitigate escalation of adjacent aspects.
- Ensure safety within on-site occupied buildings.
- Control access of unauthorized personal.
- Facilitate access for emergency services.

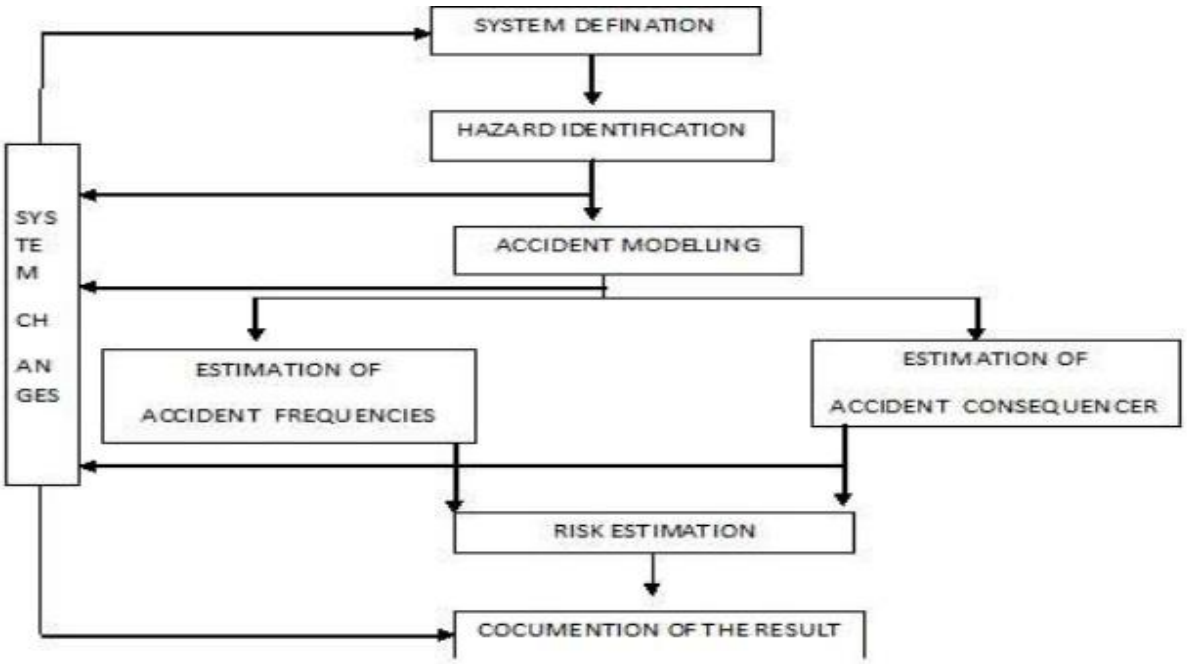
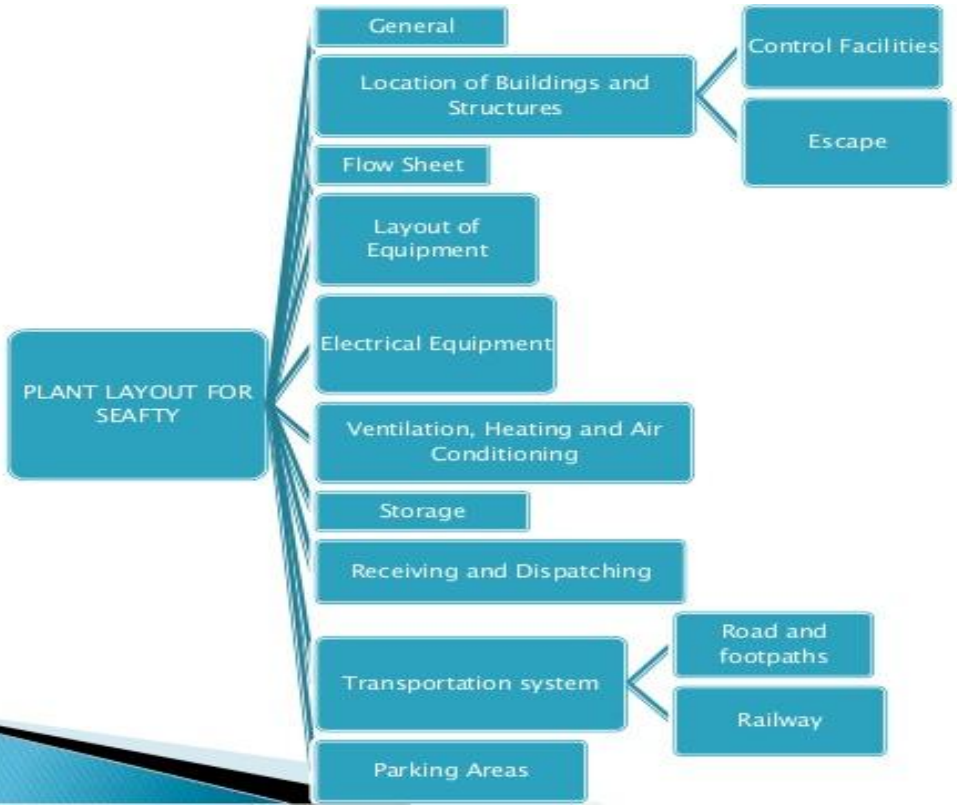


Fig. Steps of a safety and risk analysis



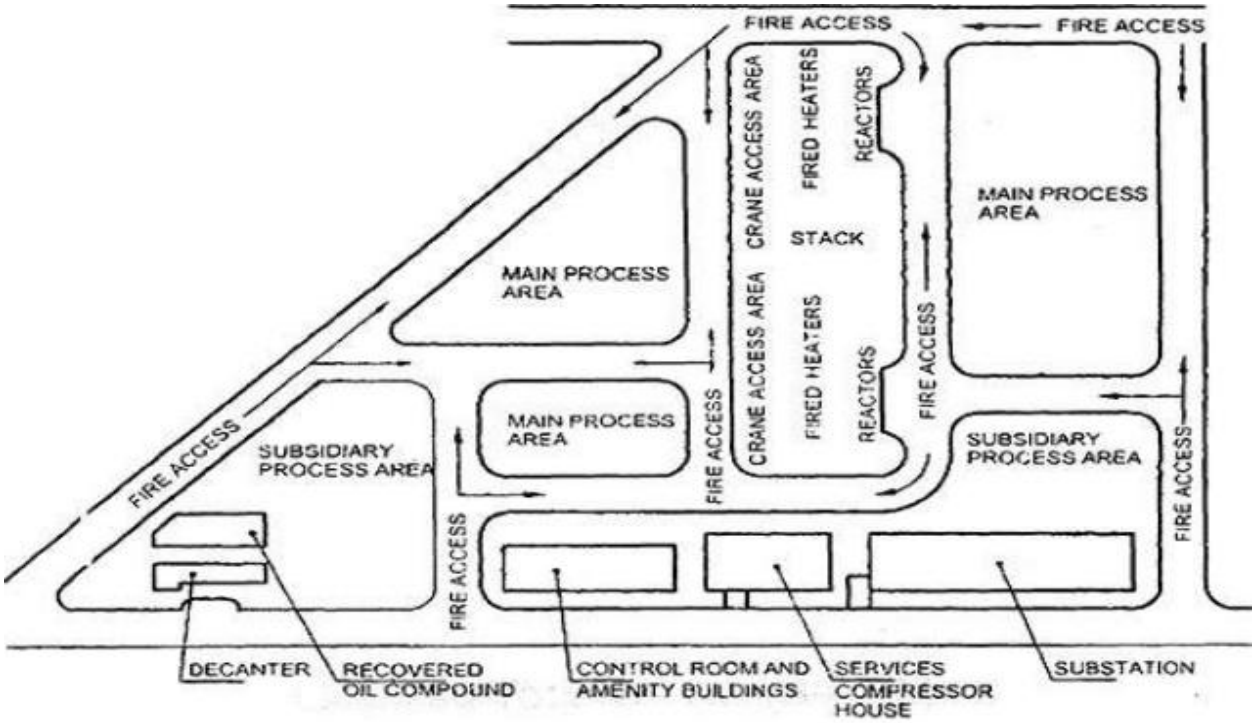


Fig. Layout System in the Process Area of a Petrochemical Plant

An ideal plant layout should provide the optimum relationship among output, floor area and manufacturing process. It facilitates the production process, minimizes material handling, time and cost and allows flexibility of operations, easy production flow makes economics use of the building, promotes effective ,safety comfort at work, maximum exposure to natural light and ventilations. It is also important because its affects the flow of material and processes, labor efficiency supervision and control, use of space and expansion possibilities.

SAFETY PROVISIONS IN THE FACTORY ACT 1948

Occupational Health and Safety in India: Health and Safety provisions under Indian Factories Act 1948. The Act has been promulgated primarily to provide safety measures and to promote the health and welfare of the workers employed in factories.

The Factories Act, 1948, has been promulgated primarily to provide safety measures and to promote the health and welfare of the workers employed in factories. The object thuss brings this Act, within the competence of the Central Legislature to enact. State Governments/Union Territory Administrations have been empowered under certain provisions of this Act, to make rules, to give effect to the objects and the scheme of the Act.

Applicability: This Act applies to factories, which qualify the definition of "Factory" under the section 2(m) of the Act or to those industrial establishments, to whom section 85 have been made applicable by the State Government, by notification in the Official Gazette. This applies to any premises wherein 10 or more persons with the aid of power or wherein 20 or more workers without aid of power are/were working on any day in the preceding 12 months, wherein manufacturing process is being carried on.

What are the provisions relating to health for employees working in factories and the manufacturing process addressed by the Factories Act, 1948?

The main focus of Factories Act is towards the Health benefits to the workers. Health Chapter of the Act contains specification from Section 11 to 20. Detailed information of the sections of is provided as under:

Section 11: This section basically specifies the issues of cleanliness at the workplace. It is mentioned in the provision that every factory shall be kept clean and free from effluvia arising from any drain, privy or other nuisance. This includes that there should be no accumulation of dirt and refuse and should be removed daily and entire area should be kept clean.

Section 12: This section specifies on disposal of wastes and effluents. That every factory should make effective arrangements for the treatment of wastes and effluents due to the manufacturing process carried on therein, so as to render them innocuous and for their disposal.

Section 13: This section focuses on ventilation and temperature maintenance at workplace. Every factory should work on proper arrangements for adequate ventilation and circulation of fresh air.

Section 14: This section details on the proper exhaustion of dust and fume in the Factory. In this it is mentioned that factory which deals on manufacturing process should take care of the proper exhaustion of dust, fume and other impurities from its origin point.

Section 15: This section specifies regarding the artificial humidification in factories. In this the humidity level of air in factories are artificially increased as per the provision prescribed by the State Government.

Section 16: Overcrowding is also an important issue which is specified in this section. In this it is mentioned that no room in the factory shall be overcrowded to an extent that can be injurious to the health of workers employed herein.

Section 18: This section specifies regarding arrangements for sufficient and pure drinking water for the workers. There are also some specified provisions for suitable point for drinking water supply. As in that drinking water point should not be within 6 meters range of any washing place, urinal, latrine, spittoon, open drainage carrying effluents. In addition to this a factory where there are more than 250 workers provisions for cooling drinking water during hot temperature should be made.

Section 19: This section provides details relating to urinals and latrine construction at factories. It mentions that in every factory there should be sufficient accommodation for urinals which should be provided at conveniently situated place. It should be kept clean and maintained. There is provision to provide separate urinals for both male and female workers.

Section 20: This section specifies regarding proper arrangements of spittoons in the factory. It is mentioned that in every factory there should be sufficient number of spittoons situated at convenient places and should be properly maintained and cleaned and kept in hygienic condition.

What are the provisions relating to safety for employees working in factories and the manufacturing process addressed by the Factories Act, 1948?

The Factories Act, 1948 also provides provisions relating to safety measures for the workers employed herein. This is to ensure safety of workers working on or around the machines. The detailed information on each provision relating to safety measures is as under:

Section 17: Under section it has been described that there should be proper arrangement of lighting in factories. In every part of the factory where workers are working or passing should be well equipped with lighting arrangement either by natural sources or artificial sources.

Section 21: This section specifies that fencing of machinery is necessary. That any moving part of the machinery or machinery that is dangerous in kind should be properly fenced.

Section 23: This section prescribes that employment of young person on dangerous machinery is not allowed. In the case where he is been fully instructed in the usage of the machinery and working under the supervision he might be allowed to work on it.

Section 24: This section provides provision of striking gear and devices for cutting off power in case of emergency. Every factory should have special devices for cutting off of power in emergencies from running machinery. Suitable striking gear appliances should be provided and

maintained for moving belts.

Section 28: This section prohibits working of women and children on specific machinery. As per this section women and children should not be appointed for any part of factory working on cotton pressing.

Section 32: In this section it has been specified that all floors, stairs, passages and gangways should be properly constructed and maintained, so that there are no chances of slips or fall.

Section 34: This section specifies that no person in any factory shall be employed to lift, carry or move any load so heavy that might cause in injury. State Government may specify maximum amount of weight to be carried by workers.

Section 35: This section provides specification regarding safety and protection of eyes of workers. It mentions that factory should provide specific goggles or screens to the workers who are involved in manufacturing work that may cause them injury to eyes.

Section 36: As per this section it is provided that no worker shall be forced to enter any chamber, tank, vat, pit, pipe, flue or other confined space in any factory in which any gas, fume, vapour or dust is likely to be present to such an extent as to involve risk to persons being overcome thereby.

Section 38: As per this section there should be proper precautionary measures built for fire. There should be safe mean to escape in case of fire, and also necessary equipments and facilities to extinguish fire.

Section 45: This section specifies that in every factory there should be proper maintained and well equipped first aid box or cupboard with the prescribed contents. For every 150 workers employed at one time, there shall not be less than 1 first aid box in the factory. Also in case where there are more than 500 workers there should be well maintained ambulance room of prescribed size and containing proper facility.

What are the specific regulations for the health and safety provisions for women employees under various legislations in the country?

There are specific regulations relating to health and safety of women employees under various laws in our country. Provisions relating to health and safety of women under various Acts are as under:

Factories Act, 1948

- Women are prohibited from working between 7.00 pm to 6.00 am. There has been a recent amended to allow women to work in night shift in certain sectors including the Special Economic Zone (SEZ), IT sector and Textiles. This is subject to the condition that the employers shall be obligated to provide adequate safeguards in the workplace, equal opportunity, their transportation from the factory premises to the nearest point of their residence.
- Section 22 of the Act prohibits that no woman shall be allowed to clean, lubricate or adjust any part of a prime mover or of any transmission machinery while the prime mover or transmission machinery is in motion, if that would expose the woman to risk of injury from any moving part either of that machine or of any adjacent machinery.
- Section 27 of the Act provides that no woman shall be employed in any part of a factory for pressing cotton in which a cotton-opener is at work.

Plantation Labour Act, 1951

- Section 25 of the Act bans employment of any women in any plantation between 7.00 pm to 6.00 am without permission of the State Government. But it specifically exempts from its purview women who are employed in any plantation as midwives and nurses.
- The Act also provides provisions relating to sickness and maternity leave for the women employees.

Mines Act, 1952

- Section 46 of the Act prohibits employment of any women in any part of a mine which is below-ground. And in any part of the mine above ground except between the hours 6.00 am and 7.00 pm. It also provides that every women employed in a mine above ground shall be allowed break of not less than 11 hours between the end of day work and the commencement of the next day of work.

Provisions relating to Offences and Penalties under the Factories Act, 1948 for contravention of laws relating to safety and health of the workers ?

- <u>For contravention of the provisions of the Act or Rules- imprisonment upto 2 years or fine upto Rs.1,00,000 or both.</u>

- Contravention causing death or serious bodily injury - fine not less than Rs.25,000 in case of death and not less than Rs.5000 in case of serious injuries.

- Continuation of contravention - imprisonment upto 3 years or fine not less than Rs.10,000 which may extend to Rs.2,00,000.

- On contravention of Chapter IV pertaining to safety or dangerous operation.

Factories Act works with a primary object to protect workers employed in the factories against industrial and occupational hazards. For that purpose, it seeks to impose upon the owners or the

occupiers certain obligations to protect works unwary as well as negligent and to secure for them, employment in conditions conducive to their health and safety from accidents.

ADVANTAGES OF ADOPTING SAFET LAWS.

POLICIES & PROCEDURES

Your business should have clearly stated health and safety policies and procedures that are designed to keep workers safe at your workplace while meeting your legal obligations.

Health and safety policies are the documented principles, objectives, obligations and commitments that guide health and safety decision-making within a business.

Health and safety procedures are the documented processes that guide your working practices. They include specific procedures that set out step-by-step instructions for carrying out a job or task.

Health and safety policies are essential for your workplace because they:

- demonstrate that your business is addressing its health and safety obligations;
- show that your business is committed to working within a set of health and safety principles;
- clarify functions and responsibilities in your business; and
- help you manage workers more effectively by defining acceptable and unacceptable behaviour.

WHY DO YOU NEED HEALTH AND SAFETY POLICIES?

The development and implementation of policies dealing with workplace health and safety is a critical aspect of your business's compliance with health and safety legislation.

If a health and safety inspector attends your workplace in response to a reported health and safety issue, they will always ask you to provide a copy of the business's workplace health and safety policy.

The type of health and safety policies you adopt will depend on the size and nature of your business, but most workplaces should have the following policies in place:

- workplace health and safety policy;
- drug and alcohol policy;
- workplace bullying, discrimination and harassment policies; and
- smoke-free workplace policy.

EACH POLICY SHOULD AT LEAST CLEARLY STATE THE FOLLOWING:

- the effect or purpose of the policy and the scope of activities that the policy covers;
- who the policy applies to – be specific;

- any other policies or procedures that relate to the policy;
- what will happen if there is a breach of the policy – set out the disciplinary action or performance management procedures a worker may face for unacceptable behaviour under the terms of the policy;
- who a worker should speak to if they have any queries about the policy – name any contact officer responsible for handling complaints and enquiries;
- the person authorising the development of the policy; and
- any legitimate circumstances when it may not be possible to follow the policy and the appropriate response to such circumstances.

HEALTH AND SAFETY PROCEDURES

Health and safety procedures are beneficial because they:

- ensure that safe systems of work are recorded, communicated to workers and implemented in a consistent way throughout the business;
- are more effective in guiding the future action of workers than an ad hoc or informal approach; and
- save time by allowing health and safety matters to be handled quickly through an existing procedure, rather than staff dealing with problems as they occur or responding differently each time the same issues arise.

7 PROCEDURES YOUR BUSINESS SHOULD HAVE IN PLACE:

1. Safety planning and objectives procedures.
2. Communication and consultation procedure.
3. Hazards identification procedure.
4. Risk assessment procedure.
5. Risk control procedures.
6. Performance monitoring and review procedures.
7. Safety management procedure.

WORKPLACE POLICIES

Policies and procedures

Every business should have clearly stated health and safety policies and procedures that are designed to keep workers safe at your business while meeting your legal obligations.

Health and safety policies are the documented principles, objectives, obligations, and commitments that guide health and safety decision-making within a business.

Health and safety procedures are the documented processes that guide working practices in a business. They include specific procedures that set out step-by-step instructions for carrying out a job or task.

Health and safety policies are essential for your workplace because they:

- demonstrate that your business is addressing its health and safety obligations;
- show that your business is committed to working within a set of health and safety principles;
- clarify functions and responsibilities in your business; and
- help you manage workers more effectively by defining acceptable and unacceptable behaviour.

WHY DO YOU NEED HEALTH AND SAFETY POLICIES?

The development and implementation of policies dealing with workplace health and safety is a critical aspect of your business's compliance with health and safety legislation in every jurisdiction.

If a health and safety inspector attends your workplace in response to a reported health and safety issue, they will always ask you to provide a copy of the business's workplace health and safety policy.

The type of health and safety policies you adopt will depend on the size and nature of your business, but most workplaces should have the following policies in place:

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EACH POLICY SHOULD AT LEAST CLEARLY STATE THE FOLLOWING POINTS:

- The effect or purpose of the policy and the scope of activities that the policy covers.
- Who the policy applies to (be specific).
- Any other policies or procedures that relate to the policy.
- What will happen if there is a breach of the policy (set out the disciplinary action or performance management procedures a worker may face for unacceptable behaviour under the terms of the policy).
- Who a worker should speak to if they have any queries about the policy (name any contact officer responsible for handling complaints and enquiries).
- The person authorising the development of the policy.
- Any legitimate circumstances when it may not be possible to follow the policy and the appropriate response to such circumstances.

HOW TO IMPLEMENT POLICIES IN YOUR WORKPLACE

You must consult with all relevant stakeholders when developing policies and procedures, including all workers and regular contractors. The consultation should ensure that workers understand why the policies and procedures are important.

The policies and procedures you adopt need to be tailored to the needs of your business, not just lifted straight from a generic manual. All policies and procedures in your workplace must have a legitimate, defined, and understandable purpose. All procedural steps should be set out clearly, and all policies should be short and succinct.

Make sure your policies and procedures are realistic. You need to ensure that your business has the time, resources and personnel to properly implement the policies and procedures you have created.

New policies and procedures must be communicated to all workers in a user-friendly and effective way. The best way to do this will depend on the nature of your business, including how many workers you have and where they are located and their literacy skills. As a general rule, make copies available to anyone who visits the work site.

You must provide adequate information, training and supervision to your workers, including making sure new workers and contractors are trained in, and familiar with, business policies and procedures. All existing staff should receive appropriate training, e.g. annual refresher courses.

The scheduled review cycle of your policies and procedures will depend on the circumstances and document type. For example, a health and safety training policy may only need to be reviewed every 3 years, but a chemical handling procedure should be reviewed more often due to the level of hazard involved.

Don't forget - all workers need to be made aware of any changes to a policy or procedure when they occur.

Once adequate information, instruction, training and supervision have been provided, any breach of policy or procedure must be treated seriously, and you must enforce your policies and procedures consistently.It's important, every now and then, to stop and look at the systems you have in place for managing health and safety in your workplace, and consider how you might improve them to create and safer, happier and more productive environment for your workers to come to every day.

Workplace health and safety policies and procedures are a huge part of this.

Policies are the documented principles, objectives, obligations and commitments that guide workplace health and safety decision-making within your business. They help you to manage legal risk and allow you to outline the benefits and opportunities provided by your company to its workers.

Not just those relating to workplace health and safety, but all **policies** underpin your health and safety management system by documenting the following things:

- what is expected of your workers, e.g. behaviour and performance standards;
- rules and guidelines for decision-making in routine situations;
- a consistent and clear response across the company in dealing with situations;

- your good faith that workers will be treated fairly and equally;
- an accepted method of dealing with complaints and misunderstandings to help avoid claims of bias and favouritism;
- a clear framework for the delegation of decision-making;
- a means of communicating information to new workers.

Workplace health and safety **procedures** are the documented processes that guide working practices in your business – these include specific procedures that set out step-by-step instructions for carrying out a job or task.

7 ADVANTAGES OF EFFECTIVE WORKPLACE HEALTH AND SAFETY POLICIES AND PROCEDURES

Health and safety policies and procedures are essential for your workplace because they:

1. Demonstrate that your business is addressing its health and safety obligations.
2. Show that your business is committed to working within a set of health and safety principles.
3. Clarify functions and responsibilities in your business.
4. Ensure that safe systems of work are recorded, communicated to workers and implemented in a consistent way throughout your business.
5. Guide the future actions of workers in a formal way.
6. Help your business to manage staff more effectively by defining acceptable and unacceptable behaviour in the workplace.
7. Save time by allowing health and safety matters to be handled quickly through an existing procedure, rather than staff dealing with problems as they occur or responding differently each time the same issues arise.

Each of these advantages works towards improving your health and safety systems to create a culture where health and safety is a commitment made by your management and board. If you can do this, you will show your workers that their welfare is your priority – leading to a safety culture and more productive worker.

SAFETY MEASURES IN HANDLING AND STORAGE OF CHEMICALS

Chemicals are present in every workplace. Even in the cleanest, most modern office, employees may be routinely exposed to inks, toners and adhesives not to mention a wide range of chemicals used in cleaning and maintenance. Chemicals can exist in many forms: Dust, fumes, fibres, powders. Liquids. Gases, vapours, mists. Any chemical, in either gas, liquid or solid form, that has the potential to cause harm is referred to as a hazardous or dangerous chemical. Such chemicals include those: Brought directly into the workplace and handled, stored and used for processing e.g. solvents, cleaning agents, glues, resins, paints. Generated by a process or work activity e.g. fumes from welding/ soldering, dust from machining of wood, flour dust, solvents. Generated as waste or residue e.g. fumes from soldering iron, carbon monoxide from engine or motor exhausts.

How can chemicals be hazardous to health? Chemicals can cause many different types of harm, ranging from mild skin irritation to cancer. The effects of hazardous chemicals may be seen: Immediately after contact (e.g. chemical burn) or many years after the exposure (e.g. lung cancer following exposure to asbestos). Following a single short exposure (e.g. infrequent use of a chemical) or longer-term exposures (e.g. daily use of a chemical in the workplace). Therefore, it is important to minimise exposure to chemicals at all times. In order for a chemical to be hazardous to a person's health, it must either be in contact with or enter the body.

Effects on brain and nervous system For example, exposure to pesticides, mercury, lead, solvents, carbon monoxide gas. Eye, nose and throat irritation (dryness, soreness or pain) For example, exposure to acid mists and vapours, welding fumes or diesel exhaust. Effects on the lung Lung damage For example asbestos (lung cancer), welding fume (chronic obstructive pulmonary disease). Irritant induced asthma For example acids ("burn effect" on airways). Allergic asthma For example flour dust, isocyanate (in 2-pack paints), wood dust. Liver damage For example, exposure to vinyl chloride. Bladder damage For example, exposure to some azo dyes (bladder cancer). Effects on skin Allergic contact dermatitis For example nickel, latex, chromate (found in some cements). Irritant contact dermatitis For example solvents, detergents, oils, lubricants. Effects on blood and bone marrow For example, exposure to benzene in petrol fumes (anaemia and leukaemia).

YOUR STEPS TO CHEMICAL SAFETY You have seen how chemicals effect the body. There are four ways chemicals can enter the body: Inhalation: Breathing in contaminated air is the most common way that workplace chemicals enter the body. Contact with the skin or eyes: Some chemicals can damage the skin or eyes (e.g. irritation) or pass through the skin into the body. Ingestion: Workplace chemicals may be swallowed accidentally if food or hands are contaminated. Injection: Injection can occur when a sharp object (e.g. needle) punctures the skin and injects a chemical directly into the bloodstream. Here are some terms that explain the health effects of exposure to chemicals.

Term What this means to you Acute toxicity An adverse health effect following a single exposure to a chemical (e.g. skin contact with insecticides, accidental ingestion of a chemical). Carcinogen A chemical that causes or can potentially cause cancer (e.g. breathing in asbestos fibres, skin contact with used motor oils). Chronic toxicity An adverse health effect following repeated exposure to a chemical, which can occur following a relatively short exposure (e.g. weeks) or longer term exposure (e.g. years). CMR A chemical that is Carcinogenic, Mutagenic or Toxic to Reproduction. Corrosive A chemical that causes irreversible damage to skin, eyes or airways (e.g. strong acids and strong bases such as concentrated hydrochloric acid or concentrated hydroxides). Irritant A chemical that causes reversible damage to skin, eyes or airways (e.g. detergents or soaps). Mutagen A chemical that can cause permanent damage to genetic material in cells, which can possibly lead to heritable genetic damage or cancer (e.g. UV rays from the sun, benzene).

General Managing chemicals in a safe and sustainable way makes sound business sense and will ensure you, your employees and the environment are protected from the harmful effects of hazardous chemicals. This section of the guide will assist you in taking a logical approach to assessing the hazards and potential risks, and ensuring the necessary controls are in place to enable you to manage your chemicals safely.

Where can you find information about chemical hazards? The most important sources of information on the hazards of your chemicals are the label and the safety data sheet (SDS). Labels Chemicals should be supplied with a label attached to the container. The label gives information on the chemical or product name, the chemical hazards and the precautions you should take into account to ensure safe use. Safety Data Sheets You must have a SDS for each hazardous chemical that you use. If you don't, contact the supplier, who is required to give you one. You should keep your SDSs in a clearly identified place where they can be easily accessed by your employees and by emergency services - they will require these sheets when they attend a chemical incident. You should make sure all your employees know where the SDSs are stored and that they have read and understood them, if required. Safety data sheets must: Be provided for chemicals classified as hazardous. Contain 16 headings. Be prepared by a competent person. Be specific to the chemical.

Your steps to chemical safety

- Be clear and understandable.
- Be provided free of charge.
- Be provided no later than at the time of first delivery.
- Be provided upon update or revision to everyone who has received the chemical during the previous 12 months.
- Be dated and the pages numbered.

Safety data sheets must contain the following headings

1. Identification of the substance/preparation and of the company/ undertaking.

2. Hazards identification.

3. Composition/ information on ingredients.

4. First aid measures.

5. Fire-fighting measures.

6. Accidental release measures.

7. Handling and storage.

8. Exposure controls/ personal protection.

9. Physical and chemical properties.

10. Stability and reactivity.

11. Toxicological information.

12. Ecological information.

13. Disposal consideration.

14. Transport information.

15. Regulatory information.

16. Other information.

The SDS plays a number of roles in managing the safe use of chemicals in your workplace: It ensures the product is being used as intended by the manufacturer or importer. It is a key tool for risk assessment as it includes detailed hazard information. It provides options for appropriate controls measures and procedures to be applied. Sufficient information should be provided to select the necessary Personal Protective Equipment (PPE) and to develop necessary emergency procedures. It may be used as the basis of a training program for workers as it covers hazards, information on safe handling and storage and emergency procedures.

A spray booth used in spray painting or a local exhaust system to remove welding fumes is an example of an engineering control. The correct design and installation of engineering controls which are suitable for your specific use is crucial if it is to give you adequate control. Therefore, you may need to obtain expert advice if you need to install engineering controls.

A spray booth used in spray painting or a local exhaust system to remove welding fumes is an example of an engineering control. The correct design and installation of engineering controls which are suitable for your specific use is crucial if it is to give you adequate control. Therefore, you may need to obtain expert advice if you need to install engineering controls.

Look how the work is done and consider how employees are exposed to the chemical. Think about how the job could be done differently to avoid exposures. Where it is not possible to eliminate or isolate the chemical hazard, you should minimize exposure to it. This can be achieved by introducing procedures in your workplace to: Minimise the number of employees who might be involved in a task. For example implementing job rotation. Exclude other employees not involved in the task from the area where the chemical is being used. Provide training to your employees on the hazards and safe use of the chemicals they work with. Ensure chemicals with hazardous properties are correctly stored. Ensure emergency procedures are in place in the event of an accident e.g. spillage. A preventative maintenance programme is an important element of administrative control. It prevents emergency breakdowns and keeps engineering controls working efficiently. Training Training needs to be well planned so that you and your employees get maximum benefit from it. It is crucial that on completion of the training your employees fully understand: What the chemical hazards are. What the potential risks to their health could be. What controls are in place to protect health and safety.

How to use, handle, move and store the chemicals in a safe manner, including proper use of equipment (e.g. engineering controls, PPE). How to safely clean up spills. How to report a problem and who to report it to. What to do in an emergency. Safe Storage of Chemicals Hazardous chemicals should be stored under appropriate conditions, taking into account the chemicals' specific properties. Instructions on safe storage of chemicals can be found in Section 7 of the SDS. It is also important to note if there are conditions under which hazardous reactions may occur. For example, chemicals that can react together to form unstable or toxic products, or produce heat, should be kept segregated. Flammable liquids stored near a heat source could result in a fire. Section 10 of the SDS gives advice on such conditions that you should take into account when storing your chemicals. Chemicals known to be carcinogenic, mutagenic or toxic to reproduction should be kept under strict control. Chemicals with typical properties and characteristics that are relevant include: Flammable chemicals. Toxic or corrosive chemicals. Chemicals that emit highly toxic fumes in the event of a fire. Chemicals which, in contact with water, give off flammable gas. Oxidising chemicals. Explosives. Unstable chemicals. Compressed gases. When storing chemicals you should consider: The compatibility of different chemicals. For example, oxidizing chemicals should be kept separate from flammable liquids or other flammable chemicals.

PPEs

The use of PPE should be the last line of defence and not regarded as an alternative to other suitable control measures which are higher up the hierarchy. It should provide adequate protection against the risk from the hazardous chemicals to which the wearer is exposed, for the duration of the exposure, taking into account the type of work being carried out. In practical terms, you may have to apply a number of control measures. For example, even with good engineering controls you may still need to examine whether administrative controls and PPE are also needed. The further up the hierarchy you take action the better. You do not want to be in a situation where you are highly reliant on PPE for protection from chemical hazards. Section 8 of the SDS gives advice on steps needed to reduce exposure, including advice on appropriate PPE. Personal protective equipment can include: Eye/face protection (e.g. safety glasses, goggles, face shields). Skin protection (e.g. chemical resistant footwear – shoes/boots/wellingtons, clothing – aprons/suits). Hand protection (e.g. gloves or gauntlets, disposable or otherwise, which are suitable for the job). Respiratory protection (e.g. respirators, masks or hoods that give adequate protection). Thermal protection (employees may need to be protected from excess heat or cold with appropriate clothing).

Ideally, each person should have their own equipment. They should be trained how to use it effectively, how to keep it in good condition, and where and how to store it safely to prevent contamination. PPE should comply with international standards i.e. be CE Marked. A CE Mark shows that the equipment conforms with the relevant standard. PPE should be suitable for its purpose and there should be a sufficient supply available in the workplace for all employees who require it. Where employees have been informed that PPE is required for a specific task, they should use the equipment provided throughout the time they are exposed to the chemical hazard and supervision should be provided to ensure that the equipment is properly used. All personal protective equipment that is necessary for the safe use of chemicals should be provided and maintained by the employer without cost to the employee. Atmospheric monitoring It may be necessary for you to carry out atmospheric monitoring (air sampling) of the workplace to

determine the level of potential exposure to hazardous chemicals or to check that controls are working effectively e.g. isocyanate levels in a car spraying booth. Some hazardous chemicals have national occupational exposure levels that must not be exceeded. See the HSA Code of Practice for list of chemicals with occupational exposure limit values. These can also be found in Section 8 of the SDS. You should consult with a qualified occupational hygienist to determine the most appropriate method for sampling and analysis. Health surveillance Where exposure to a hazardous chemical can cause an identifiable disease or illness (e.g. skin or respiratory sensitisers) and there is a reasonable likelihood of illness occurring (e.g. where control of exposure relies heavily on PPE and strict work procedures), then health surveillance should be carried out by a occupational healthcare professional.

Examples of control measures

Substance, process	Control equipment	Way of working	Managing
■ Cleaning with solvent on rag.	■ Use a rag holder. ■ Provide a small bin with a lid for used rags.	■ Avoid skin contact. ■ Reduce solvent vapour from used rags.	■ Check controls are used. ■ Safe disposal.
■ Dust and sparks from abrasive wheel.	■ Put an enclosure around the wheel and extract the air to a safe place.	■ Check the airflow indicator. ■ Make sure the extraction works.	■ Maintain controls. ■ Test controls as required by law.
■ Fume from cutting demolition scrap.	■ Ventilated welding helmet, gloves. ■ Washing facilities.	■ Work outdoors upwind of the fume wherever possible. ■ Allow the fume to clear before removing helmet.	■ Check if there is any lead paint on the scrap being cut. ■ Carry out health checks.
■ Cutting-fluid mist from a lathe. ■ Swarf.	■ Put an enclosure around the lathe and extract the air to a safe place. ■ Protective gloves.	■ Use skin-care products. ■ Make sure the extraction works. ■ Allow time for the mist to clear from the enclosure before opening it.	■ Train workers. ■ Check and maintain fluid quality. ■ Test controls as required by law. ■ Carry out health checks.
■ Dust from disc cutter on stone worktop.	■ Use an enclosure to extract air to a safe place. ■ High-efficiency vacuum cleaner.	■ Cut and polish worktops inside an enclosure. ■ Vacuum up dust.	■ Test and maintain controls. ■ Carry out health checks.

PERSONNEL PROTECTION

ELEMENTS OF A PERSONAL PROTECTION PROGRAMME

The apparent simplicity of some personal protective equipment can result in a gross underestimation of the amount of effort and expense required to effectively use this equipment. While some devices are relatively simple, such as gloves and protective footwear, other equipment such as respirators can actually be very complex. The factors which make effective personal protection difficult to achieve are inherent in any method which relies upon modification of human behaviour to reduce risk, rather than on protection which is built into the process at the source of the hazard. Regardless of the particular type of protective equipment being considered, there is a set of elements which must be included in a personal protection programme.

HAZARD EVALUATION

If personal protection is to be an effective answer to a problem of occupational risk, the nature of the risk itself and its relationship to the overall work environment must be fully understood. While this may seem so obvious that it barely needs to be mentioned, the apparent simplicity of many protective devices can present a strong temptation to short cut this evaluation step. The consequences of providing protective devices and equipment which are not suitable to the hazards and the overall work environment range from reluctance or refusal to wear inappropriate equipment, to impaired job performance, to risk of worker injury and death. In order to achieve a proper match between the risk and the protective measure, it is necessary to know the composition and magnitude (concentration) of the hazards (including chemical, physical or biological agents), the length of time for which the device will be expected to perform at a known level of protection, and the nature of the physical activity which may be performed while the equipment is in use. This preliminary evaluation of the hazards is an essential diagnostic step which must be accomplished before moving on to selecting the appropriate protection.

SELECTION

The selection step is dictated in part by the information obtained in hazard evaluation, matched with the performance data for the protective measure being considered for use and the level of exposure which will remain after the personal protective measure is in place. In addition to these performance-based factors, there are guidelines and standards of practice in selecting equipment, particularly for respiratory protection. The selection criteria for respiratory protection have been formalized in publications such as Respirator Decision Logic from the National Institute for Occupational Safety and Health (NIOSH) in the United States. The same sort of logic can be applied to selecting other types of protective equipment and devices, based upon the nature and magnitude of the hazard, the degree of protection provided by the device or equipment, and the quantity or concentration of the hazardous agent which will remain and be considered acceptable while the protective devices are in use. In selecting protective devices and equipment, it is important to recognize that they are not intended to reduce risks and exposures to zero. Manufacturers of devices such as respirators and hearing protectors supply data on the performance of their equipment, such as protection and attenuation factors. By combining three

essential pieces of information—namely, the nature and magnitude of the hazard, the degree of protection provided, and the acceptable level of exposure and risk while the protection is in use—equipment and devices can be selected to adequately protect workers.

FITTING

Any protective device must be properly fitted if it is to provide the degree of protection for which it was designed. In addition to the performance of a protective device, proper fit is also an important factor in the acceptance of the equipment and the motivation of people to actually use it. Protection which is ill-fitting or uncomfortable is unlikely to be used as intended. In the worst case, poorly fitted equipment such as clothing and gloves can actually create a hazard when working around machinery. Manufacturers of protective equipment and devices offer a range of sizes and designs of these products, and workers should be provided with protection which fits properly to accomplish its intended purpose.

In the case of respiratory protection, specific requirements for fitting are included in standards such as the United States Occupational Safety and Health Administration's respiratory protection standards. The principles of assuring proper fit apply over the full range of protective equipment and devices, regardless of whether they are required by a specific standard.

TRAINING AND EDUCATION

Because the nature of protective devices requires modification of human behaviour to isolate the worker from the work environment (rather than to isolate the source of a hazard from the environment), personal protection programmes are unlikely to succeed unless they include comprehensive worker education and training. By comparison, a system (such as local exhaust ventilation) which controls exposure at the source may operate effectively without direct worker involvement. Personal protection, however, requires full participation and commitment by the people who use it and from the management which provides it.

Those responsible for the management and operation of a personal protection programme must be trained in the selection of the proper equipment, in assuring that it is correctly fitted to the people who use it, in the nature of the hazards the equipment is intended to protect against, and the consequences of poor performance or equipment failure. They must also know how to repair, maintain, and clean the equipment, as well as to recognize damage and wear which occurs during its use.

People who use protective equipment and devices must understand the need for the protection, the reasons it is being used in place of (or in addition to) other control methods, and the benefits they will derive from its use. The consequences of unprotected exposure should be clearly explained, as well as the ways users can recognize that the equipment is not functioning properly. Users must be trained in methods of inspecting, fitting, wearing, maintaining, and cleaning protective equipment, and they must also be aware of the limitations of the equipment, particularly in emergency situations.

MAINTENANCE AND REPAIR

The costs of equipment maintenance and repair must be fully and realistically assessed in designing any personal protection programme. Protective devices are subject to gradual degradation in performance through normal use, as well as catastrophic failures in extreme conditions such as emergencies. In considering the costs and benefits of using personal protection as a means of hazard control it is very important to recognize that the costs of initiating a programme represent only a fraction of the total expense of operating the programme over time. Equipment maintenance, repair, and replacement must be considered as fixed costs of operating a programme, as they are essential to maintaining the effectiveness of protection. These programme considerations should include such basic decisions as whether single use (disposable) or reusable protective devices should be used, and in the case of reusable devices, the length of service which can be expected before replacement must be reasonably estimated. These decisions may be very clearly defined, as in cases where gloves or respirators are usable only once and are discarded, but in many cases a careful judgement must be made as to the efficacy of reusing protective suits or gloves which have been contaminated by previous use. The decision to discard an expensive protective device rather than risk worker exposure as a result of degraded protection, or contamination of the protective device itself must be made very carefully. Programmes of equipment maintenance and repair must be designed to include mechanisms for making decisions such as these.

RESPIRATORS

Respirators serve to protect the user from breathing in contaminants in the air, thus preserving the health of one's respiratory tract. There are two main types of respirators. One type of respirator functions by filtering out chemicals and gases, or airborne particles, from the air breathed by the user. The filtration may be either passive or active (powered). Gas masks and particulate respirators are examples of this type of respirator. A second type of respirator protects users by providing clean, respirable air from another source. This type includes airline respirators and self-contained breathing apparatus (SCBA). In work environments, respirators are relied upon when adequate ventilation is not available or other engineering control systems are not feasible or inadequate.

In the United Kingdom, an organization that has extensive expertise in respiratory protective equipment is the Institute of Occupational Medicine. This expertise has been built on a long-standing and varied research programme that has included the setting of workplace protection factors to the assessment of efficacy of masks available through high street retail outlets.]

The Health and Safety Executive (HSE), NHS Health Scotland and Healthy Working Lives (HWL) have jointly developed the RPE (Respiratory Protective Equipment) Selector Tool, which is web-based. This interactive tool provides descriptions of different types of respirators and breathing apparatuses, as well as "dos and don'ts" for each type.

In the United States, The National Institute for Occupational Safety and Health (NIOSH) provides recommendations on respirator use, in accordance to NIOSH federal respiratory regulations 42 CFR Part 84. The National Personal Protective Technology Laboratory (NPPTL) of NIOSH is tasked towards actively conducting studies on respirators and providing recommendations.

SKIN PROTECTION

A worker wearing a respirator, lab coat, and gloves while weighing carbon nanotubesThis is an incorrect use of personal protective equipment, because the gap between the glove and the lab coatexposes the wrist to hazardous materials.

Occupational skin diseases such as contact dermatitis, skin cancers, and other skin injuries and infections are the second-most common type of occupational disease and can be very costly.[6] Skin hazards, which lead to occupational skin disease, can be classified into four groups. Chemical agents can come into contact with the skin through direct contact with contaminated surfaces, deposition of aerosols, immersion or splashes. Physical agents such as extreme temperatures and ultraviolet or solar radiation can be damaging to the skin over prolonged exposure. Mechanical trauma occurs in the form of friction, pressure, abrasions, lacerations and contusions. Biological agents such as parasites, microorganisms, plants and animals can have varied effects when exposed to the skin.

Any form of PPE that acts as a barrier between the skin and the agent of exposure can be considered skin protection. Because much work is done with the hands, gloves are an essential item in providing skin protection. Some examples of gloves commonly used as PPE include rubber gloves, cut-resistant gloves, chainsaw gloves and heat-resistant gloves. For sports and other recreational activities, many different gloves are used for protection, generally against mechanical trauma.

Other than gloves, any other article of clothing or protection worn for a purpose serve to protect the skin. Lab coats for example, are worn to protect against potential splashes of chemicals. Face shields serve to protect one's face from potential impact hazards, chemical splashes or possible infectious fluid.

EYE PROTECTION

Each day, about 2000 US workers have a job-related eye injury that requires medical attentionEye injuries can happen through a variety of means. Most eye injuries occur when solid particles such as metal slivers, wood chips, sand or cement chips get into the eye. Smaller particles in smokes and larger particles such as broken glass also account for particulate matter-causing eye injuries. Blunt force trauma can occur to the eye when excessive force comes into contact with the eye. Chemical burns, biological agents, and thermal agents, from sources such as welding torches and UV light, also contribute to occupational eye injury.

While the required eye protection varies by occupation, the safety provided can be generalized. Safety glasses provide protection from external debris, and should provide side protection via a wrap-around design or side shields.

- Goggles provide better protection than safety glasses, and are effective in preventing eye injury from chemical splashes, impact, dusty environments and welding. Goggles with high air flow should be used to prevent fogging.
- Face shields provide additional protection and are worn over the standard eyewear; they also provide protection from impact, chemical, and blood-borne hazards.
- Full-facepiece respirators are considered the best form of eye protection when respiratory protection is needed as well, but may be less effective against potential impact hazards to the eye.
- Eye protection for welding is shaded to different degrees, depending on the specific operation.

HEARING PROTECTION

Industrial noise is often overlooked as an occupational hazard, as it is not visible to the eye. Overall, about 22 million workers in the United States are exposed to potentially damaging noise levels each year. Occupational hearing loss accounted for 14% of all occupational illnesses in 2007, with about 23,000 cases significant enough to cause permanent hearing impairment.About 82% of occupational hearing loss cases occurred to workers in the manufacturing sector.The Occupational Safety and Health Administration establishes occupational noise exposure standards.NIOSH recommends that worker exposures to noise be reduced to a level equivalent to 85 dBA for eight hours to reduce occupational noise-induced hearing loss.

PPE for hearing protection consists of earplugs and earmuffs. Workers who are regularly exposed to noise levels above the NIOSH recommendation should be furnished hearing protection by the employers, as they are a low-cost intervention.

PROTECTIVE CLOTHING AND ENSEMBLES

A complete PPE ensemble worn during high pressure cleaning work

This form of PPE is all-encompassing and refers to the various suits and uniforms worn to protect the user from harm. Lab coats worn by scientists and ballistic vests worn by law enforcement officials, which are worn on a regular basis, would fall into this category. Entire sets of PPE, worn together in a combined suit, are also in this category.

ENSEMBLES

Below are some examples of ensembles of personal protective equipment, worn together for a specific occupation or task, to provide maximum protection for the user.

- Chainsaw protection (especially a helmet with face guard, hearing protection, kevlar chaps, anti-vibration gloves, and chainsaw safety boots).
- Bee-keepers wear various levels of protection depending on the temperament of their bees and the reaction of the bees to nectar availability. At minimum most bee keepers wear a brimmed hat and a veil made of fine mesh netting. The next level of protection involves leather gloves with long gauntlets and some way of keeping bees from crawling up

one's trouser legs. In extreme cases, specially fabricated shirts and trousers can serve as barriers to the bees' stingers.

- Diving equipment, for underwater diving, constitutes equipment such as a diving helmet or diving mask, an underwater breathing apparatus, and a diving suit.
- Firefighters wear PPE designed to provide protection against fires and various fumes and gases. PPE worn by firefighters include bunker gear, self-contained breathing apparatus, a helmet, safety boots, and a PASS device.

IN SPORTS

Participants in sports often wear protective equipment. Studies performed on the injuries of professional athletes, such as that on NFLplayers question the effectiveness of existing personal protective equipment.

LIMITS OF THE DEFINITION

Workers using personal protective equipment while painting poles. While basic head protection is present, no engineering fall protection systems appear to be in place.

The definition of what constitutes as personal protective equipment varies by country. In the United States, the laws regarding PPE also vary by state. In 2011, workplace safety complaints were brought against Hustler and other adult film production companies by the AIDS Healthcare Foundation, leading to several citations brought by Cal/OSHA. The failure to use condoms by adult film stars was a violation of Cal/OSHA's Blood borne Pathogens Program, Personal Protective Equipment.This example shows that personal protective equipment can cover a variety of occupations in the United States, and has a wide-ranging definition.

LEGISLATION IN THE EUROPEAN UNION

At the European Union level, personal protective equipment is governed by Directive 89/686/EEC on personal protective equipment (PPE). The Directive is designed to ensure that PPE meets common quality and safety standards by setting out basic safety requirements for personal protective equipment, as well as conditions for its placement on the market and free movement within the EU single market. It covers 'any device or appliance designed to be worn or held by an individual for protection against one or more health and safety hazards'.[15] The directive was adopted on 21 January 1989 and came into force on 1 July 1992. The European Commission additionally allowed for a transition period until 30 June 1995 to give companies sufficient time to adapt to the legislation. After this date, all PPE placed on the market in EU Member States was required to comply with the requirements of Directive 89/686/EEC and carry the CE Marking.

Article 1 of Directive 89/686/EEC defines personal protective equipment as any device or appliance designed to be worn or held by an individual for protection against one or more health and safety hazards. PPE which falls under the scope of the Directive is divided into three categories:

- Category I: simple design (e.g. gardening gloves, footwear, ski goggles)

- Category II: PPE not falling into category I or III (e.g. personal flotation devices, dry and wet suits)
- Category III: complex design (e.g. respiratory equipment, harnesses)

Directive 89/686/EEC on personal protective equipment does not distinguish between PPE for professional use and PPE for leisure purposes.

Personal protective equipment falling within the scope of the Directive must comply with the basic health and safety requirements set out in Annex II of the Directive. To facilitate conformity with these requirements, harmonized standards are developed at the European or international level by the European Committee for Standardization (CEN, CENELEC) and the International Organization for Standardization in relation to the design and manufacture of the product. Usage of the harmonized standards is voluntary and provides presumption of conformity. However, manufacturers may choose an alternative method of complying with the requirements of the Directive.

Personal protective equipment excluded from the scope of the Directive includes:

- PPE designed for and used by the armed forces or in the maintenance of law and order;
- PPE for self-defence (e.g. aerosol canisters, personal deterrent weapons);
- PPE designed and manufactured for personal use against adverse atmospheric conditions (e.g. seasonal clothing, umbrellas), damp and water (e.g. dish-washing gloves) and heat;
- PPE used on vessels and aircraft but not worn at all times;
- helmets and visors intended for users of two- or three-wheeled motor vehicles.

The European Commission is currently working to revise Directive 89/686/EEC. The revision will look at the scope of the Directive, the conformity assessment procedures and technical requirements regarding market surveillance. It will also align the Directive with the New Legalislative Framework. The European Commission is likely to publish its proposal in 2013. It will then be discussed by the European Parliament and Council of the European Union under the ordinary legislative procedure before being published in the Official Journal of the European Union and becoming law.

SAFETY COLOR CODES OF CHEMICALS.

LABELING OF CHEMICAL CONTAINERS

All containers holding chemical or commercial substances with chemical hazards must be labeled appropriately, including those used long term as well as short term storage. Labels will be provided by the department. Labels may be purchased from a vendor, made by the department, or provided by the vendor. The label should be easy to understand and convey the appropriate hazards. The following requirements apply:

1. Containers used by more than one person or that will be stored or left unattended require a label identifying the contents and the hazards associated with its use and storage.

2. Labels on products from the vendor shall not be removed or defaced until the container is empty.

3. Containers to be reused for holding chemicals must have all old labels removed before reusing the container.

4. Very small containers, such as vials, require labeling too, but may be too small to attach a label. In such instances, it is appropriate to store the small containers within a larger container, and then provide an appropriate label out the outside of the larger container.

5. Common names may be used on the label (i.e. Brush Cleaner, Gram Stain, or Nessler Reagent) providing the major components are indicated.

6. Containers that hold a carcinogen or potential carcinogen (>0.1% concentration), must be labeled with a cancer hazard label.

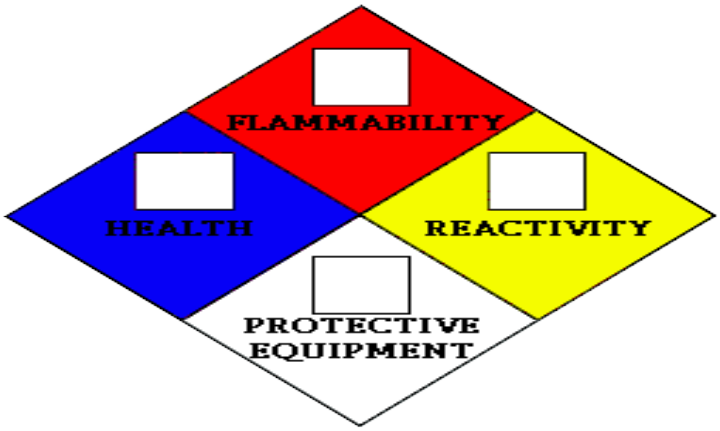
7. The hazard information is available on the label of the original chemical, on the MSDS or chemical catalog.

8. The following information shall be included on all labels:

    - The complete chemical name (no abbreviations). The formula may be added as an option.
    - Concentration & units, if it is not a pure compound.
    - Date of preparation.
    - Initials of the preparer.
    - Hazard warnings to indicate the health and physical hazards of the chemical.
    - Assume that dilutions will have the same hazards as the concentrated material.
    - The hazard information can be copied from the label of the original product or MSDS or chemical catalog.

9. Every container shall have a storage color (see Chemical Storage by Hazard Class below).

EXAMPLES OF HAZARD PICTOGRAMS THAT CAN BE USED TO CONVEY CHEMICALHAZARDS



Many container labels will have diamond or a box that is divided into color coded sections: Health (blue), Flammability (Red), Reactivity (Yellow) and Other or Corrosive (white). Numbers of 0-4 will be assigned to each section of the diamond to indicate the degree of hazard; 0 indicates low hazard, and 4 is highest level of hazard.

Toxic or Poisonous

Electrical Shock Hazard

Biohazardous

Corrosive

CHEMICAL STORAGE BY HAZARD CLASSIFICATION

Chemicals are to be stored according to hazard class in all chemical storage areas. The uniform color-code system developed by the J. T. Baker Chemical Company will be amended for use by all departments. Individual modifications of the color code system used within departments should be described in Appendix D of Section D of the department Chemical Hygiene Plan.

Many suppliers use a color coding system for chemical storage classification. All of the companies use the color red for flammability, blue for health, and yellow for reactivity as taken from the National Fire Protection Association (NFPA) color code system. Most chemical suppliers use white for contact hazard. Colors for general storage conditions and unusual requirements will vary between manufacturers. A chemical may not always be assigned to the same hazard classes by different suppliers. The J. T. Baker system uses orange to signify general storage. UW Superior will use the color green to indicate general storage conditions.

The goal of any chemical storage classification system is to prevent accidental combination of 2 or more incompatible materials in the same space. *Chemicals must be separated by space and even physical barriers to prevent an unwanted reaction*. Chemical storage areas should be appropriately labeled.

At a minimum, each department will assign the following color codes to represent the appropriate hazard class of the chemical:

- Red Flammable, flash point of $< 100^{o}$ F. Store away from ignition sources and corrosive and reactive materials.
- Yellow Reactive. Store separately and away from combustible or flammable materials.
- Blue Health Hazard. Poisonous.
- White Contact hazard. Generally corrosive, but may include skin absorption and irritants.
- Green General Storage. Substances with a rating no higher than 2 in any hazard category.

Storage code colors by other companies should be converted to this system. Each chemical should be labeled with a color code to avoid confusion of colors assigned by other manufacturers.

A department may elect to further segregate incompatible materials within the same storage class by using a striped label of the same color. The materials should be segregated within the storage area.

When a color code has not been assigned by a chemical company, a determination must be made based upon the available information. This may include:

1. Using the highest rating issued by the NFPA or a hazardous material information (HMIS) system as the primary storage code. (NFPA address acute hazards, such as may occur during storage). Ratings of 2 or less in all categories would be considered general storage (Green)
2. Department of Transportation (DOT) classifications are available for most chemicals, and generally reflect acute hazards associated with transportation.
3. Use available reference materials to derive the most appropriate storage code.
4. All flammable materials (flash point < 100^{o} F) shall be given a red (or red stripe) color code.
5. All oxidizers and reducing agents shall be given a yellow or (yellow stripe) color code.

EXAMPLES:

Benzene: Benzene has **NFPA codes** of: Health: 2; Flammability: 3; Instability: 0 therefore this is coded Red.

Sodium Chloride: Sodium chloride has NFPA codes that are all below 2 therefore this is coded Green.

Nitric Acid: The NFPA codes for nitric acid are Health: 4; Flammability: 0; Instability: 0; Special Hazard: OX. By using rule 5 above we see that the oxidizer code overrides the health code therefore this is coded Yellow.

Hydrochloric acid: The NFPA codes for hydrochloric acid are Health 3 and the hazard warning in section 3 indicates this is corrosive. The color for this is White.