Skill India
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GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP
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HYDROCARBON SECTOR
SKILL COUNCIL

Participant Handbook

Sector
Hydrocarbon Industry

Sub-Sector
Upstream

Occupation
Production

Reference ID: **HYC/Q0102**
NSQF level: 4

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Assistant Technician - Production (Oil & Gas)

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> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi
Prime Minister of India

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Certificate

COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

HYDROCARBON SECTOR SKILL COUNCIL

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role / Qualification pack: **"Assistant Technician- Production (Oil & Gas)"**
QP No. "HYC/Q0102, **NSQF Level 4"**

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The preparation of this manual would not have been possible without the Hydrocarbon Industry's support. Industry feedback has been extremely encouraging from inception to conclusion and it is with their input that we have tried to bridge the skill gaps existing today in the industry.

This participant manual is dedicated to the aspiring youth who desire to achieve special skills which will be a lifelong asset for their future endeavours.

About this Book

This Participant Handbook is designed for providing skill training and /or upgrading the knowledge level of the Trainees to take up the job of an "Assistant Technician- Production (Oil & Gas)" in the Hydrocarbon Sector.

This Participant Handbook is designed based on the Qualification Pack (QP) under the National Skill Qualification framework (NSQF) and it comprises of the following National Occupational Standards (NOS)/topics and additional topics.

- Introduction
- HYC/N0104 Perform Production activities (On Shore and Off Shore)
- HYC/N0102 Occupational health and safety (OHAS)
- HYC/N0103 Working effectively with colleagues and supervisor
- Employability and Entrepreneurship Skills

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1. Introduction

Unit 1.1 An Introduction to the Sector and its Sub-sectors

Unit 1.2 An Introduction to the Job Role (prospects, job responsibilities, job description, skillset, personal attributes, etc.)

Key Learning Outcomes 

After attending the session, you will be able to:

1. Analyze the general information about Hydrocarbon sector
2. Evaluate the Job Role (prospects, job responsibilities, job description, skillset, personal attributes, etc.) of the production technician (Oil and Gas)

Unit 1.1 An Introduction to the Sector and its Sub-sectors

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate the condition and possibilities of growth of the Hydrocarbon Sector in India

Hydrocarbon sector, to be more precise Oil and Gas sector plays a pivotal role in determining the economy of India. It is one of the six "core sectors" or "core industries" that influence the Indian market and the economic strategies of the country. Owing to the rising demand for Energy and Energy Supplies, the Indian Government envisaged a new policy in 19997-98, the New Exploration Licensing Policy (NELP). The project was initiated to meet the increasing demand for energy which in turn would control the domestic economy of the country as well. The Indian Government, unlike its policies and norms with the other industrial sectors, has been quite lenient with the Hydrocarbon sector. Even in the case of several segments of the Hydrocarbon sector, the Indian Government has allowed 100 percent Foreign Direct Investment (FDI) including natural gas, petroleum products, and refineries, among others.

At present, India is the third-largest oil-consuming country in the world. In 2016, the growth of oil consumption was 8.3 percent, whereas, the global rate of growth of the oil-consumption was 1.5 percent. The statistics show the dire need for oil and petroleum in India. Therefore, the Oil and Gas sector has been given special emphasis and the domestic production of the energy has become one of the most important factors to drive the Indian economy.

Figure 1.1.1: Oil Mining at Site (Western Coast of India)

It is expected that by 2040, the requirement for oil will grow at a CAGR of 3.6 percent to 458 million tonnes while the demand for energy will get doubled (by 2040). Therefore, the Oil and Petroleum production has become a chief parameter in regulating the Indian market and economy.

The oil industry in India is based on a threefold structure. That means, from the excavation and production to selling the oil at retail price undergoes three phases. They are –

Upstream

Mid-stream

Downstream

- **Upstream Phase** refers to the exploration, excavation, and production of oil
- **Mid-stream Phase** deals with the unrefined oil came directly from the upstream sector. The key responsibility of the Mid-stream phase is to refine the oil and prepare it for selling
- **Downstream Phase** is the final phase where the refined oil from the Mid-stream sector is marketed at the current retail price

In this book, we will discuss the upstream phase, the details of oil mining. The upstream sector is associated with the production of oil and gas. Few of the most famous upstream oil companies in India are –

- ONGC [Oil and Natural Gas Corporation Limited] **(National Company)**
- OIL [Oil India Limited] **(National Company)**
- Vedanta **(National Company)**
- Shell **(Private Company)**
- Reliance **(Private Company)**

Figure 1.1.2: ONGC Logo

Unit 1.2 An Introduction to the Job Role (prospects, job responsibilities, job description, skillset, personal attributes, etc.)

Unit Objectives

At the end of this unit, you will be able to:

- Gauge the job responsibilities of the production assistant (oil and gas)

The key job responsibilities of a production assistant (oil and gas) can be classified into two parts-

1. Technical Skills
2. Soft Skills

Technical skills refer to the skills related to the job profile. In this case, the technical skill refers to the set of skills related to oil and gas production. The Production Assistant is responsible for all duties associated with gathering, tabulating and performing data entry of the Company's oil and gas **daily operations. This includes daily production and pressure information, drilling, completion and remedial well work reports** and any additional required information for all activities in the assigned region.

The key job responsibilities of a production assistant are:

- Performing well visit/ site visits/plant visit (observing all static and rotary equipment)
- Collecting the data during well visit/ site visits/plant visit (Note down the data from instrument display) and reporting timely to the Officer In- charge
- Assisting to the technical staff with special projects and research
- Locating, retrieving, exchanging information, and coding well field and log data
- Assisting in preparation of computer generated reports and corresponding as required
- Helping to maintain and monitoring data and providing assistance with routine application

Figure 1.2.1: Sucker Rod Pump(SRP)

Other than these, a production assistant must be –

- Well acquainted with the production equipment, machines and Instruments as per their function in operation.
- Able to operate the equipment, machines as per their SOPs and operational requirement.
- Obey the instructions of control room.
- Follow the safety rules.
- Doing the particular job sure shot with cool mind.
- Reported Immediately to the In-charge, whatever abnormality observed
- in entire production process system

In the upcoming chapters, we will discuss the job responsibilities, machines, and their functions, essential technical skills to excel as a competent worker.

The soft skills refer to the physical and mental attributes to cope with the production assistant job profile. The job role of a production assistant calls for physical dexterity. The conditions may not be soothing all the time, and therefore, a production assistant must adapt to the circumstances even if it is hostile. Working in an oil mine associates the risk factors as well. Oil is highly combustible and therefore, the risk of fire is something that always prevails in an oil mining area. A worker must possess the basic knowledge of firefighting. Above all, like any other job profile, it requires patience. In the case of oil and gas production, one should always be patient and not to rush. Oil excavation is a delicate job and thus, one must keep his cool and be composed while working at an oil mine.

Reporting any incident or deciphering any information to the supervisor is also a significant job responsibility of a production assistant. An employee should know the process and protocol of reporting something. Even at the time of reporting, an employee is expected to maintain proper decorum. These all are parts of the essential soft skills of a worker. It is useless if a worker has great technical abilities if he is devoid of the proper manner and soft skill.

Oil production is a hard working job and thus, the workers should be prepared to maintain good health. Here is a bunch of tips to be physically fit in adverse circumstances.

- Drink about 250 ml or 1 cup of water every 15 minutes while working
- Ensure that you are properly hydrated before you start working in the heat
- A person loses water and salt from the body through sweat
- On an average, more than one liter of water per hour must be drunk to replace lost water and salt
- Ensure that you drink water from time to time even if you are not thirsty
- If you are properly hydrated, you will urinate more often than usual
- Ensure that there is enough cool (10-15°C) or room temperature (20°C) drinking water available at the work site

Summary

- Owing to the rising demand for Energy and Energy Supplies, the Indian Government envisaged a new policy in 19997-98, the New Exploration Licensing Policy (NELP)
- In case of several segments of the Hydrocarbon sector, the Indian Government has allowed 100 percent Foreign Direct Investment (FDI) including natural gas, petroleum products
- India is the third-largest oil-consuming country in the world
- In 2016, the growth of oil consumption was 8.3 percent, whereas, the global rate of growth of the oil-consumption was 1.5 percent
- Upstream Phase refers to the exploration, excavation, and production of oil
- Mid-stream Phase deals with the unrefined oil came directly from the upstream sector. The key responsibility of the Mid-stream phase is to refine the oil and prepare it for selling
- Downstream Phase is the final phase where the refined oil from the Mid-stream sector is marketed at the current retail price
- The Production Assistant is responsible for all duties associated with gathering, tabulating and performing data entry of the Company's oil and gas daily operations

Notes

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2. Perform Production Activities (On Shore and Off Shore)

Unit 2.1: Basic Oil & Gas Production Process and Operations

Unit 2.2 Basic Measuring and Marking-out Instruments: Outline typical maintenance requirements of measurement systems and equipment

Unit 2.3 Basic Production Techniques

Unit 2.4: Basic Maintenance Techniques and Practices

Unit 2.5: Oil & Gas Production Processes (Onsite Training)

Unit 2.6: Health and Safety in Production and Maintenance

Unit 2.7: Basic Engineering Communications

Unit 2.8: Basic Numerical Skills

Unit 2.9: Physical Science and Basic Properties of Materials

HYC/N0104

Key Learning Outcomes 

After attending the session, you will be able to:

1. Analyze Oil and Gas production process and operations
2. Categorize measuring and marking-out and control systems' instruments
3. Ensure 100% adaptation of production techniques
4. Prioritize the Jobs according to saving the losses and safety severity as per situation and condition may be
5. Review the Oil and Gas production processes
6. Emphasize the health and safety in production and maintenance
7. Quantify the engineering communications
8. Evaluate the numerical data
9. Revise Physical Science and basic properties of materials

Unit 2.1 Basic Oil & Gas Production Process and Operations

Unit Objectives

At the end of this unit, you will be able to:

- Analyze oil and gas production and processing method
- Interpret the operations and maintaining processes

Understand Production Process in Oil & Gas field operation

The production of oil is a subtle work and should be calculated multiple times before excavating. The entire process has four major steps:

1. Exploration
2. Well Development
3. Production
4. Abandonment

Name of the Phase	Image
Exploration: Explore literally stands for the quest, in simpler terms, search. In this phase, the rock-formations and geophysical prospects of the possible sites for oil production are examined. It is absurd to excavate every possible site. Therefore, proper scrutiny is carried out before excavation to understand the prospect of production and its economic viability.	
Well Development: After successful exploration, a site (which is confirmed) is excavated. This refers to the construction of wells, often termed as spud, to mine oil and gas. At the time of construction, the economic viability, amount of resources and plausible abandonment strategies are taken into the account.	
Production: Oil is extracted from the wells in this phase. At first, the extracted oil contains impurities. The crude oil is a mixture of oil, gas, water, minerals and other impurities. The production phase takes care of the excavation of the crude oil and segregating the hydrocarbon in two major classes – oil and gas.	
Abandonment: When a well runs out of enough resource or becomes economically less viable, the well is plugged and the site is restored to its previous form. This is known as abandonment. This is the final stage of the entire oil production process.	

A. Oil and Gas Processing Operations: Identify the key features of oil and gas well

Oil and gas wells produce crude oil, which is a mixture of various materials. Generally, the mixture contains –

- Hydrocarbon Gas
- Condensate or Oil
- Water with Dissolved Mineral
- A large amount of Salt
- Other Gases such as Nitrogen, Carbon dioxide, Hydrogen sulphide etc.
- Reservoir Dirt
- Sand
- Corrosion Wastes

The purpose of oil and gas processing is to separate, remove, or transform these various components to make the hydrocarbons ready for sale.

For the hydrocarbons (gas or liquid) to be sold, they must be:

- Separated from the water and solids
- Measured
- Sold
- Transported by pipeline, truck, rail, or ocean tanker to the user

Figure 2.1.1: Crude Oil

To obtain excellence, the oil and gas processing is segregated in various wings. The segments are:

1. Well Surveillance
2. Monitoring and Maintenance
3. Wireline Operation

Well Surveillance: Oil well surveillance is a practice that reduces the possibility of any accidental calamities. Previously, the wells used to be supervised on a calendar-date basis. For example, the wells used to be invigilated in a periodic manner (assume, every Monday). However, the method was not capable enough to avoid accidents or an emergency crisis. The new practice of well surveillance, with the help of modern equipment like CCTV, Sensor, Smoke Detector, Oil Detector, and Combustible Scale allows the supervisors to invigilate a well on a 24 by 7 basis.

Figure 2.1.2: Flow of Surveillance

There are handful gadgets available in the market which aid the oil industry to monitor wells on a 24 by 7 basis. The stages of well surveillance are monitoring, reviewing and taking proper actions. The first and foremost parameter in the well surveillance is to ensure the safety of the worker and the environment. In case any anomaly is observed, a quick action must be taken to prevent it.

To maintain the sustainability of Production from the well, well testing, daily monitoring and maintenance and pipe line maintenance is required.

Regular Monitoring is Key to identify the requirement of well maintenance & services. In case of On-shore, each and every well should be daily checked physically in order to ensure whether the well is following and production is going on.

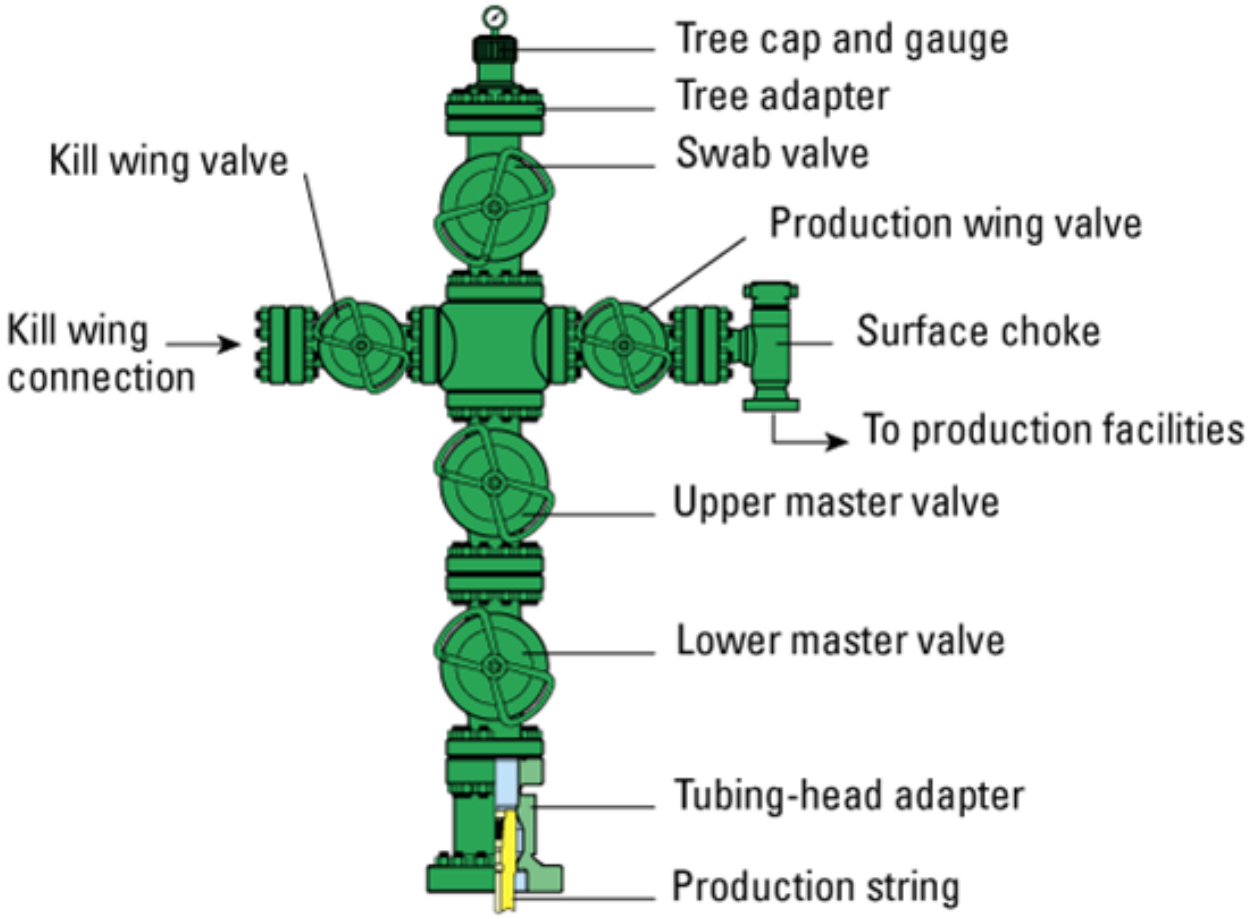


Fig 2.1.3: A view of horizontal christmas tree

Monitoring and Maintenance: A constant monitoring allows the oil industries to get real-time updates of the well. Oil wells need to be monitored to measure and prevent –

- Suboptimal water injection rates
- High water-cut producers
- Artificial lift equipment faults
- Scale build-up

Surveillance instrument installation is a way to avoid such things. The instruments are planted on the path of the fluid-flow. This allows capturing real-time data. The data stream informs a predictive model for:

- Solids deposition
- Corrosion
- Rheology
- Thermodynamics

Another vital task in this phase is to monitor and maintain the well-condition. This is done by well-mode calculation. Well mode calculations determine the operational mode of a well and an estimated real-time well flow rate. The calculation is based on the amount of pressure variation during a specific time period.

- If the production wing valve is open, the well mode is either “stable” or “unstable”
- A stable well is within a particular variability threshold based on the previous behavior of that well
- An unstable well shows more variability than allowed
- If the well choke is closed, the mode is termed “shut-in”

Well performance, also known as Key Performance Indicator (KPI) measures and estimated the amount of hydrocarbon production from a well in real-time. There is an optimum value or a predetermined level which indicates a well to be stable.

- KPI is below the predetermined level – investigate well for production loss
- KPI significantly above predetermined level – you may have an invalid well model, substantial changes in production conditions, or an expected change in water cut

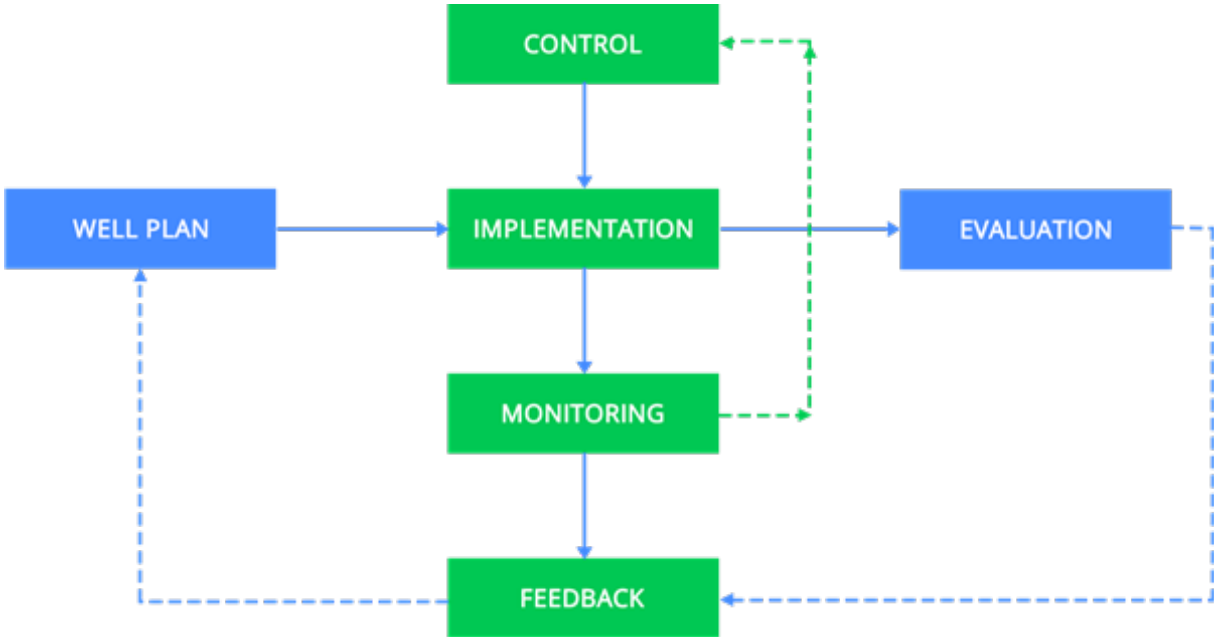


Figure 2.1.4: Plan monitoring and evaluating system

Wireline Operation: In oil and gas industry, wireline operations refer to the cabling technology. Wireline operators need to deal with various equipment to lower the measuring instruments into the oil reservoir or well. Wireline is an equipment, also known as slickline, is used to single strand wire which is used to run tools into the wellbore for several purposes.

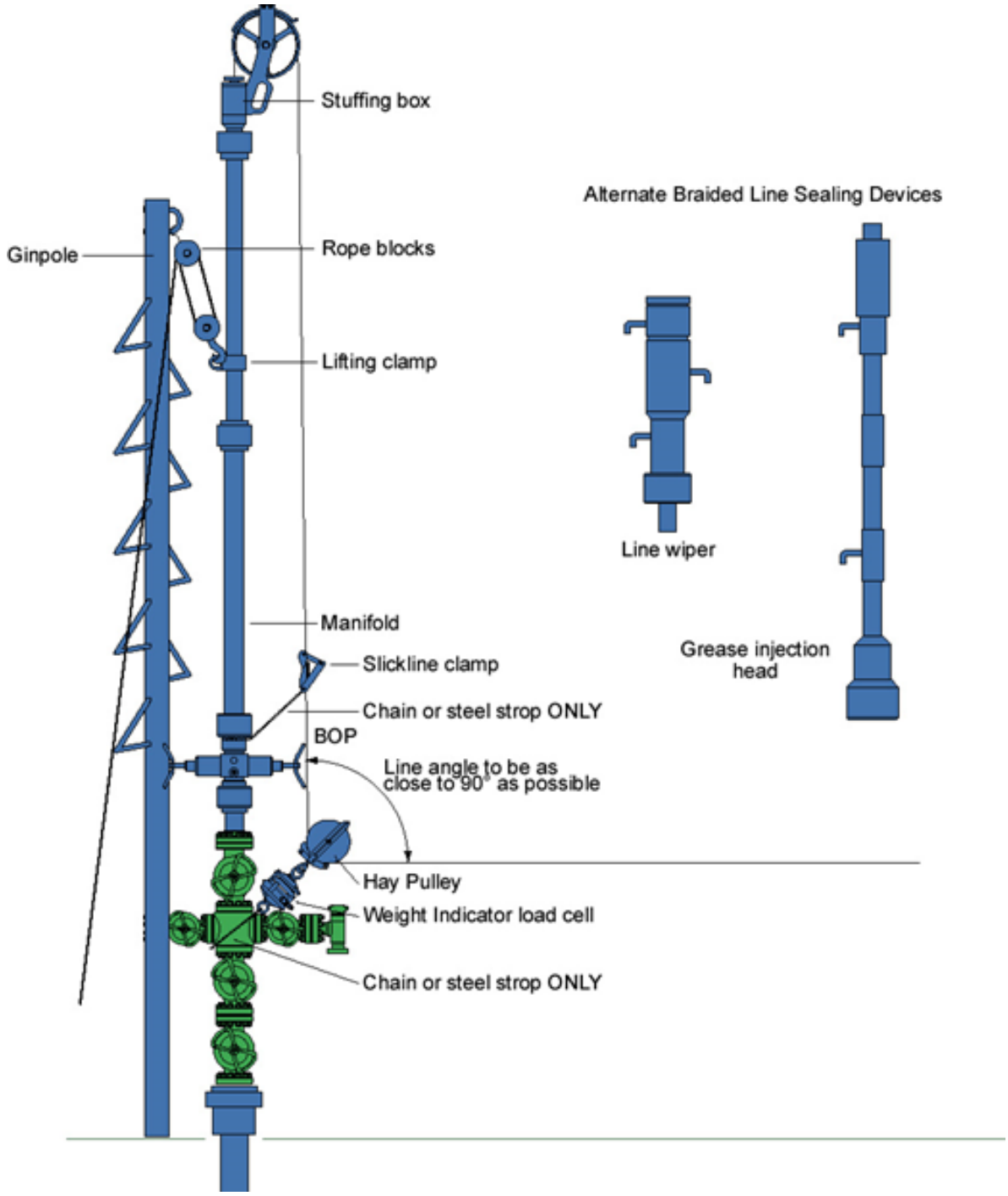


Figure 2.1.5: Wireline or Slickline

Wireline is more commonly used in the production tubing. The wireline operator monitors at surface the slickline tension via a weight indicator gauge and the depth via a depth counter 'zeroed' from surface, lowers the downhole tool to the proper depth, completes the job by manipulating the downhole tool mechanically, checks to make sure it worked if possible, and pulls the tool back out by winding the wireline back onto the drum it was spooled from. The wireline drum is controlled by a hydraulic pump, which in turn is controlled by the wireline operator'.

This is a significant process as this determines the depth, temperature, pressure along with many other parameters inside a well. A wireline operator's duty is not only limited to measuring and monitoring the well but also expanded to the documentation of the observations.

B. Oil & Gas Production Processes

Identify tools, equipment and material that would be required for a range of basic routine for Off Shore Oil and Gas Production tasks and Prepare the tools, equipment and materials for given Production tasks

The generated well fluid is usually a mixture of oil, water, salt and natural gas. Separation of gas and liquid is the first processing step. The separated liquid is further subjected to refinery. The water removed from oil known as effluent water is treated to meet the environmental system disposal requirements and is then disposed of. The gas separated from oil is further treated for dehydration, liquid recovery / LPG production and finally sent to consumers.

Field processing of crude oil involve three objectives:

- **Separation** of crude oil from free and emulsified water or brine and entrained solids (mainly sand)
- **Stabilization** of crude oil (removal of free or dissolved gases to the extent that it is safe for transportation)
- **Removal** of impurities from the crude oil and any separated gases to meet the sales/ transport/reinjection specifications requirement

Separation

The separation of well fluids into gas and liquid components is the first step in the processing of well fluids and it is carried out in the pressure vessel called separator.

A separator can be referred in the following ways

1. Oil and gas separator
2. Stage separator
3. Trap
4. Knock out vessel/ knock out drum
5. Flash chamber/vessel
6. Scrubber

The physical separation of gas and liquids is based on three principles:

Name of the Principle	Features
Momentum Change	• Fluid phases with different densities will have different momentum • If two Phase stream changes direction sharply, greater momentum will not allow the particles of the heavier phase to turn as rapidly as the lighter fluid, so the separation occurs
Gravity Settling	• Liquid droplets will settle out of gas phase • If the gravitational force acting in the droplet is greater than the force of the gas flowing around the droplet.
Coalescing	• Very small droplets such as fog or mist cannot be separated by gravity • These droplets can coalesce to form larger sized drops that will settle by gravity

Sections of the Separator:

Primary Separator section:

The primary separator section is used to segregate the bulk portion of the free liquid in the inlet stream. The inlet component allows the bulk separator is the diverter. These devices take advantage of the inertial effects of the centrifugal force or a sudden change in the momentum or direction. Usually inlet baffles are used for the purpose.

Secondary section or gravity separation:

The secondary section or the gravity separation is formulated to utilize the force of gravity to increase separation of the entrained droplets. It contains a segment of the vessel where the gas moves at a relatively low velocity with little turbulence.

Coalescing section:

The coalescing section utilizes a coalescer or mist extractor, which comprises a knitted mesh pad, or a series of vanes. Very small droplets cannot be separated by gravity alone. In this section they are made to impinge on the surface where they coalesce to form the larger droplets, which settle, by gravity.

Classification of Separators

- **Vertical separators**

  - Vertical separators are usually used when the gas to liquid ratio is low or the total gas volume is low
  - In the vertical separator the fluid enters the vessel striking the baffle plate, which initiates the primary separation
  - Liquid removed by the inlet falls to the bottom of the vessel
  - The gas moves upward usually passing through the mist extractor to remove the suspended and then the dry gas flows out
  - Liquid removed by the mist extractor is coalesced into larger droplets which fall through the gas to the liquid section at the bottom of the vessel
  - The liquid collected is removed through a level control valve

- **Horizontal separator**

  - Horizontal separator is used where the large volumes of fluids and large quantities of gas are present with the liquid
  - The greater liquid surface area in the separator provides optimum conditions for the releasing entrapped gas
  - The liquid, which has been separated from the gas, moves along the bottom of the separator to the liquid outlet

- **Spherical separators**

  - This is used where extremely large volumes of gas from extremely small volumes of liquid
  - It is mainly used as scrubber and seldom used at well site as an oil and gas separator
  - These are occasionally used as high-pressure separator.

Dehydration and Desalting Of Oil:

The presence of water in the crude oil presents the single largest problem to the producers. Difficulties experienced due to the water are:

- Marketability of the oil is adversely affected
- Corrosion problems are enhanced
- Production costs are increased.
- Frequently results in reduced net oil production
- Higher pressure drop in the pipeline

Condition of water in Petroleum

Water may be carried mechanically with the oil in either or both of the two forms -

Free water: The microscopic droplets remaining in suspension due to viscosity of oil and • severe agitation which settles out when left undisturbed.

Emulsified water: In this the water is in the site of emulsion in which the droplets of microscopic size are more or less in permanent suspension.

This water does not separate when left standstill. The petroleum emulsion contains the electrified charge. As the charge increase the stability increases and the reluctance of the globules from coalescing may be due to these phenomena.

Dehydration of crude oil: Dehydration of crude can be categorized as:

- Removal of free water
- Removal of emulsified oil

Removal of free water

Free water can be separated from liquid hydrocarbons by giving sufficient settling time and absence of turbulence without the aid of heat.

This can be achieved by:

- Free water knock out
- Three phase separator

Emulsified water

There are three different methods of treating the emulsion which are widely used in the industry

- Mechanical
  This can be further divided into:
  - Gravity settling
  - Thermal treating
  - Centrifuge method Filtration method
- Electrical method
- Chemical method

Storage Tanks

Once the incoming fluid has been segregated into oil, water and gas, these must be either stored or transported. Gas is normally not stored as it is expensive to store it. Oil and water are stored in tanks for limited time. Welded steel tanks are used widely for the storage of crude oil. Various sizes of tanks are used depending on the requirements of storage. The most common oil storage tank is the vertical upright cylindrical tank made of steel sheet.

Metering of Oil and Gas

The measurement of crude oil is normally carried out by using any of the following meters

1. Positive displacement meter
2. Turbine meter
3. Orifice meter
4. Ultrasonic meters
5. Mass flow meters

Positive Displacement (PD) Meter:

- As the name suggest the PD meters are unique because they mechanically isolate and pass a known volume of liquid with every revolution
- The trapped volume is defined by sliding vanes, oval gears, reciprocating pistons etc. One type of sliding vane meter is the Lease Automatic Custody Transfer(LACT) unit which is the traditional standard for measuring crude oil
- In this meter the measuring element measures the volumetric flow by separating the flow into segments or measuring chambers of known volume and counting the segments

Turbine Meters:

- Turbine meters operate under the principle that a free running rotor (coaxially mounted on the pipe centreline) with an angular speed proportional to the actuating fluid velocity
- Inline turbine meters are the standard method for custody transfer of high volume , low viscosity crude
- Other uses include natural gas measurement and water

Orifice Meter

- An orifice meter consists of an orifice plate (thin plate having a circular hole located centrally) installed in the circular pipe with the pressure taps, upstream and downstream
- The pressure difference measured by the pressure taps is used to calculate the flow rate ‘of the fluid

Waste Water Treatment

- Proper disposal of wastewater is very important
- In order to prevent the contamination of surface and ground water, the wastewater is not permitted to be discharged without proper treatment
- The treatment consists of reducing the oil and sediments content within the permissible limits
- Effluent treatment plants are installed to meet the effluent water disposal requirements

Precautions during Pumping and Compressor Stations

- No repairs shall be undertaken in respect of any gas compressor and pipelines and fittings connected to it unless the control valves on the inlet and discharge lines are closed and securely locked.
- Every flywheel and every other dangerous exposed part of any machinery used as or while the parts of the machinery are in motion or in use but they may be removed for forming part of the equipment shall be adequately fenced by suitable guards of substantial construction to prevent danger and such guards shall be kept in position carrying out any examination, adjustment or repairs if adequate precautions are taken.

- Crew to examine I inspect/ observe the running compressor or pump should use ear muff/ear plug. Noise level at the machine should be written at the machines.
- No repairs, lubrication or pressing shall be done unless the pumping /compressing unit is stopped.
- All surface control valves for compressed gas distribution for gas lift, intermittent gas lift or free plunger lift, customer etc. all shall be clearly marked for ready identification
- Every engine, motor, compressor, turbine and pump room hall be kept clean and provided with at least two exits. Every such exit shall be clearly marked, properly maintained and kept free from obstruction.
- Adequate general lighting arrangements shall be provided during working hours at the allowing places -
  - every engine and pump house;
  - every place where persons are to work;
  - every means of escape, access or egress;
- No person shall be allowed to shift or adjust a driving belt, chain or rope while the machinery is in motion unless a proper mechanical appliance is provided for the purpose
- No person in close proximity to moving machinery shall wear or be permitted to wear loose outer clothing. Wearing neck chain, wrist watch, wrist chain, finger rings etc. while at running machines are strictly prohibited.
- No unauthorised person shall be permitted to enter in any engine room, including gas turbine, compressor, or other machine area, or in any way interfere with the machinery .
- No machinery shall be operated otherwise than by or under the constant supervision of a competent person.
- Every person in charge of pumping & compressing stations shall before commencing work shall see that it is in proper working order and if he observes any defect therein, he shall immediately report the fact to the installation manager or other competent person.
- Standard Operating Procedures of the engines, pumps, compressors should be conspicuously displayed in all languages convenient to the operating crew
- Prohibitory signs and instructions like “no use of mobile”, “no naked fire”, “use of proper PPE like safety shoe, helmet, goggles, ear muff/plug” etc. should be displayed at the pumping I compressing stations
- Constant monitoring of hydrocarbon concentration at the pump or in the vicinity should be carried out. Automatic gas detection is must at the gas compressing station.
- A competent person or persons appointed for the purpose shall, once at least in every seven days, make a thorough inspection of all machinery and plant in use, and shall record the result thereof in a bound paged book kept for the purpose. In respect of electrical machinery and plant, the competent person shall be a person holding qualifications specified in the Central Electricity Authority (Measures relating to Safety & Electric Supply) Regulations, 2010.

Heater Treater

De-emulsification of emulsion oil to the required characteristics of oil and water by chemical, thermal and electrical means.

Heater treater is a pressure vessel consisting of the following four sections:

1. Inlet degassing section
2. Heating section
3. Differential oil control system
4. Coalescing section

1. **Inlet degassing section**

   Function

   - Emulsion oil from separator is first mixed with de-emulsifier and then taken into Heater Treater.
   - Emulsion oil first enters Inlet Degassing Section
   - A fire tube is fitted in the heater treater encompassing degassing section and heating section
   - Due to the effect of heat, the free gas in emulsion oil is liberated and then enters into the heating chamber through the equalizer
   - The fluids enter into the heating chamber through multiple orifice distributors

2. **Heating section**

   Function

   - The fire tubes which extend up to this section are in a submerged condition in emulsion oil
   - The heating of emulsion oil decreases the viscosity of oil and water and reduced the resistance of droplet movement
   - The heat further reduces the surface tension of individual droplets by which they collide form bigger droplets
   - This progressive action results in separation oil and free water to a greater extent and water settles down in the heating chamber

3. **Differential oil control system**

   Function

   - The fluids from the heating chamber enter into this chamber through fixed water
   - It does not allow the gas to pass into electrical chamber which is hazardous.
   - The gas which enters heating chamber through equalizer leaves the heater treater from the top of this chamber through a mist extractor contained in a centrifugal scrubber
   - From scrubber the gas releases into a gas line through a back pressure control valve, which maintains the pressure of the valve
   - The oil level in the chamber is controlled by the oil level controller which operates through a float

4. **Coalescing section**

   Function

   - Oil enters this chamber through a distribution tube
   - Constant level of water is maintained in this section so that oil is washed and free water droplets are eliminated before the fluids proceed towards electrode plates
   - These plates are connected with high voltage supply of 10,000-25,000 volts
   - When fluids pass between these electrode plates, the droplets are polarized and attract each other
   - This attraction causes the droplets combine; they become larger enough to settle into oil and water layers by the action gravity
   - The interface level controller which senses oil water interface level and actuates the control valve for draining free water

Utility System Description

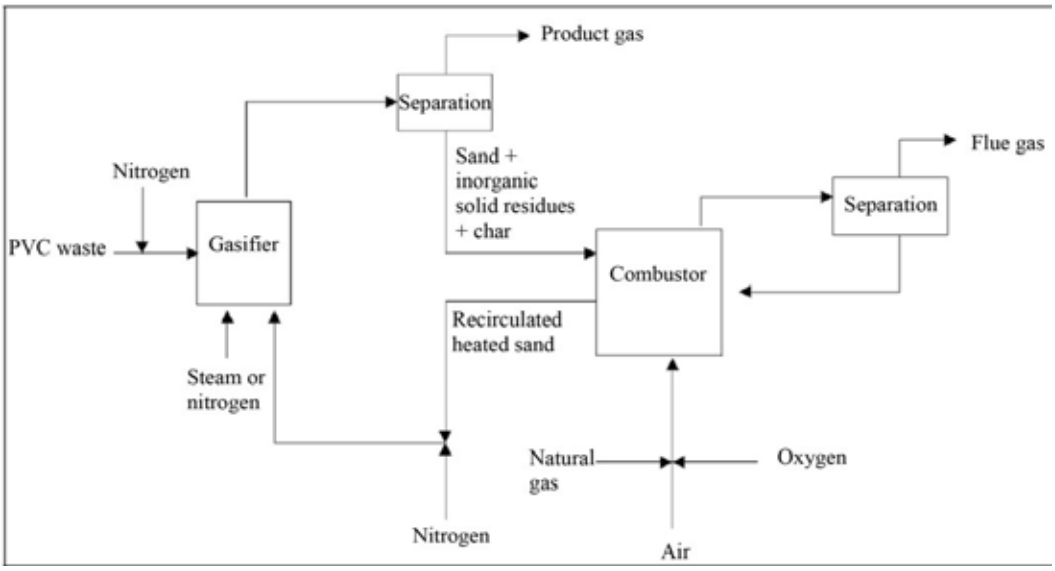


Fig 2.1.6: Process Block Diagram

The utility system of GGS consists of the following components:

Fire Water System: Generally A reservoir Tank having a capacity of 400 m3 is provided for storing of fire water. There is one diesel engine driven fire water pump of 170m3/hr capacity at 10.0 Kg/cm2 discharge pressure and one motor driven pump of same capacity and pressure. Fire water is supplied to the system through a 6" cp ring to which discharge of all the above pumps are connected. Jocky pump is also provided to keep the fire network pressurized.

Drinking water system: An overhead tank is provided to cater the drinking water requirement. RO -is provided for hygienic drinking water.

Power Supply System

Normal Power

- The normal power to the plant is supplied from 11KV grid of the State Electricity Board
- The overall normal power requirement envisaged has been of the order of 100 KVA.

Emergency Power

- Emergency power to the plant is maintained by a Diesel Generator set
- In case of normal power failure, the DG set shall be manually started to provide power supply to essential services
- However, it shall not be possible to run all the equipment at the same time because of limitations of the generator capacity
- Depending on the situation, the operator will select the equipment to be operated
- The normal sequence of starting the system with power supply from the DG set may be lighting, dispatch pump etc.

Two numbers of 12 volt batteries are provided for starting the DG set. A trickle and booster charger is provided is provided to maintain the batteries fully charged, even when the DG set is not running. As there is no uninterrupted power supply system, there will be total shut down of the plant in case of power failure. Emergency light is available at the plant to provide lighting till DG set is started in case of power failure during night.

Recording well head pressures

After Bean Pressure (ABP)

- Fit the pressure gauge carefully on the needle valve provided on the flowline
- Open the needle valve ensuring no leakage and record the ABP.
- Close the needle valve and remove the pressure gauge gradually so that trapped fluid pressure is bled off slowly.

Tubing Head Pressure (THP)

- Fit the pressure gauge on needle valve provided on bull plug of bean housing /cross or tee of 'X' mass tree .
- Open the needle valve ensuring no leakage and record THP.
- Close the needle valve and remove the pressure gauge gradually so that trapped fluid pressure is bled off slowly.

Casing Head Pressure (CHP)

- Fit the pressure gauge on needle valve provided on annulus valve.
- Open the annulus valve
- Open the needle valve and record the pressure.
- Close the annulus valve.
- Close the needle valve and remove the pressure ga•uge gradually so that trapped pressure is bled off slowly.

Checking of changing the bean

- Close the flow arm valve of X- mass tree
- Close the line valve

Release the pressure through needle valve

- Open the bean/housing cap carefully
- Remove the bean from housing
- Check the bean for paraffin deposition/sand cutting/gas cutting, clean if necessary, replace the bean and close the housing cap tightly
- Close the needle valve

Working Guidelines for Installation

- Check the instruction register and enquire from the relieving shift about any abnormality, if not mentioned in instruction register.
- Check all the belonging of installation including tools for maintenance safety torch, first aid box and key bunch etc.
- Check the dip of all the oil storage tanks. Ensure tank level should not be more than 213rd of its capacity.
- Record pressure, temperature and flow rate at regular interval wherever required.
- Check level transmitter and controller, temperature controller and pressure controller wherever fitted. If any abnormality observed, which cannot be rectified by the shift personnel, write in the complaint register and inform the instrument party.
- Check proper functioning of flow recorders.
- Check tubes oil in pumps. In case of any abnormality inform the mechanical maintenance party for rectification.
- Check Gen.-Set (Diesel) i.e. Diesel in tank/batteries cable connections/oil level in crank case/start-up/shut off etc. In case of any abnormality inform the mechanical maintenance party.
- Check well position in header as per instruction register/DPR.

Guidelines for testing of well in GGS

- Take the dip of the tank before diverting the well in test header.
- Set the pressure (through controller fitted on gas outlet line) of test separator as per the need.
- Divert the well into the test header by first closing the group's header valve of the well and then open the valve in the test header. If the high pressure testing is carried out in low pressure test separator open the valve of test header slowly so that line pressure of well is stabilized.
- Take the tank dip hourly.
- Difference of final and initial dip will give the rate of production of the well.
- For the measurement of gas, fit proper size orifice plate between the orifice flanges so that differential reading in the recorder should be in the range 40% to 80%.
- The ratio of total gas to total liquid will give the value of GLR and the ratio of total gas to total oil will give the value of GOR
- Before starting the engine of the tanker ensure gas concentration around the area is below the lower explosive limits

Compressor: A Compressor is a machine that increases the pressure on the naturals gas and oil while it travels through the pipeline to the refineries. Refining industry or the mid-stream industry is an offshore industry. The common practice of the upstream industry is to send the oil (crude oil) to the refining industry. The crude oil, after excavation, is sent to the refineries through metal pipelines. The compressor increases the pressure inside the pipeline to push the crude oil from the spot of production to the refineries. It acts more like a pump.

In the oil and natural gas sector, the most prevalent types of compressors used are reciprocating and centrifugal compressors.

- **Reciprocating Compressor:** Reciprocating compressor is also known as Piston Compressor because of its traditional piston-push functional structure. In the reciprocating compressor, there is a piston, which is driven by a crankshaft to deliver gases with high pressure.

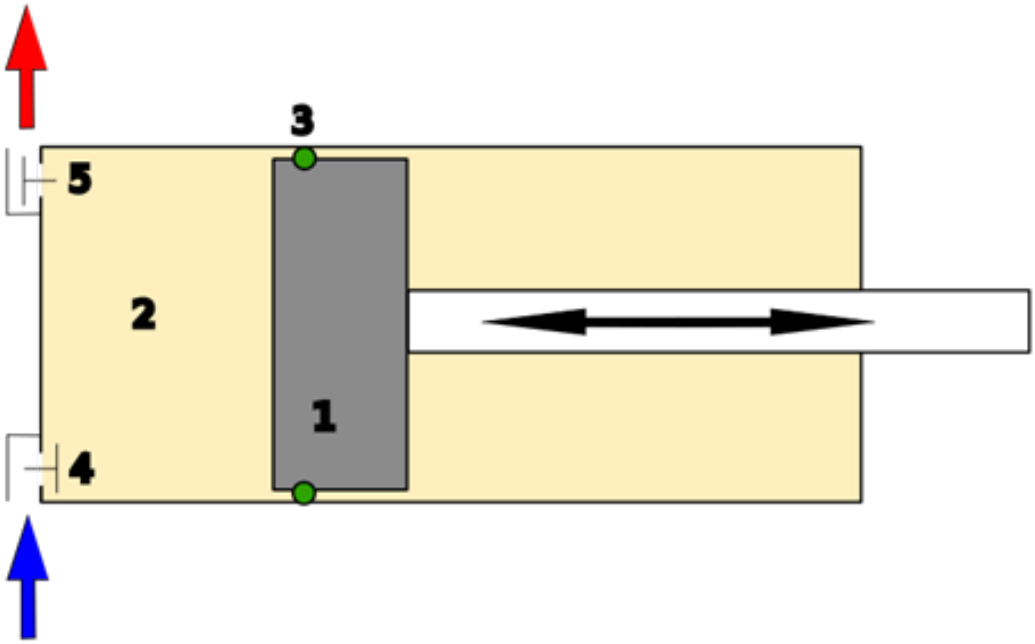


Figure 2.1.7: Reciprocating Compressor Function Layout

The reciprocating compressor allows the gas to enter through the manifold and goes into the cylinder. Once the gas gets into the cylinder, the piston is driven to produce ample amount of pressure. The pressure generated by the piston helps the gas to reach the pipeline (running to the refineries or any other destination). The gas inside the cylinder needs extra pressure to get delivered through the pipeline and the piston creates the pressure by compression. Thus, the compressor is called a piston compressor.

Reciprocal compressors are used in gas, oil, chemical or plastic industries where compression plays a major role in the production. In the case of oil and gas sector, the reciprocal compressor is used to deliver crude oil or gas to the destinations.

Figure 2.1.8: A six-cylinder Reciprocating Compressor

- **Centrifugal Compressor:** Centrifugal compressor, also termed as Radial Compressor, is a type of compressor that works on the theory of conversion of energy.

The compressor allows the fluid (or gas) inside its impeller which at first gains kinetic energy due to rotation of the compressor. The rigorous rotation converts the kinetic energy of the fluid in static pressure. The pressure within the impeller compresses the material inside it. There is a perforation situated at the front (beyond the turbine) which acts as an outlet. Due to high pressure inside the impeller, the fluid (or gas) gets out of the outlet and runs through the pipeline. We will discuss the parts and functions of a centrifugal compressor below.

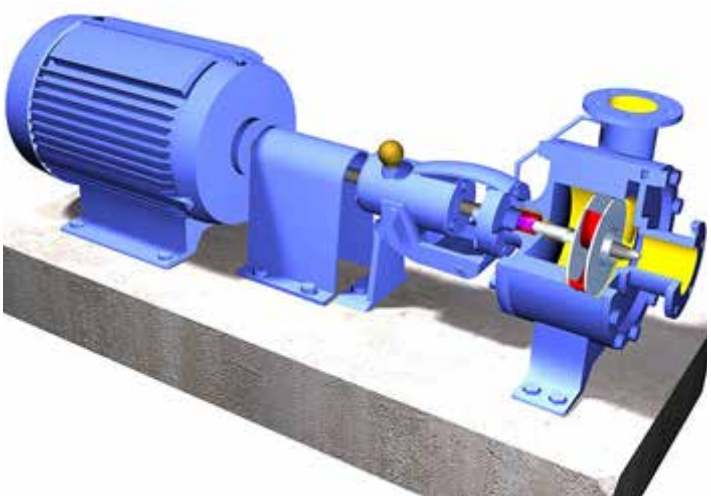


Figure 2.1.9: Centrifugal Compressor 3D Model

Parts of a Centrifugal Compressor

- **Inlet:** the inlet of a centrifugal compressor is a normal pipe along with several joineries like a valve, stationary vanes or airfoils. These joinery features help to regulate pressure and temperature inside the inlet and allow the fluid (or gas) to swirl inside the pump or centrifugal impeller.
- **Centrifugal Impeller:** Centrifugal impeller is the main functioning body of the compressor. The impeller rotates and gradually increases the Rotation per Minute (RPM). As a result of the increase in the speed, the kinetic energy of the fluid or gas inside the impeller increases. The rise in kinetic energy is the key feature of the impeller which allows the fluid or the gas inside it to get released with a much higher velocity. In some modern compressors, the fluid or the gas gets delivered at a speed of sound through the outlet.

Figure 2.1.10: Centrifugal Impeller

- **Diffuser:** The next component of the centrifugal compressor is a diffuser. The diffuser is attached to the impeller and after the fluid (or gas) getting triggered from the impeller, travels through the diffuser. The diffuser slows down the speed of the exerted material. The decrease in the speed of the fluid creates pressure inside the diffuser. In the diffuser, the kinetic velocity of the fluid gets converted to high pressure by slowing down the speed of the exerted material. The high pressure inside the diffuser allows the fluid or gas inside it to travel through the pipelines, from the compressor to the destination.

Figure 2.1.11: Diffuser

- **Collector:** Collector is the last component of the centrifugal compressor. The shape and size of the collector vary depending on the amount of discharge it receives from the diffuser. Normally, the collectors are snail-shaped or take a shape of the French horns. The collectors may or may not have any valves attached to its body. The key function of the collector is to receive the discharge of fluid (or gas) from the diffuser.

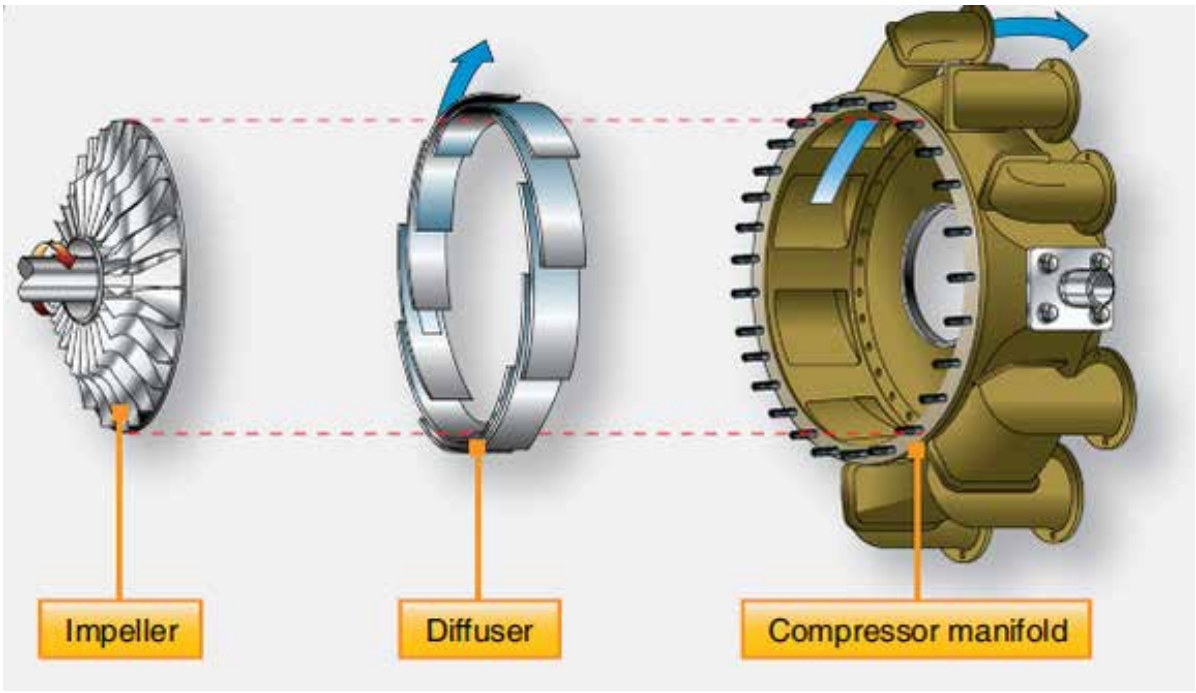


Figure 2.1.12: Components of Centrifugal Compressor

Static and Mobile Boiler

The boiler is a closed vessel which converts the water inside it to steam by the application of high magnitude of temperature. The initial temperature is gained by the combustion of the fuel (oil or gas). Due to the combustion of the fuel, the high temperature is generated. The temperature passes from the boiler to the substance inside it (temperature tends to flow from one body to another when they are kept in contact). The substance inside the boiler gets boiled quickly as the boiler is a closed vessel and capable of producing excess pressure when the temperature rises.

The boiler is a closed pressure vessel and inside this vessel, any liquid or water heated by another heat source and convert this liquid and water to steam. Now generated steam when used for another purpose which is outside from the main vessel then it will call a boiler. Primary generated steam can contain humidity level from 0.5% to 5%. Then a super heater and re-heater use to heat primary steam to make full steam that can use in power plant operation.

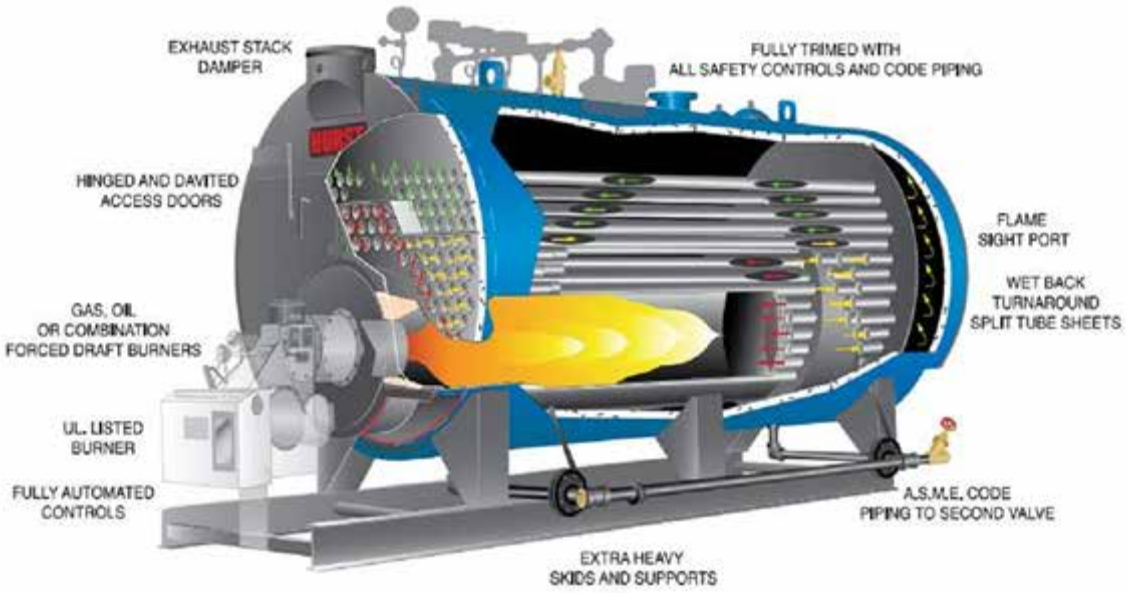


Figure 2.1.13: Boiler

In chemical, oil or in a broad sense, hydrocarbon sector, boiler acts as the source of energy. Boilers keep the entire system up and running by producing a sufficient amount of pressure. There are mainly two types of boilers used:

1. Water-Tube Boiler
2. Fire-Tube Boiler

Water-tube boiler uses hot water as the source of heat, which in turn produces energy. In this case, hot water passes through the tubes producing heat (steam) which helps the system to run smoothly.

Fire-tube boiler uses hot gases to produce energy. Hot gases pass through the tubes which through thermal conduction, heats the surrounding water. The water then turns to hot steam which keeps the system running.

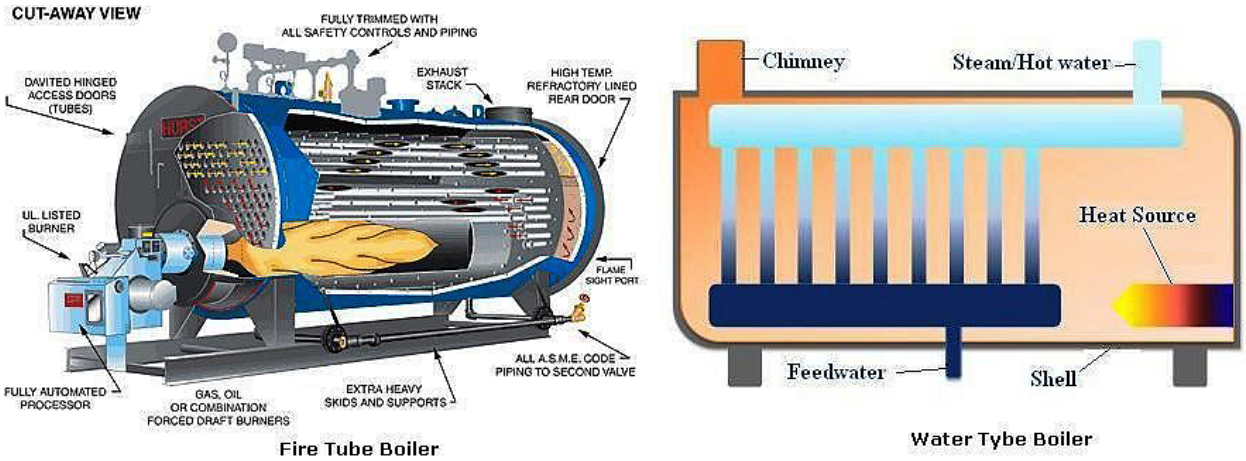


Figure 2.1.14: Fire-tube boiler and Water-tube boiler

Major Components of Boilers

1. Feedwater Heaters

Function

- Feedwater heaters are energy recovery devices generally found only in the large steam generating plants where all of the steam generated is not reduced to condensate by the steam user
- This “waste steam” is reduced to condensate for a return to the boiler in the feedwater heater
- The boiler feedwater is used as a cooling medium to reduce the steam to condensate, which increases the temperature of the feedwater and, thereby, increases the thermal efficiency of the boiler

2. Fuel Heater

Function

- Many boilers firing heavy fuel oil require fuel heaters to reduce the fuel viscosity, so the fuel can be atomized by the burner system for complete combustion

3. Deaerators

Function

- A deaerator is a special case of feedwater heater that is designed to promote the removal of non-condensable gases from the boiler feedwater
- The principal gases of concern are oxygen, carbon dioxide, and ammonia, which are major contributors to boilers, and steam and condensate piping corrosion problems
- In small steam plants, a portion of the steam generated by the boiler is used to operate the deaerator if “waste steam” is not available
- Failure to maintain and properly operate the deaerator can lead to early failure of the boiler, steam using equipment, and the steam and condensate piping

4. Pumps

Function

- In most hot water systems, the system circulating pumps are electric motor-driven, end suction centrifugal pumps. In steam systems, the condensate return pumps are typically electric motor-driven, end suction, centrifugal or turbine-type pumps
- Feedwater pumps are generally electric motor-driven, multiple-stage, end suction centrifugal pumps
- The shutoff head of the pump must be greater than the steam or hot water system operating pressure

5. Combustion Air Blowers

Function

- In many packaged boiler installations, the combustion air fan is designed and provided by the boiler manufacturer and is integral with the boiler housing
- In installations where a stand-alone fan is provided, low-pressure centrifugal blowers are commonly used
- An important characteristic of the blower is the ability to maintain a relatively constant air pressure over a wide range of airflows

6. Economizer

Function

- An economizer is an energy recovery device that uses the hot exhaust gases from the boiler (waste heat) to heat combustion air or feedwater

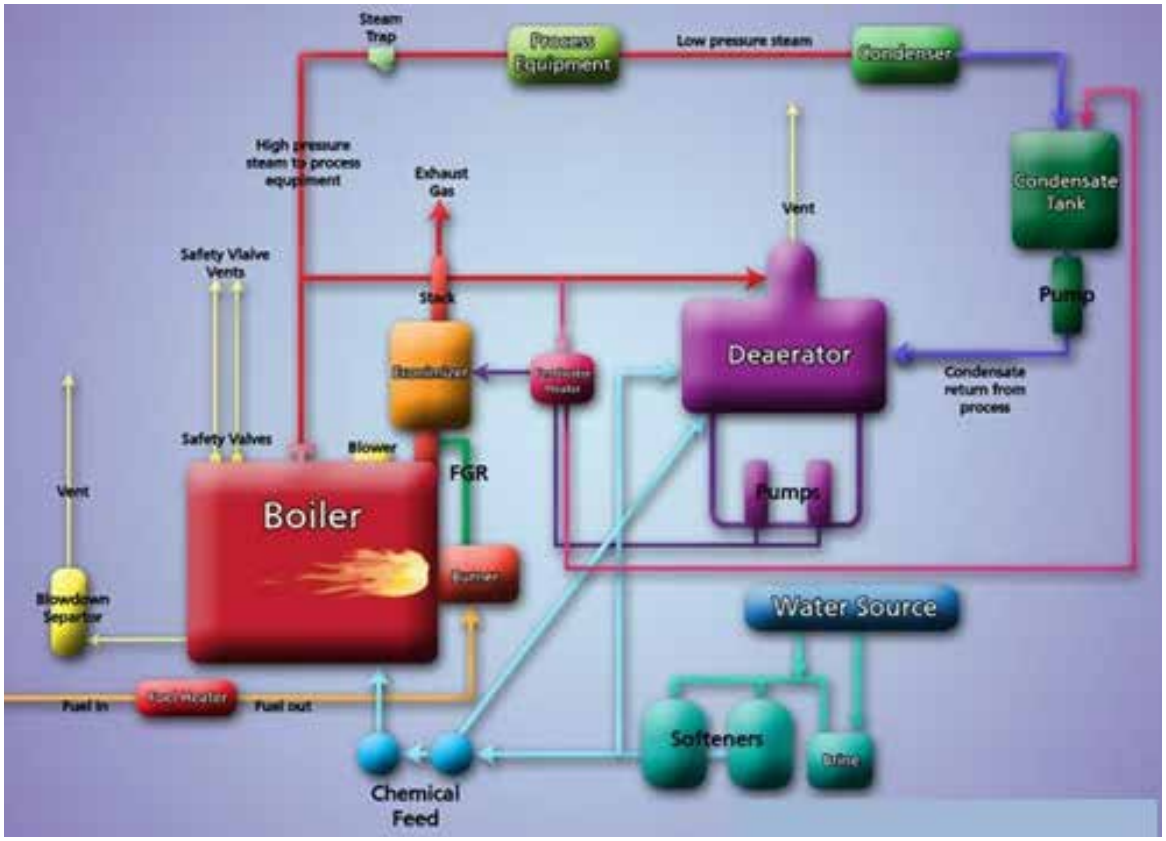
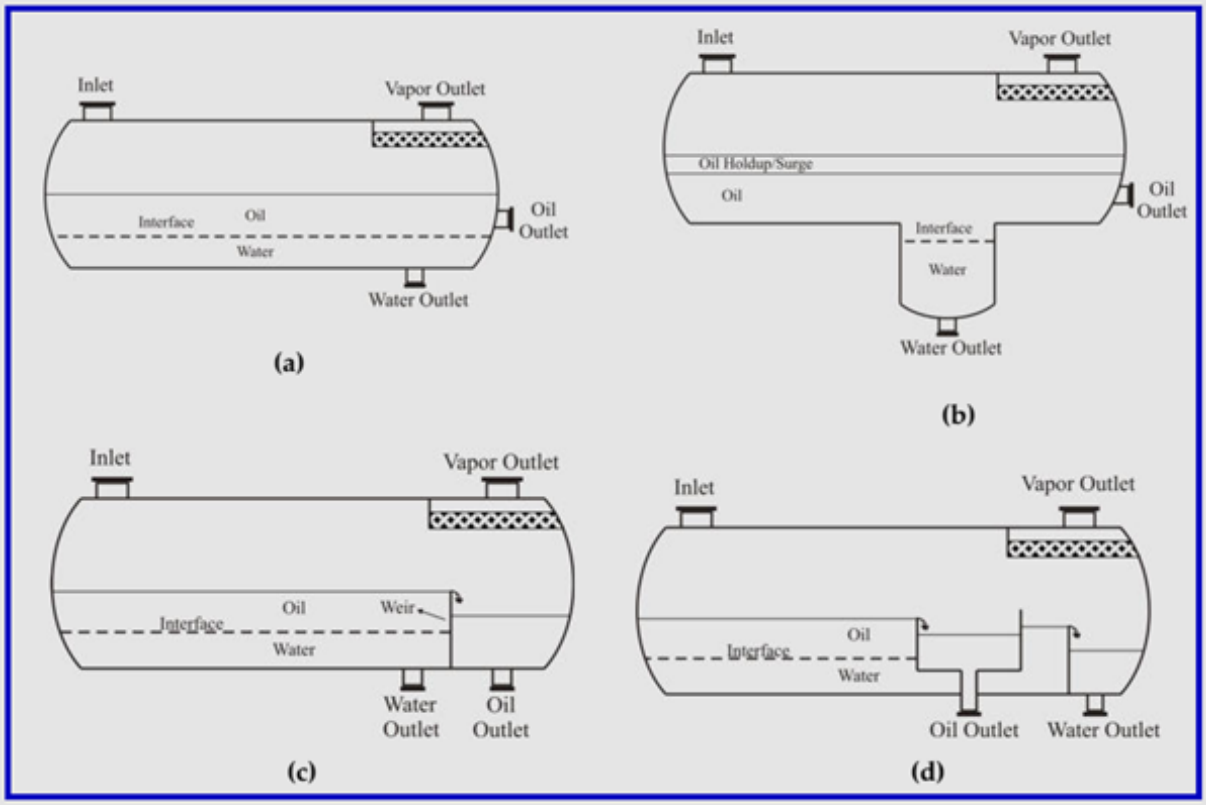


Figure 2.1.15: Components of a boiler

Multi-Phase Separation in Separators and Emulsion Treaters: Knowledge of the Key Features of Separation System

The multi-phase separator is the most important instrument in an oil-production platform. When the oil is first excavated from the oil well, it contains impurities. Thus, the oil is called crude oil. The task of the multi-phase separator is to separate the gaseous and liquid portion of the crude oil. After the separation of the crude oil, it goes through various equipment like compressor, boiler etc. the first task of separation is done by the multi-phase separator.



Different Common Designs of Horizontal Three-Phase Separators; (a) "Simple", (b) "Boot", (c) "Weir", and (d) "Bucket and Weir".

Figure 2.1.16: Multi-phase separators

The oil and gas separator is conventionally installed on the oil production facility. These separators work usually at a low temperature. A "gas scrubber" is an oil and gas separator with a high gas to liquid ratio. In a "wet-type gas scrubber", dust, rust, and other impurities of the gas phase are washed using a bath of oil or other liquid, and the gas flows through a demister to further remove liquid droplets from the gas stream. A "dry-type gas scrubber" or "gas filter" is equipped with demisters and other coalescing media to aid in the removal of most of the liquid from a gas stream.

Understand Oil and Gas Processing Operations

Oil and gas processing is a significant job of a production assistant. We have already discussed that the oil excavated from the wells are blended with impurities and needs to undergo processing. The processing of the crude oil involves different stages, such as –

1. Pigging
2. Hot Tapping
3. New flow line laying
4. Replacement of existing flow lines
5. Clearing of flow line plugging
6. Gas dehydration
7. Water injection

Pigging

- "Pig" stands for Pipeline Intervention Gadget
- A pig is inserted into the pipeline by a pipeline launcher
- The pig moves through the pipeline and detects if there is any obstruction or unnecessary build-up within the pipeline. In case there is any hindrance created within the pipeline, it is removed to enhance performance
- A pig receiver or pig trap is placed at the other end of the pipeline to receive the pig
- Pigs are usually spherical or cylindrical in shape

Hot Tapping

- Hot tapping is also known as pressure tapping
- The key function of hot tapping is to allow the gas or fluid tank to undergo modifications as per requirement without disturbing the fluid or gas inside the tank
- This process is very useful in oil and gas industry as the process is not dependent on the other processes. Tanks or vessels are not required to be emptied when hot tapping is performed
- The process is also used to drain off pressurized casing fluids and add test points or various sensors such as temperature and pressure
- Hot taps can range from a ½ inch hole designed for something as simple as quality control testing, up to a 48-inch tap for the installation of a variety of ports, valves, T-sections or other pipes

New Flow Line Laying

- The well flowline, or simply flowline, is the first “pipeline” system connected to the wellhead
- The flowline carries total produced fluids (e.g., oil, gas, and production water) from the well to the first piece of production equipment—typically a production separator
- The flowline may carry the well-production fluids to a common production battery, a gathering pipeline system, process facility, or other
- This is the first process of connecting the well, which is the source of the oil and gas, and the production platform.

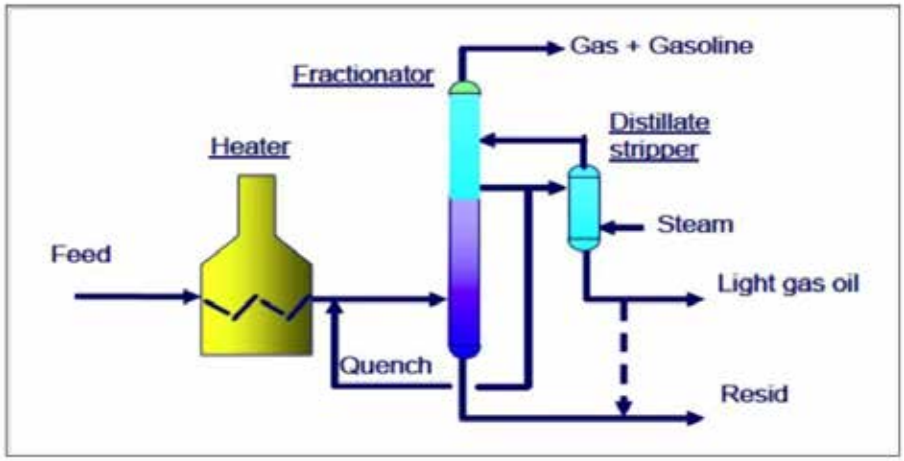
Replacement of Existing Flow Lines

- Flowlines need to be replaced from time to time
- The main reason behind the replacement is that the pipelines may under-perform due to long usage
- To enhance the performance, or to avoid accidents, flowlines are replaced after inspection

Clearing of Flow Line Plugging

- Arterial blockage of the flowline is a common phenomenon of the hydrocarbon industry
- Due to deposition of heavy organic molecules from the petroleum, deposition of wastes like minerals block the flowline, choking the entire passage
- This results in slow production. Thus, plugging is incorporated to abandon the wells which are no longer economically viable.
- Plugging must be done carefully with patience.

Gas Dehydration



- Dehydration is the method of removing water part from the oil
- When crude oil is excavated from the well, it contains a large number of water molecules
- Gas dehydration is the process of eliminating water from the hydrocarbon. There are many methods to implement gas dehydration:
  - Water absorption
  - Glycol dehydration
  - Dry gas method

Water Injection

- In the oil industry, waterflooding or water injection is where water is injected into the oil field, usually to increase pressure and thereby stimulate the production
- Water injection wells can be found both on- and offshore, to increase oil recovery from an existing reservoir

Operation and maintenance of various well stimulation & servicing units

Well Stimulation:

The word "stimulation" stands for inhibition, in simpler words, enhancement of a particular action. In the case of oil and gas production, well stimulation refers to the action of increasing the flow of hydrocarbon from the well, which makes the oil production economically viable. Well stimulation can be done using an offshore ship or drilling vessel, also known as Well Stimulation Vessel.

The flow of hydrocarbon from the well gets affected due to two reasons:

- Rock or chips may block the flow of path of the hydrocarbon
- Debris, produced at the time of drilling the well, may act as obstacles during the flow of hydrocarbon from the well

Well stimulation takes care of these issues by getting rid of the blockages, making the flow of hydrocarbon smooth and steady.

Stimulation services include following jobs:

- Acidization
- Hydraulic fracturing
- Surfactant/solvent treatment
- Nitrogen application and Coiled tubing
- Hot oil services
- Sand control

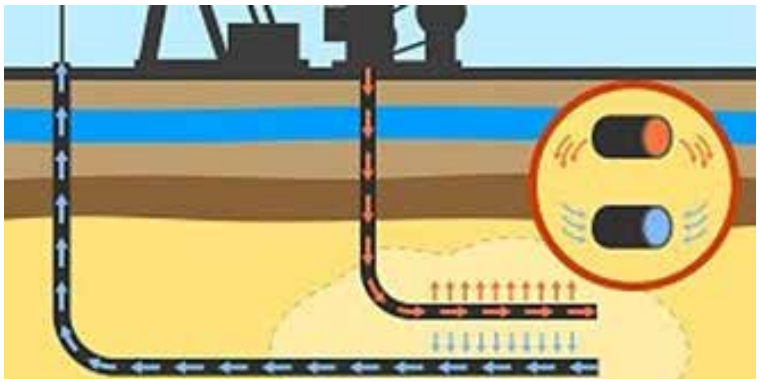


Figure 2.1.17: Well stimulation

Acidization: After initial drilling, the wells are treated with formic acid to clean the mud and skin damage. This process is known as acidization. If mud and skin damages are not cleaned, they block the flow of the hydrocarbon.

Hydraulic Fracturing: Hydraulic fracturing at times referred to as "fracking," is an oil and gas well stimulation process that involves injecting water, sand, and chemicals under high pressure into a bedrock formation. This process is intended to create new fractures in the rock as well as increase the size, extent, and connectivity of existing fractures. Hydraulic fracturing is a well-stimulation technique used commonly in low-permeability rocks like tight sandstone, shale, and some coal beds to increase oil and/or gas flow to a well from petroleum-bearing rock formations.

Surfactant/ Solvent Treatment: While drilling wells, deposition of wax, paraffin, asphalt or sludge is a common thing. The deposition hinders the flow of hydrocarbon, results in slow production. To remove the deposition of such things, surfactant or solvents are used. The solvents react with the deposition layer components and remove them from the path of flow of the hydrocarbon.

Nitrogen Application and Coiled Tubing: Nitrogen is an inert gas and in the recent past, the production cost of nitrogen has reduced drastically. Hydrocarbons are highly reactive with oxygen. When a well is dug, the hydrocarbon may come in contact with the atmospheric oxygen. Nitrogen is used as a blanket, making the hydrocarbon inert to the atmospheric oxygen. Another usage of nitrogen is to decrease the weight of the hydrocarbon. Usually, nitrogen is pumped into the hydrocarbon through a coiling tube. When nitrogen gets mixed with the hydrocarbon, the weight of the hydrocarbon gets reduced, making the production smooth.

Hot Oil Servicing: Hot oiling is one of the most popular methods of deposited wax removal. Wax is melted and dissolved by hot oil, which allows it to be circulated from the well and the surface producing system. Hot oil is normally pumped down the casing and up the tubing; however, in flowing wells, the oil may be circulated down the tubing and up the casing. This is a thermal solution for the wax deposition.

Sand Control: Sand is produced while drilling, which obstructs the flow of hydrocarbon from the oil well. Sand control refers to the precautions taken to minimize sand. Sand is also responsible for erosion and plugging. There are many methods to control the sand production. Few of them are –

- Resin coating
- Plastic consolidation
- Gravel Packing

Figure 2.1.18: Stimulation services

Operation and maintenance of work-over well completion

A work-over is any operation done on, within, or through the wellbore after the initial completion. Although proper drilling, cementing, and completion practices minimize the necessity of work-over, virtually every well will need several work-overs during its lifetime to satisfactorily fulfill its purpose. Work-overs may be required for one or more of the following reasons:

- Unsatisfactory production or injection rates
- Supplemental recovery project requirements
- Regulatory requirements
- Competitive drainage
- Reservoir data gathering
- Lease requirements
- Abandonments

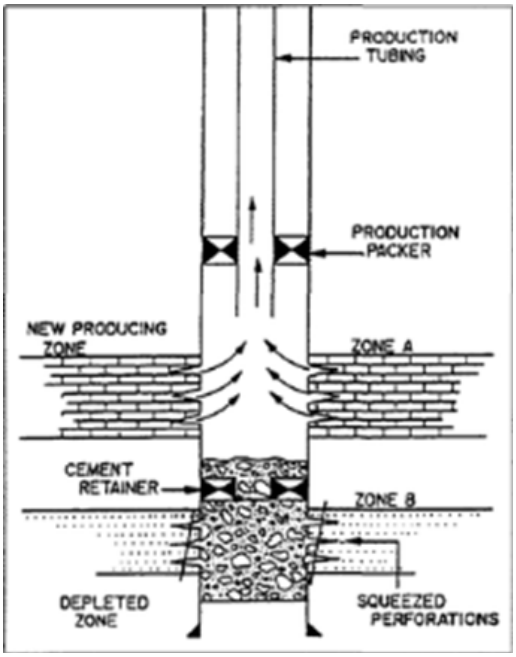


Figure 2.1.19: Recompletion wells or work-over

Wellbore work-overs include equipment repair or casing, but may also simply involve circulating chemicals to remove scale or paraffin or cleaning out fill over the producing zone. Many work-overs include the maintenance, installation, and repair of artificial lift equipment in the wellbore.

Work-over is performed by using conventional drilling rigs; however, non-conventional rigging is also implemented often to abandon the wells. Wireline unit (discussed under monitoring system) is a very useful instrument in work-over.

Rig Building Operations

During rig building, rig remains idle and therefore best efforts should be made to complete all the activities in a shortest possible. Rig building operations are very critical and require time bound fool proof planning while ensuring safety in each operations/ activities. Rig building operations involves following activities.

1. Site Preparations
2. Route Survey
3. Rig Release I Rigging Down
4. Load Handling, Transportation of Rig and Rig Equipment
5. Rigging Up

Site Preparation (Before Rig Release)

- Once decision is taken to deploy a rig on a well, all statutory and regulatory clearances should be obtained, wherever it is necessary
- It should be seen that no overhead electrical line passes through well site area (at least 30 meters away from well mouth).
- An area of 110 m x 110 m size should normally be available / acquired for safe operation of a work-over rig.
- Based on the type of rig, the well site must be prepared for proper placement of rig and associated equipment. The land around the well site should be cleared, graded & levelled.
- Surrounding area of all equipment foundation should be hardened to bear the load of heavy transport vehicles. Hard surfacing of the well site should be done for movement and proper handling of equipment during rigging up.
- Rig foundation should be prepared as per the rig manufacturer design and design should be based on load bearing capacity of soil. Check the level of the base foundation. Unevenness of the foundation may cause problems in rig centring. Foundation level should be maintained for sub base structure and for the auxiliary equipment.
- Rig foundation can be made new or by modifying the existing foundation of drilling rig. However, levelling and load bearing capacity of the rig foundation must be assured.
- For auxiliary equipment placement, levelled foundation strips should be made. If concrete slabs or wooden logs are used as foundation for auxiliary equipment or work-over fluid tanks,
- Then all the slabs should be at the same level and ground should be strong enough to support the load.
- If necessary, approach roads/ bridges/ culverts etc. should be repaired and appropriate areas around the rig should be surfaced to facilitate the transportation of rig equipment.
- Check the level of the base foundation. Unevenness of the foundation may cause problems in rig centring. Foundation level should be maintained for sub base structure and for the auxiliary equipment.
- Anchors for top man escape device, wind guy ropes etc. should be grouted properly as per the recommendations of the rig manufacturer/APLIf old anchors are to be used, they should be inspected for rust, damage; general condition, load bearing capacity etc. To ensure they don't fail during rig operation .In the absence of mast manufacturer's recommendations or where mast manufacturer's recommendations

cannot be utilized because of obstructions at the well site location (such as roads, pits, energized power lines, etc.), then the values shown in API RP- 4G.

- Entire drill site area should be fenced with barbed wire and there should be only one entry point.
- X-mass tree of old wells in cluster location should be caged and nearby wells should be checked for any leakage.
- Security personnel should be posted at new location before commencing transportation.

Route Survey (Before Rig Release)

- Route survey shall be conducted prior to rig shifting .In case, if any problem r;elated to following aspects is noticed, then it should be rectified before start of rig shifting.
- Check width and strength of the roads, bridges and culverts for safe passage of rig and equipment during transportation
- Look for radius of curvature on turnings. Approach road should not have sharp turnings as this may cause over turning of trailers during transportation . Approach road should preferably be such that enough space for vehicle movement is available.
- Look for any low lying electrical cables/transmission lines crossing the approach roads. Disconnect/de -energise them with the approval of Competent Authority, if required.
- Look for railway crossing and traction lines, obstruction due to trees / branches, crossing points availability / requirement, traffic in the cities en-route at peak hours.
- Route survey team should consist of: -
  - Rig In-charge
  - Electrical Engineer
  - Civil Engineer
  - Logistics personnel
  - Land acquisition man

Rig Release/ Rigging Down

- Derrick floor should be free of all unwanted materials prior to lowering of mast. It should be ensured that there is no loose item on mast members.
- Flow line of the existing well or cluster wells, if any should be protected from any inadvertent damage by using half cut casing or sand bags.
- It should be ensured that safety clips of every pin are in place.
- Rotary hoses should be secured.
- Mast raising and lowering lines, sheaves and their guards should be inspected for any damage .
- Tackle system should be checked for free rotation of pulleys.
- Proper functioning of the clutches, brakes and quick release valve should be checked.
- It should be ensured that the monkey board railings and fingers are folded.
- All long hanging lines, cat lines, and sand lines should be tied up to the mast.
- Ensure that all un-wanted persons are away from rig floor during mast lowering. 11) Before telescoping top section down:
  - Release all guy lines to allow easy retraction of load
  - Bleed air from rams and circulate hydraulic oil (one complete cycle) before releasing load latches.
  - Uncouple all electric and air lines in mast and free all other lines
  - Remove tools/ loose material from derrick

- Unlock the mast locking system

- Mast should be lowered at slowest possible speed. Application of brakes at any stage should not create any jerk. During lowering, check the rotation of the pulleys, and if any abnormality is observed, operations should be stopped for taking corrective action.
- A designated experienced person who knows the procedures should lower the mast.

Load Handling and Transportation Of Rig

- Rig equipment dimensional details, weight with regard to transportation should be well documented. Proper transport fleet should be deployed chosen based on equipment dimensions and weight and route selected, especially in hilly area.
- Capacity and fitness certificates of transport fleet including cranes should be checked/ ensured before commencing load handling/ shifting.
- Ensure that crane operator and other logistic crew are working with proper PPE.
- Planks / concrete slabs should be provided below the crane jacks based on the weight of the equipment to be lifted and soil condition.
- Hooks for lifting should be engaged only on lifting lugs/eyes provided on the equipment being lifted.
- Unwanted person should not be allowed in the vicinity of the lifted load. Tug lines should be used for handling loads while lifting / placing. Never walk under suspended load.
- Damaged or kinked or twisted slings should not be used for lifting of loads. Only undamaged and load certified slings should be used.
- On trailers, load should be properly secured with chains/ropes during transportation.
- The equipment with liquid inside the tanks e.g. work-over fluid, diesel etc. Should not be lifted/ transported.
- Minimum clearance from overhead lines to the transporting equipment shall be maintained. In case minimum clearance required is not met, then power lines shall be de-energized/ disconnected.
- In case there are sharp bends and/ or sloppy hill terrains en route to well site, there may be need to dismantle the mast from the rig trailer . This type of situations should be considered well in advance to avoid problems in transportation of the rig.
- Transportation of Mobile Rig
  - Tyres pressure
  - Pneumatic/ air system pressure (100 psi minimum)
  - Engine instruments are functional d. Power steering oil level
  - Radiator water level
  - Fuel level
  - Lubrication oil level: check with dipstick the lubrication oil level of engine crankcase, hydraulic reservoir, and torque converter/transmission.
  - Drive control in-position
  - Transmission in neutral
  - Derrick lowered
  - Rigs brakes on
  - Rig tied down
  - Inter-axle differential in unlock position
  - Wheel brake system
  - Parking brake released.
  - Mast is secured to the carrier.
  - Proper pads are available at mast rest.

- Secure all matting boards, cables, etc.
- Secure travelling block in its cradle
- Ensure that jacks are retracted to maximum.

Rigging Up

- Ensure all equipment reaches at new location in good working condition.
- Align sub-base structure to the centre of the well. Assemble the sub-structure. Place the rig on foundation and level the rig.
- All hoisting lines, casing and sand lines should be inspected thoroughly for broken wires, corrosion, incidenta l da mage etc.
- Fix the casing line guide roller on the mast wherever it is applicable.
- Reeve the travelling block, fix fast end, spool the casing line on drum and tighten the dead end properly.
- Check functioning of clutch and brake.
- Check mast members for corrosion, cracks and bends etc before lifting.
- Grease all the pins before fitting and fit all the safety clips in all pins.
- Observe casing line of tackle system for any obstruction with monkey board while lifting of mast.
- Before raising mast to vertical position:
  - Level the rig from side to side
  - Get the mast free and ready to raise (hoses, cables, lines, etc.)
  - Unwanted lines like tong hanging lines, cat lines etc. should be tied to the side of the mast to avoid entangling during lifting of mast
  - Check the hydraulic fluid level
  - Bleed the air out of all erect cylinders by circulating the hydraulic oil
  - Make sure derrick and guy lines will not come within close proximity to power lines
  - Park automobiles out of fall lines
- While mast is raising:
  - Unwanted crew members, not involved in operation of raising mast, should be at safe distance from the rig carrier, rig floor and mast
  - No employees should be allowed in derrick before mast is engaged
  - Keep block positioned in its cradle during this operation
  - Keep all lines free while mast is being raised
  - Raise the mast with slowest possible speed while observing the lifting mechanism sheaves for any hindrance in rotation
  - Keep a watch on hydraulic oil pressure. If it exceeds the normal operating pressure, stop the operation and check the system before proceeding further
  - Keep a watch on sequence of ram opening during mast raising operation. If any abnormality observed, stop the operation and check the system before proceeding further
- While telescoping the mast:
  - Check again to insure that all wire lines stay clear
  - Secure mast properly to the base section with bolts
  - Operator should keep the travelling block close to the floor at all times during the operation
  - Move ram stabilizers into place and properly secure the telescoping ram cylinder
  - Bleed out air from the cylinders by circulating the hydraulic oil. (One complete cycle)

- After mast is up:
  - Climb the derrick (with a ladder climbing safety device) to visually inspect load latches are engaged and properly locked.
  - Operator should crack control valve to “lower position to relieve pressure on telescoping cylinder.
  - Tighten load guys with equal tension.
  - Space out crown wind guys according to manufacturer’s specifications.
  - The guy wires should never be turned back over small radius eyes when making an end termination. Wire rope thimbles or appropriately sized sheaves should be used to turn back the guy wire ends.
  - Guy w ire hardware such as shackles, turnbuckles, walking boomers, chain come-a longs, load binders, etc., that remain in the live guy wire system should have safe working load capacities.
  - The use of grab hooks or open hooks on guy wire terminations is not recommended.
  - Lock mast erection control valve in neutral.
  - Align block and hook with well centre.
  - Inspect guy lines for the required number of clamps.

Procedure for Raising and Lowering Of Mast

- The well has been killed/ closed and is in inactive condition.
- Hydraulic and pneumatic pressure lines functioning and sealing .
- Test pneumatic system of rig at a pressure 1.5 times the working pressure but not less than 3 atmospheres above the working pressure.
- Check brakes, pins and shoes (if necessary burn brakes in case there is oil on the same).
- Lubrication of all necessary parts.
- Locking device functioning properly.
- Briefing of all operating crews and defining signalling procedures.
- Do away with the jerks while lowering and raising the mast.
- Emergency plan drawn up a nd briefed to the operating crews.
- Raising and lowering of mast should be done in daylight
- Guy lines, sub lines and such other lines shall not be installed within six metres of any electric overhead transmission lines.
- All normal checks, as per the instructions of manufacturer, during positioning, rigging and de-rigging should be made and recorded.

DO’S and DON’TS

Dos

- Obtain all statutory and regulatory clearances
- For safe operation of a work over rig, ensure the availability of an area of 110 m x 110 m size.
- Ensure no overhead electric line is passing through well site area (at least 30 meters away from well mouth)
- Cellar pit size should be reduced to 1.1 m X 1.1 m in size, if necessary, and rig specific foundation should be made for placement of rig
- Based on the type of rig, the well site must be prepared for proper placement of rig and associated equipment. The land around the well site should be cleared, graded & levelled. Surrounding area of all equipment foundation should be hardened to bear the load of heavy transport vehicles. Hard surfacing of the drill site should be done for movement and proper handling of equipment during rigging up
- Rig foundation should be prepared as per the rig specifications and designed based on load bearing capacity

of soH. Check the level of the base foundation. Unevenness of the foundation may cause problems in rig centring. Foundation level should be maintained for sub base structure and for the auxiliary equipment

- For auxiliary equipment placement, levelled foundation strips should be made. If concrete slabs or wooden logs are used as foundation for auxiliary equipment or work over fluid tanks, then all the slabs should be at the same level and ground should be strong enough to support the load
- If necessary, approach roads/ bridges/ culverts etc. should be repaired and appropriate areas around the rig should be surfaced to facilitate the transportation of rig equipment. Approach road. should preferably be such that enough space for vehicle movement is available
- Anchors for top man escape device, wind guy ropes etc. should be grouted properly as per the recommendations of the rig manufacturer. If old anchors are be used, they should be inspected for rust, damage, genera l condition, load taking capacity etc. To ensure they don't fail during rig operation
- Entire drill site area should be fenced with barbed wire and there should be only one entry point and
- X-mass tree of other wells in cluster location should be caged
- Check width and strength of the roads, bridges and culverts for safe passage of equipment during transportation
- Look for radius of curvature on turnings as sharp turnings may cause over turning of trailers during transportation, any low lying electrical cables/transmission lines crossing the approach roads. Disconnect/ de-energise them with the approval of Competent Authority, railway crossing and traction lines, obstruction due to trees / branches, crossing points availability / requirement, traffic in the cities en-route at peak hours
- Derrick floor should be free of all unwanted materials prior to lowering of mast. It should be ensured that there is no loose item on mast members
- Flow line of the existing well or cluster well, if any should be protected from any inadvertent damage
- Mast raising and lowering lines, sheaves, proper functioning of the clutches, brakes and quick release valve and their guards should be inspected for any damage and Raising and lowering of mast should be done in daylight
- Tackle system should be checked for free rotation of pulleys
- Test pneumatic system of rig at a pressure 1.5 times the working pressure but not less than 3 atmospheres above the working pressure
- It should be ensured that the racking board, stabbing board, railings, fingers of monkey board etc. is folded wherever applicable and rotary hoses should be secured
- All long hanging lines, cat lines, and sand lines should be tied up to the mast
- A designated experienced person who knows the procedures should lower the mast and all un-wanted persons should keep away from the rig floor during mast lowering/ raising
- Before telescoping top section down , release all guy lines, bleed air from rams and circulate hydraulic oil before releasing load latches, uncouple all electric and air lines in mast and free all other lines, unlock the mast locking system
- Wooden planks / concrete slabs should be provided below the crane jacks based on the weight of the equipment to be lifted and soil condition
- Hooks should be engaged only on lifting lugs/eyes provided on the equipment and on trailers, load should be properly secured with chains/ropes during transportation
- Grease all the pins before fitting and fit safety clips in all pin
- Observe casing line of tackle system for any obstruction with monkey board while raising the mast
- Before raising mast to vertical position, level the rig, make the mast free from hoses, cables, lines etc. By tying them to the side of the mast to avoid entangling during lifting of mast, check the hydraulic fluid level, bleed the air out of all erect cylinders and circulate the oil
- Rig should be of sound construction, maintained in safe working order, adequate strength, sufficient height and should be adequately secured to prevent it from overturning because of wind velocity and dynamic loading

- Guy , ropes should be anchored properly as per the recommendations of the manufacturer/APL
- All normal checks, as per the instructions of manufacturer, during positioning, rigging and de-rigging should be made and recorded.
- The exhausts of internal combustion engines shall be provided with water quenched or other effective spark arrestors
- While dismantling the rig the wellhead shall be protected against damage from sliding or falling object
- Tongs, ends of rotary hose and suspension sheaves shall be fitted with Safety Chains or wire line

Don'ts

- Don't transport equipment/ tanks with liquid inside e.g. work over fluid, diesel etc.
- Don't use damaged or kinked or twisted slings for lilting of loads. Only load tested and certified slings should be used
- Never walk under suspended load
- Do not use grab hooks or open hooks on guy wire terminations
- Don't allow any person in derrick before mast is engaged
- Never turn back the guy wires over small radius eyes when making an end termination. Wire rope thimbles should be used to turn back the guy wire end
- Don't allow anyone to work at site without proper PPE

As procedure for lowering and raising the mast may differ from rig to rig, procedure as recommended by the manufacturer in operation manual should strictly be followed. The recommended practices described above are general in nature based on experience and should be followed to inbuilt safety in operations. Further, following checks should be performed and recorded before initiating the rigging up or down operations;

Prior to taking the carrier mounted rig on the road for transportation to well site, the carrier should be checked to ensure that it is in proper operating condition. Following, but not limited to, should be checked:

Monitoring and maintenance of field Indirect Heaters

The indirect heater is widely used in oil and gas wells to avoid direct contact between fire and the hydrocarbon (which is highly combustible). In the indirect heater, the fire is fuelled by the natural gas or propane and is kept within the burning chamber. The burning chamber heats the "heat exchanger" situated over the burning chamber. There is a passage over the heat exchanger which allows cool air to pass through it. The cool air, when comes in contact with the heat exchanger gets hotter. Thus, the process is known as indirect heating. The cool air does not come in direct contact with the fire; however, the heat exchanger heats the cooler air or gas.

Indirect fired heaters offer several positive aspects, like:

- 100% clean, dry air – The air being circulated never comes in direct contact with the flame
- Built-in thermostats – Almost all indirect fired heaters use a thermostat
- Can operate in tightly sealed spaces – Indirect fired heaters do not release carbon dioxide into space

Some negative aspects about indirect fired heaters are:

- Higher Cost – The rental cost is nearly quadruple that of direct fired
- Lower Efficiency – Fuel efficiency is usually close to 80%
- Electricity Required – Indirect fired heaters always need an electrical outlet
- Requires exhaust ventilation – You must either vent the exhaust outside or duct the hot air inside. This makes installing and removing indirect heaters cumbersome because of the setup and tear down of duct work
- Hard to transport – Indirect fired heater units are much larger and less portable

Emulsion Treaters and Crude Oil Storage Tanks

The emulsion is a chemical term, which refers to the colloid or a mixture of minute particles of two immiscible liquids. For example, oil and water do not mix with each other. When the mixture of oil and water forms a colloid, it can be termed as an emulsion.

Mo0st of the oil wells around the world produces a mixture of oil and water. The liquids are subjected to shear forces through pumps or other lifting methods or are sheared as they pass through pressure-reducing devices in the production line.

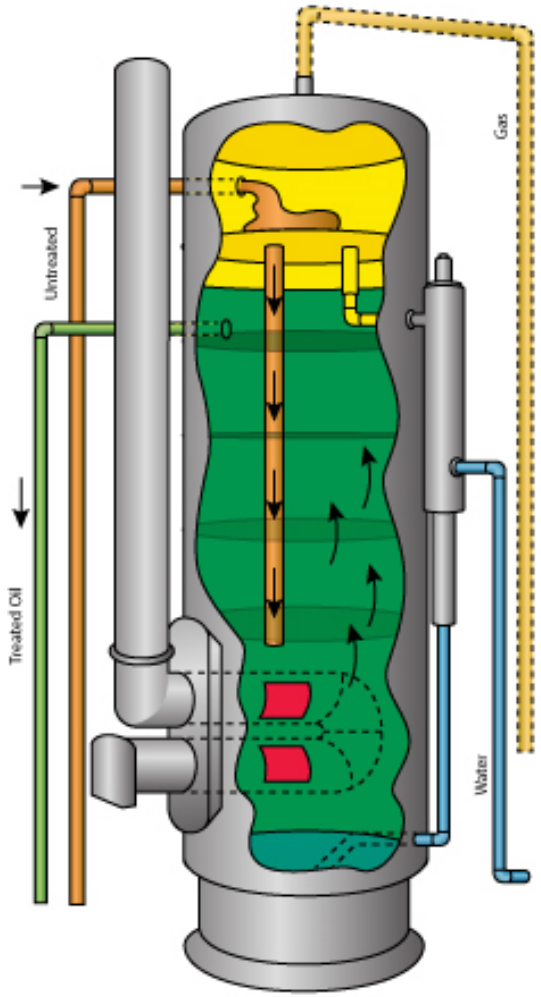


Figure 2.1.20: Emulsion Treater

Storage tanks containing organic liquids, non-organic liquids, and vapours and can be found in many industries. Most storage tanks are designed and built to the American Petroleum Institute API-650 specification.

These tanks can have different sizes, ranging from 2 to 60 m diameter or more. They are generally installed inside containment basins in order to contain spills in case of rupture of the tank.

Industries, where storage tanks can be found, are petroleum producing and refining, petrochemical and chemical manufacturing, bulk storage and transfer operations, other industries consuming or producing liquids and vapours.

Types of Storage Tank:

- Fixed-roof tanks
- External floating roof tanks
- Internal floating roof tanks
- Domed external floating roof tanks
- Horizontal Tanks
- Pressure Tanks
- Variable vapor space tanks
- LNG (Liquefied Natural Gas) tanks

The first four tank types are cylindrical in shape with the axis oriented perpendicular to the sub grade. These tanks are almost exclusively above ground. Horizontal tanks can be used above and below ground. Pressure tanks often are horizontally oriented and spherically shaped to maintain structural integrity at high pressures. They are located above ground. Variable vapour space tanks can be cylindrical or spherical in shape.

Figure 2.1.21: Crude oil storage tank

Unit 2.2 Basic Measuring and Marking-out Instruments: Outline typical maintenance requirements of measurement systems and equipment

Unit Objectives

At the end of this unit, you will be able to:

- Recognize different types of measuring instruments
- Identify the method of measurement
- Analyze the marking instruments and their applications

What are Measuring Instruments?

- Measurement is the process of determining the magnitude of and quantifying a physical parameter
- The method of measuring physical parameters is called Metrology
- Each physical parameter is estimated and expressed in numerical values, along with Units. For example, the units for temperature are Kelvin, Celsius, Fahrenheit, etc.
- Units of measurement are of many types: System International (SI) and the Centimeter - Gram - Second (CGS), Meter- Kilogram- Second (MKS), Foot- Pound- Second (FPS)

A. Understanding System International

This comprises the **Base Units,** measuring the Base Quantities and the **Derived Units,** measuring the Derived Quantities. **Base Quantities** are those physical quantities, which are distinct and are independent of other physical quantities. **Derived Quantities** are those physical quantities, which result from the Base Quantities.

Base Quantities: Length, Time, Mass, Electric Current, Temperature, Amount of Substance and Luminous Intensity.

Derived Quantities: Velocity, Acceleration, Area, Volume, Force, Capacitance, Density, Electric Charge, Voltage, Energy, Work, Resistance, etc.

Examples of SI units are: (Both Base and Derived Quantities)

Physical Quantity	SI Unit
Length, Width, Height, Depth	Meter
Time	Second
Mass	Kilogram
Temperature	Kelvin
Electric Charge	Coulomb
Force	Newton
Electric Current	Ampere
Electric Power	kiloWatt
Energy	Joule
Luminous Intensity	Candela
Plane Angle	Radian
Solid Angle	Steradian

B. Understanding CGS Unit

Examples of CGS units are:

Physical Quantity	SI Unit
Length, Width, Height, Depth	Centimeter
Time	Second
Mass	Gram
Temperature	Kelvin
Electric Charge	Franklin
Force	Dyne
Electric Current	Biot
Energy	Calorie

C. Understanding the MKS and the FPS system

The FPS system, or the Foot - Pound - Second system, comprises the following:

Parameter	Name of the Unit	Measure	
Length	Inch	1/12th	ft
	Foot	1	
	Yard	3	
	Mile	5280	
	Nautical Mile	6080	
Area	Acre	43,560	Sq. ft
Volume	Fluid Ounce	1/20th	Pint
	Pint	1	
	Quart	2	
	Gallon	8	
Weight	Ounce	1/16th	Lb
	Pound	1	
	Stone	14	
	Ton	2240	

The MKS system, or the **Meter - Kilogram - Second** system, comprises the following:

Length	Weight	Volume
1 Km = 1000 m	1 Kg = 1000g	1 kL = 1000 L
1 m = 0.001 Km	1 g = 0.001 Kg	1 L = 0.001 kL
1 m = 100 cm	1 g = 100 cg	1 L = 100 cL
1 cm = 0.01 m	1 cg = 0.01 g	1 cL = 0.01 L
1 m = 1000 mm	1 g = 1000 mg	1 L = 1000 mL
1 mm = 0.001 m	1 mg = 0.001 g	1 mL = 0.001 L

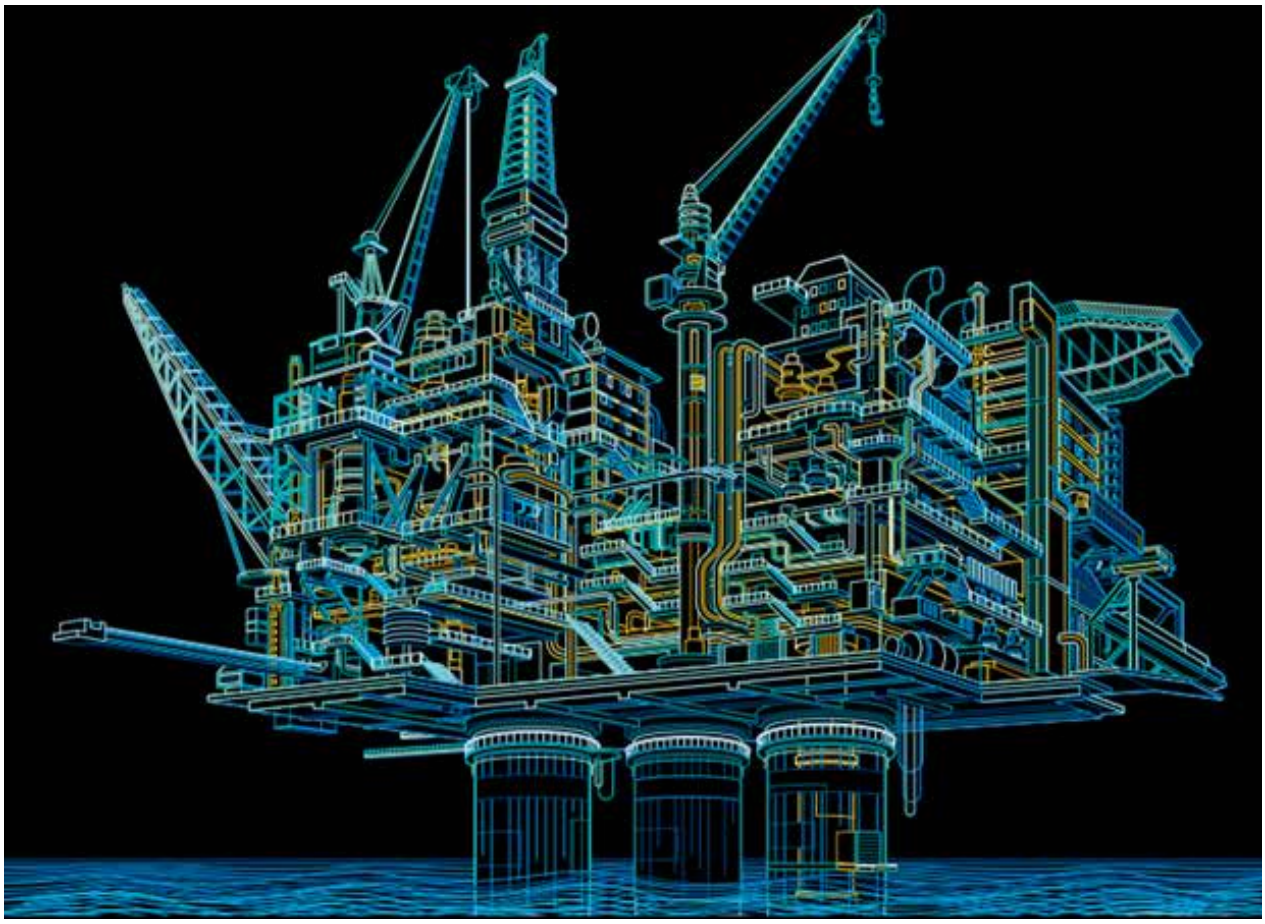


Figure 2.2.1: Various tools used in oil and gas production platform

Types of Measuring Instruments

Various measuring instruments include UV photometric analyzers, electrolytic moisture analyzers, quartz crystal moisture analyzers, quadruple mass spectrometers, hydrocarbon dew point analyzers, and trace oxygen analyzers in oil and gas industry.

In the following table, we will discuss the measuring instruments and their usages.

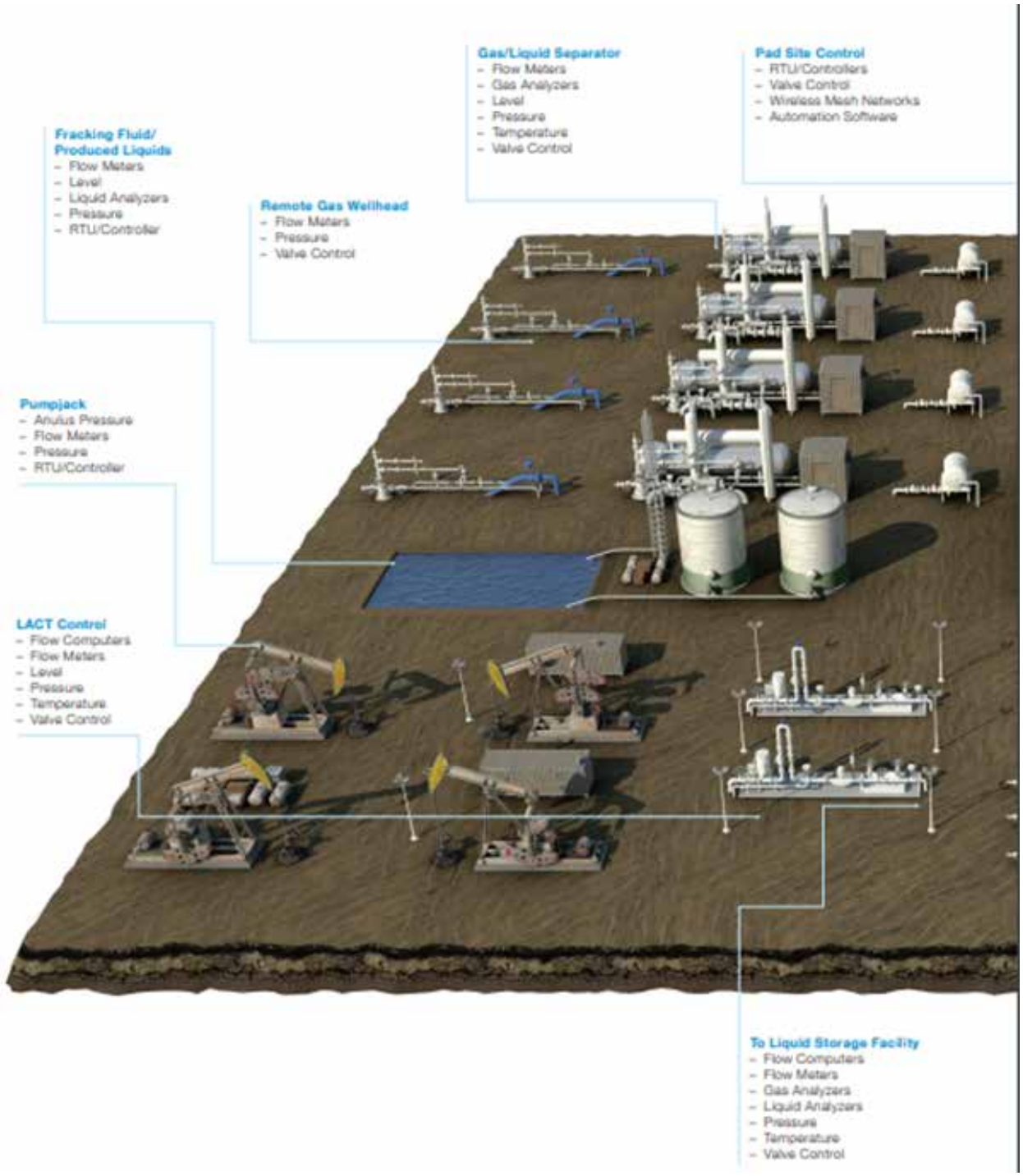


Figure 2.2.2: Tools layout (sample picture 1)

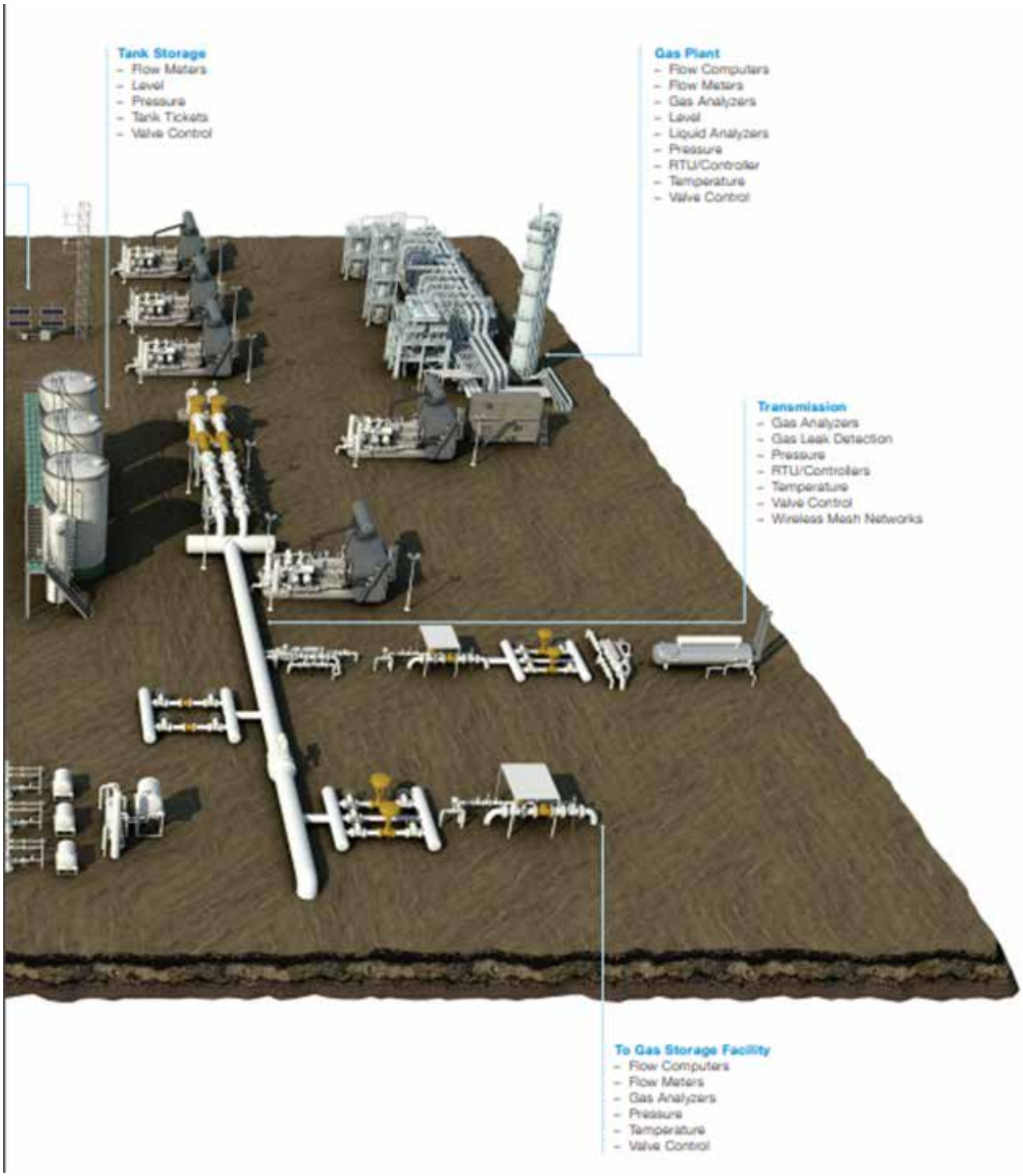


Figure 2.2.3: Tools layout (sample picture 2)

Siemen, Rosen, Noshok are few of the reputed companies which manufacture equipment for Hydrocarbon industry. In a hydrocarbon industry, the parameters of measurement are mainly:

1. The temperature of the Well/ Site
2. Pressure the Well/ Site
3. Level of Fluid
4. The flow of Fluid and Gas

How to Measure using these Measuring Instruments (for each tool - steps and images)

1. Resistance Thermometers (RTD)

RTD

Thermocouple

- RTD is used to measure the temperature. Previously Thermocouples were used to measure temperature. However, RTD has higher accuracy and can be used for a long time (repeatability)
- The three main categories of RTD sensors are thin-film, wire-wound, and coiled elements. While these types are the ones most widely used in industry, other more exotic shapes are used; for example, carbon resistors are used at ultra-low temperatures (−173 °C to −273 °C)
- Resistance thermometers are constructed in a number of forms and offer greater stability, accuracy, and repeatability in some cases than thermocouples. While thermocouples use the Seebeck effect to generate a voltage, resistance thermometers use electrical resistance and require a power source to operate
- The platinum detecting wire needs to be kept free of contamination to remain stable. A platinum wire or film is supported on a former in such a way that it gets the minimal differential expansion or other strains from its former, yet is reasonably resistant to vibration

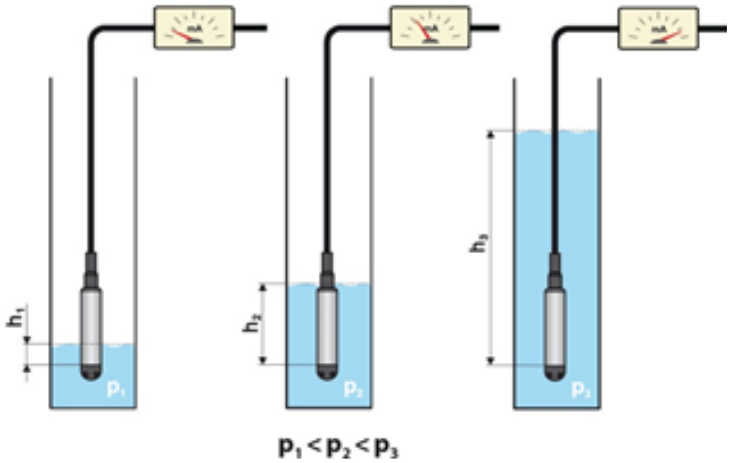
2. P/I Convertor (Pressure-to-Current convertor)

- It converts pressure input to a current in mili-ampere range. P/I converter is a common instrument in the automation system
- It transmits data to other sources like PLC, an instrument to control systems Here the input is a pressure which gets converted to current
- If we set 0 to 6 bar for 4-20 mile-amps current, in case of 0 bar pressure there will be 4 mile-amps current in the P/I converter output and for 6 bar there will be 20 mile-amp current

Flow Meter

- A flow meter is a device used to measure the flow rate or quantity of a gas or liquid moving through a pipe
- Flow meters are referred to by many names, such as flow gauge, flow indicator, liquid meter, etc. depending on the particular industry; however, the function, to measure flow, remains the same
- Flow meters consist of a primary device, transducer, and transmitter. The transducer senses the fluid that passes through the primary device. The transmitter produces a usable flow signal from the raw transducer signal. These components are often combined, so the actual flow meter may be one or more physical devices
- Flow measurement can be described by
  - Q = A · v, which means that the volume of fluid passing through a flow meter is equal to the cross-sectional area of the pipe (A) times the average velocity of the fluid (v); and
  - W = r · Q, which means that the mass flow of fluid passing through a flow meter (A) is equal to the fluid density (r) times the volume of the fluid (Q)

3. Hydrostatic Pressure Level Sensor



- Hydrostatic pressure level sensors are submersible or externally mounted pressure sensors suitable for measuring the level of corrosive liquids in deep tanks or water in reservoirs. For these sensors, using chemically compatible materials is important to assure proper performance
- Sensors are commercially available from 10mbar to 1000bar
- Since these sensors sense increasing pressure with depth and because the specific gravities of liquids are different, the sensor must be properly calibrated for each application
- These sensors can be designed to keep the diaphragm free of contamination or build-up, thus ensuring proper operation and accurate hydrostatic pressure level measurements

What are Marking-out Instruments?

Marking is the process of creating a rough layout of the finished product with useful markings on the piece of work. For example, before drawing a blueprint, we use to draw margins. This is also a form of marking where we determine the working area. Similarly, in the oil and gas industry, there are different parameters which require proper measurement. Marking is essential in those cases. In a nutshell, marking is the second step after measurement. The flow of work is –

- Measure the piece of work
- Mark accordingly
- Work on the piece
- Finish the product (or service)

The instruments, which help in marking-out, are known as marking-out instruments. There are different instruments which help in the marking-out process. For example, we need a ruler, pen/ pencil to mark the work-piece. Thus the instruments can be referred to as marking-out tools.

Figure 2.2.4: Marking-out is the second step after measurement

Unit 2.3 Basic Production Techniques

Unit Objectives

At the end of this unit, you will be able to:

- Prepare the work area for a given task
- Analyze basic oil and gas production process
- Prioritize the significance of inspecting, recording and reporting the data

Prepare the work area for given Production tasks

The workplace in case of oil and gas production is the oil plants or the oil terminals, generally known as oil production platforms. We have already discussed the oil production procedure and the necessary equipment in the last unit. Here, we will discuss a few essential tips to prepare the workstation for the oil production process.

Perquisites

- Explore and confirm the site of installing an oil terminal
- Calculate the risk factors
- Consider the ecological effects of installing the oil terminal at a particular place
- Understand the viability in terms of economy
- Prepare a blueprint or an extended diagram with useful markings (mark where the wells will be dug, where the platform will be installed, positioning of the pipes etc.)

Process

- After exploration, the excavation of the well begins
- In this phase, with the help of drilling rigs, oil wells are dug
- Throughout the process, strict invigilation is required
- Oil well digging is a tedious task and requires a lot of patience. Ensuring the safety of the workers and the ecology are of utmost importance

Preparing the Workplace

- Once the oil well starts producing crude oil, the key functions of the production artists begin
- Check the pipes, valves and other equipment before using them. Once the production begins, ensure the functionality of the equipment and accessories are at par. DO NOT TAKE CHANCES
- Allow the hydrocarbon fluid to flow through the pipes with proper choke valves. Choke valves control the flow of fluid. We have discussed in the last unit that the flow meter is a popular equipment to measure the flow of the fluid inside the pipes. Choke valves come into operation to control the flow of liquid through the pipe
- A coalescer is a tool which comes handy to separate the components of an emulsion. The emulsion is a colloid of two immiscible liquids. Coalescer separates the constituting liquids, which in oil and gas industry plays an important role
- Crude oil is a mixture of oil, water, gas and other components. Always keep the coalescer up and running to separate the oil and water from the crude oil

- The produced water is often routed to a hydrocyclone to remove entrained oil and solids and then either re-injected into the reservoir or dumped overboard depending on the circumstances and cleanliness of the water. The associated gas is initially dubbed “wet gas” as it is saturated with water and liquid alkanes. The gas is typically routed through scrubbers, compressors, and coolers which will remove the bulk of the liquids. This “dry gas” may be exported, re-injected into the reservoir, used for gas lift, flared or used as fuel for the installation’s power generators. To maintain the process, always keep the machine functional
- To get rid of the blockages, obstructions from the path of flow of the hydrocarbon fluid, keep on monitoring the same on a 24 by 7 basis. This not only raises the production rate but also reduces the accidents in the oil terminals

Figure 2.3.1 Coalescer machines to separate oil and water from the emulsion

Carry out Basic routines for Oil and Gas Production Process

Routine is a term that we all are familiar with. It stands for the schedule. For example, routine in school life refers to the classes or the subjects that would be taught on a particular day. Similarly, in the case of oilrigs, there are certain duties that a worker should abide by. Although the routine and timing vary from rig to rig, depending on the time zone, culture and other parameters – the basic concept of the routine work remain the same.

- Usually, a day at an oilrig is divided into two shifts, which is termed as “tour” and pronounced as “tower”
- The span of each shift is 12 hours (usually the timing is 6 a.m. to 6 p.m. and 6 p.m. to 6 a.m.
- Before every shift, there is a half-an-hour pre-tour is held to hand over the job
- The shifts timing depends on the time zone, however, the span and concept of shifts are by and large generic as all the oilrigs work on a 24 by 7 basis
- The workers need to check the equipment before starting their duties
- Maintenance of the equipment is another significant part of the routine. Equipment used at an oilrig are expensive and thus, regular maintenance of the equipment is so important

- On Sundays, a weekly safety report meeting is held
- For a production technician assistant, documenting and reporting the data to the immediate boss 9Field Supervisor) is extremely important. The report contains a thorough detail of the work progress, current status, production rate, expenses, equipment and their condition, anomalies etc.
- In case the rig and the head office is at different time zones, meetings (video conference) are fixed beforehand and the participants should be available at the time of the meeting

This is a picture of an oilrig and the life there. The life is no doubt a hard one; duties and responsibilities bestowed on the production technician are humongous.

Figure 2.3.2: An oilrig during the shift change

Ensure Appropriate Cleaning Routines Using the Correct Cleaning Agents

The selection of cleaning agents at the oil plant is the significant task of the production technician. Considering the impact of the reaction between the chemicals used as a cleaning agent and the hydrocarbon, housekeeping should be done.

Global Drilling Fluids and Chemicals Ltd. is one of the most famous manufacturers of cleaning agents for oilrigs. The essential cleaning agents are discussed below.

1. Drilling Detergent

- Drilling detergent is a special aqueous blend of anionic and non-ionic surfactant equally effective regardless of makeup water, whether it is fresh or saturated salt water
- It also has a Lubricating effect. It is designed to reduce the surface tension of the Water-based Mud System
- It may be used in any area where it is desirable to reduce the foaming tendencies of water base muds
- It is compatible with fresh water mud, sea water mud and brine system mud. It is also effective in KCL and sea water muds
- Advantages:
  - It can be used in all drilling areas of water base drilling fluids.
  - It works as an oil emulsifier in fresh water and sea water mud's and reduces the viscosity of oil contaminants
  - Reduces torque and drag
  - Minimizes Bit balling
  - Effective in all water-based muds
- Drilling detergent must be handled as an Industrial chemical, wearing protective equipment

2. Rig Wash

- Rig wash s an Environmentally Friendly non-polluting liquid detergent designed for Rig wash application
- It is a special aqueous blend of anionic and non-ionic surfactant equally effective regardless of makeup water, whether it is fresh or saturated salt water
- It is an excellent emulsifier and may be used at any point in the drilling operation to improve emulsification and to reduce torque and drag. It is highly effective in both fresh water and sea water
- Advantages:
  - It can be used in all drilling areas of water base drilling fluids
  - It works as an oil emulsifier in fresh water and sea water muds
  - It reduces torque and drag

Carry Out Routine Lubrication, Using the Correct Lubricant for the Application

Lubricants are the special type of additives when mixed in drilling fluids imparts lubricating properties into metal and metal to borehole contacts under extreme pressure conditions. These are specially used in directional and crooked holes, deeper holes and the packed hole where frictional forces tend to be relatively high to reduce the loss of mechanical power.

Figure 2.3.3: Lubricating oil

1. Water Base Mud Lubricants

- Water Base Mud Lubricants is water-soluble lubricant designed to reduce torque and drag and to lower the potential of bottom hole assembly balling in all water base mud's under extreme pressure conditions

- Advantages:
  - It reduces torque and drag
  - It will not adversely affect rheology or gel strength
  - It is easily miscible in water base muds and works in all fresh water or salt water muds
  - Dispersible in water-based muds and high compatibility with most additives

2. Ester-Based Mud Lubricants

- Ester-Based Mud Lubricants is an environmentally friendly biodegradable water-soluble lubricant designed to reduce torque and drag and to lower the potential of bottom hole assembly balling in all water base mud's under extreme pressure conditions
- It imparts extreme pressure Lubricating Properties to the drilling fluids
- Advantages:
  - It reduces torque and drag
  - It will not adversely affect rheology or gel strength
  - It is easily miscible in water base muds and works in all fresh water or salt water muds
  - Dispersible in water-based muds and high compatibility with most additives
  -

3. Oil Based Mud Lubricant

- Oil Based Mud Lubricant is an environmentally friendly Oil Based lubricant specially formulated for Sodium Silicate systems, designed to reduce torque and drag

- It imparts extreme pressure Lubricating Properties to the drilling fluids and prevents wall sticking
- Advantages:
  - It reduces torque and drag
  - It will not adversely affect rheology or gel strength
  - Stable at high circulation temperatures and does not undergo chemical degradation
  - May Help in Shale inhibition

4. High-Temperature Mud Lubricant

- High-Temperature Mud Lubricant is a Hi-performance lubricant designed to reduce torque and drag and to lower the potential of bottom hole assembly balling in all water base mud's under extreme pressure conditions
- Advantages:
  - It reduces torque & drag
  - It will not adversely affect rheology or gel strength
  - It is easily miscible in water base muds and works in all fresh water or salt water muds
  - Stable at high circulation temperatures and does not undergo chemical degradation
  - Dispersible in water-based muds and high compatibility with most additives

Tighten Fastenings Using Correct Tools and Equipment

In oil and gas industry, equipment in use are mainly related to drilling, pumping and transporting. The equipment has to work in some of the harshest conditions. All the tools have to survive and perform under a magnitude of adverse temperature and pressure. Fasteners are the instruments come into the picture when assembling of the equipment is considered.

A fastener is used to tighten the joints of two different modules or sub-assemblies. Providing strength is the key concern of the fasteners. However, the flexibility of the machine (assemblies) has to be considered so that the fasteners don't become a hindrance in the production rate. Fasteners can be used in the assembly of

- Oilfield skids
- Solids handling systems
- Offshore structures.

The fasteners use in oil and gas industry include –

- Assemblies, Brackets, and Plugs
- Cold Form Fasteners
- Inserts
- Lock Bolts
- Metal clips
- Nuts
- Pins
- Plastic Fasteners
- Rivets
- Studs
- Screws and Bolts

Figure 2.3.4: Screws and Bolts

In this chapter, we will discuss several fasteners which are widely used in the hydrocarbon industry.

Assemblies, Brackets, and Plugs

1. Crest Cup

- Ideal for use with soft materials
- Stamped into a broad pentagon shape
- Burr formed upwards, producing a truly flat bearing surface, free of sharp edges
- Preassembled to fasteners
- Can eliminate double washer combinations.
- Eliminates handling of loose washers and screws
- Adapts easily to automatic assembly equipment

- Maximizes joint integrity
- Helps prevent embedding, notching, and marring in application materials

2. Cage Nut

- Allows for variation management in a multitude of applications
- Heat treated floating nut inside a wieldable cage
- Automotive industry applications include body-to-frame, engine cradle, suspension, and body components

3. Flag Nut

- Designed for hard-to-reach areas
- Used in anti-rotation applications
- Available as a custom design
- Can be heat-treated
- Offered in straight, single bend, offset bend, double bend, and clip-on configurations
- Assembly applications include fuel tank hold-downs, interior cargo fasteners, and small footprint locations

4. Mini-cage Nut

- Two-piece design allows for variation management in a multitude of applications
- Proprietary coating helps achieve clamp-load with less torque. Protects from the build-up in threads
- Assembly applications include fuel tank hold-downs, interior cargo fasteners, and small footprint locations

5. Nut Plate

- Used when the additional bearing surface is required
- Increased bearing surface reduces rupture or pull-through in the parent material
- Used in transportation for powertrain applications

Cold Form Fasteners

1. Cold Form Fasteners

- Improved strength and reliability through work hardening and an uninterrupted grain flow
- Improved surface finish over screw-machined components
- Reduced scrap rates
- High production rates
- Multi-piece components can be manufactured as a single component

Inserts

1. Tangless Screw Thread Insert

- Require no staking, locking, swaging, keying, or interference fit (Free-Running)
- Automatically adjusts to any expansion or contraction of the parent material (Free-Running).
- Anchor permanently in place against the tapped hole (Free-Running)
- Positively secures threaded members against vibration or shock loosening (Screw-Locking)
- High reusability factor due to the exclusive Heli-Coil Resilient Screw-Lock which permits frequent removal and reassembly of the bolt without appreciable loss of torque (Screw-Locking)

- Available in inch and metric series.
- Successful applications in aviation, electronics, industrial, automotive, and military

2. Pitch Screw Thread Insert

- A unique series of screw thread inserts specially designed for 8-pitch threaded holes
- Helps save valuable parts that would otherwise have to be scrapped
- No special taps are ever needed
- Available in 18-8 stainless steel and Inconel X-750

3. Pipe thread Insert

- Eliminates thread failure due to stripping, vibration, fatigue, corrosion, or seizing.
- Prevents thread wear, even after repeated disassembly and reassembly
- Greatly increases thread strength under all operating conditions
- Leak-proof joints when used with thread sealant and recommended torque
- Savings in material, weight, and space, as minimum size bosses and flanges are permissible
- Allows the use of light materials instead of ferrous castings because connections will be protected by the inserts

4. Wire thread Insert

- Accepts standard 2A/3A bolts (4g6g and 6g)
- Replaces Helicoil locking inserts

- Spiralock insert meets or exceeds the applicable parts of NASM8846, e.g. the wire tensile strength, chemical composition, and methods of inspection
- The spiralock insert is not a prevailing torque-type screw-locking insert—no risk of galling or seizing of the bolt and insert
- Similar to NASM1130 inserts
- Provides proven superior vibration resistance to standard locking inserts
- Duplicates a Spiralock tapped hole
- Combines the advantages of wire inserts with the vibration resistance and load distribution of Spiralock

Check Tensions and Adjust As Required

For a production technician in the oil and gas industry, it is absolutely necessary to know the properties of oil and gas. Few of the properties have been discussed before. Surface tension is one such property which must be familiar with the production assistants.

Surface Tension

- Surface tension is defined as the measurement of the force of attraction acting between the surfaces or the points of contact of two different elements
- For example, the measurement of the force of attraction between the layer of oil and well surface is the surface tension of the oil
- Fluids tend to take the least possible surface area when it is kept in contact with a solid surface
- In the case of two immiscible liquids (or phases of elements), the surface tension is termed as interfacial tension
- Surface tension is the elastic property of the liquid which allows it to take the shape of the surface of the adjacent material

Calculation of Gas Oil Surface Tension

Two forms of correlations for calculating gas/oil surface tension have been developed.

- The first form is a pseudo-compositional black oil approach. Two components, gas, and oil, are identified, and techniques used with compositional models are used to calculate surface tension
- The second approach uses empirical correlations to determine surface tension

Black oil correlations may provide less than accurate results because of the simplified characterization of the crude oil. Generally, the heavy end components of a crude oil may be made of asphaltic and surface active materials that have a measurable effect on surface tension.

With the compositional approach, surface tension is determined by the following equation proposed by Weinaug and Katz.

$$\sigma_{go}^{\frac{1}{4}} = \sum_{i=1}^{N} P_i \left(x_i \frac{\rho_o}{M_o} - y_i \frac{\rho_g}{M_g} \right),$$

Figure 2.3.4: Weinaug and Katz Equation for Surface Tension

Here the density terms are defined with units of g/cm3. Pi is the parachor of each component. This property is a characteristic of pure components and is determined from surface tension measurements where the density of the gas and liquid phases are known.

The du Nouy apparatus is essentially used to measure the surface tension of the crude oil. It is, in fact, a torsion balance which exploits the ring method instead of using weights to measure the same. Using weights is a time-consuming process, whereas, torsion balancing is comparatively quicker and more accurate method. The torsion of the du Nouy apparatus is used to counteract the tension of the liquid (crude oil).

The readings come in Dyne per centimeter.

A production assistant should be aware of these things and must check the surface tension from time to time because –

1. It gives the best idea of the cohesive properties of the crude oil
2. It allows the production team to get an idea of the amount, density, temperature and force of liquid flow inside the well
3. Checking regularly produces a steady record and in case of any deviation or anomaly, it can be rectified without facing huge damages

Figure 2.3.5: du Nouy Ring (often referred to as tension meter)

Carry Out Basic Visual Inspection for Common Faults and Record Observed for Any Faults: Carry out basic inspections

Daily Inspection:

One of the positives of oilfield equipment is its reliability, and with the proper maintenance can function for years before experiencing any serious issues. However, in order to prolong the unit's life expectancy, daily inspections should be performed to locate any issues prior to occurring damage.

When making inspections, lease pumpers should ensure the radio volume in the vehicle is completely down (or shut off). By listening carefully, you can determine a great deal about the pumping unit's condition. Lease pumpers should also include checks for leaks (ex. lubricating oil) or loose objects (ex. nuts, bolts, washers, etc.) in their daily inspections.

Weekly Inspection:

Weekly checks should include the following:

- Perform Daily Inspection Steps
- Observe the Pumping Unit (make sure to completely walk around the unit)
- Stop at Proper Observation Points and Watch Each Component for One Entire Rotation (The lease pumper should be looking for any signs of unusual motion, uncommon noises, or vibrations.)
- Examine the white safety line to ensure the pitman arm safety pins are correctly aligned

Monthly Inspections:

Monthly inspections should include:

- Completing the weekly check duties
- Examining the gearbox fluid levels (helps to determine if any leaks are present)
- Lubricating any worn components such as the pitman arm bearings, saddle, or tail

Figure 2.3.6: Worker inspecting the gearbox at the work site

Quarter and Semi-Annual Inspections:

Quarter and semi-annual inspections are essential. This is especially true for many new units, as many of these devices require semi-annual lubrication procedures.

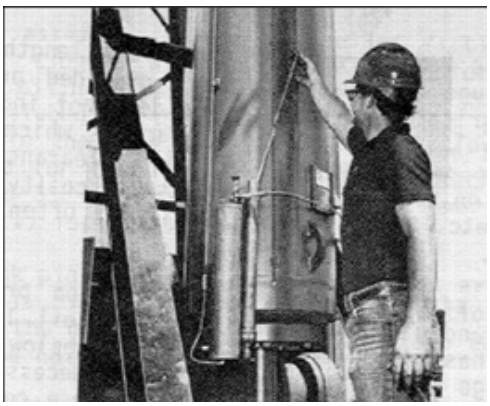


Figure 2.3.7: Worker examining the air cylinder (air balanced unit) to determine the level of oil

As the pumping unit gains wear over time, it will require the interval to gradually change first to five months,

then four, and eventually every three months. However, some units may require monthly lubrication, as well as additional special maintenance requirements in between lubrications. A portion of these examinations is performed during operations, while others require the unit to be completely shut down and to set the brake lever.

Pumping units have a variety of sizes, styles, gearboxes, and types of gearbox oil. This can include chain drives, double-gear drives, and single-gear drives. In addition, each of these gears contains dippers, and with each rotation, the dipper will pick up the oil, carry it, and empty it into a lubrication trough (allowing for the four shaft bearings to be lubricated). However, poor maintenance can cause a variety of problems. This includes:

- Accumulating Sludge – typically caused by aged oil, incorrect additives, or mixing oil
- Difficulty Starting – typically caused by low oil or overly viscous oil, especially in cold weather
- Foam – typically caused by an overfilled gearbox
- Gear Wear – typically caused by contaminants (ex. bits of dirt, metal, etc.) in the oil
- Poor Lubrication – typically caused by low oil levels
- Rust – typically caused by water in the oil
- Poor Gear Surface Coverage – typically caused by overheating the oil, or too thin of oil

Figure 2.3.8: Workers at site inspecting the equipment

Unit 2.4 Basic Maintenance Techniques and Practices

Unit Objectives

At the end of this unit, you will be able to:

- Discuss the importance of maintenance
- Evaluate the method of maintaining practices
- Analyze the SRP system
- Describe the gas lift system
- Estimate the transmission system and its components

Basic Maintenance Hand Tools: Prepare for basic routine maintenance tasks and Describe basic routine maintenance techniques

Diligent and routine maintenance on your oil and gas equipment is paramount to keep it running as efficiently and effectively as possible for as long as possible. With the purchase prices of equipment being so steep, it's only logical to take as many precautions as possible to keep it all in excellent operating condition.

Every organization, where a Lead Assembler for Modular Furniture would work, has few predefined Standard Operating Procedures (SOPs) for the safe handling of the various tools and equipment. Adherence to these organizational procedures is extremely crucial for ensuring the safety of the individual as well as others.

A. Safe Handling of Powered Tools

- **Before Using**
  - Appropriate measures should be taken to inspect the tool and the power supply. If the tool or any part/accessory is found defective, it must be either replaced immediately or removed from service and tagged appropriately as "Out of Service for Repair".
  - Care should be taken that no defective tool must be used at any point of time.
  - All repair and maintenance work must be accomplished by licensed and experienced persons.
  - Before operating Powered Tools, the Instruction Manual must be read thoroughly.
  - The guidelines and recommendations (by manufacturer) must be stringently followed, as per the Instruction Manual or Directions of Use.
  - The tools must be grounded adequately with the help of a three-pronged plug (equipped with relevant 3-wired colour coded cord) and double insulation. This helps in preventing electric shocks.
  - All powered tools must be checked with a continuity tester or a Ground Fault Circuit Interrupter (GFCI), for effective grounding.
  - Powered tools must be switched off before connecting them to a power supply.
  - Powered tools must be switched off before connecting them to a power supply.
- **While Using**
  - Issues, like a tool getting heated too soon or appearance of sparks, must be inspected and rectified by a licensed electrician only.
  - All power cords must be kept clear of tools and the path along which the tool will operate.
  - Approved extension cords, with proper specifications, power requirement (for the tool) and dimensions must be used, to prevent overheating and fraying of the cord.

- Outdoor work must be done with the help of outdoor extension cords labeled with “W-A” or “W”.
- Cords must be suspended over the work area to mitigate trips and falls.
- Octopus connections must be avoided by deploying a power bar or power distribution, comprising multiple receptacle plugs.
- While unplugging the tool from the socket, the plug must be pulled gently and not the cord. Forcibly pulling the cord leads to fraying and subsequent risk of electric shocks.
- The entire work area must be kept dry and away from heat, sharp edges, and oil, to avoid damage of insulation.
- Cords, instead of knots, may be looped, using a twist lock plug.

B. Identify the use of basic maintenance hand tools

- The user must ensure that he/she is adequately trained in the secure usage of hand tools.
- The appropriate and accurate choice must be made on the right tool for the task.
- The user must deploy the correct techniques of handling and use the hand tools thus selected for the task.
- The user must operate hand tools by keeping the wrist straight.
- Hand tools must be thoroughly inspected before use and must be repaired immediately or replaced, whenever necessary.
- The user must ensure that handles of axes, hammers, saws, and chisels must fit tightly into the head of the tool, to avoid accidental injuries.
- One must always pull on pliers or wrench.
- Worn jaws of pliers, pipe tools, and wrenches must be replaced immediately.
- All hand tools must be kept in a robust toolbox, in a clean and dry place, away from the work area.
- While using hand tools, one must wear appropriate PPE, according to the types of hazards involved in the task. This includes protective gloves of appropriate material, heavy aprons, safety goggles and face shields.
- When not in use, sharp and cutting tools must be covered with appropriate sheaths to avoid injuries.

Carry Out Basic Routine Maintenance Tasks

1. If your equipment does not consistently run and must be fired up from time to time instead, be sure to check the equipment before you turn it on; this is especially true if the equipment hasn’t been used in a while. You’ll want to make sure that all the engine components appear to be in good working condition, and inspect the fuel lines and any wires and connections to make sure there is no corrosion. Check any and all bolts and ensure they are not loose; tighten them as necessary.
2. Be sure that if applicable, the furnace nozzle is cleaned regularly to prevent dangerous and damaging build-up. In addition, keep in mind that air flow is crucial; your equipment will not run as efficiently as it should without proper air flow. Be sure to check for dirty air filters and replace them as often as is necessary. When professional maintenance services are needed, experts can perform everything from component repair and spare parts supply to in-field overhauls and more. Professionals can perform upgrades, repairs, and services with advanced technology and diagnostics.
3. Pumps should be serviced for draining, and any furnace chimney bases that are connected to furnaces (for example) should be regularly cleaned, especially during periods of heaviest use. Any build-up of dirt, grease, and grime can increase the amount of heat generated by your oil and gas equipment. When this happens, unnecessary strain on your equipment can occur, shortening its lifespan and potentially causing permanent (and expensive) damage. Use a degreaser to clean any dirt and grease, and keep any cooling fins clean with a bristle brush.
4. Don’t underestimate the value of equipment upgrade programs and maintenance programs. These programs provide much more than just peace of mind; they also help you avoid costly repairs, inconvenient down

times, and the stress and upset that comes along with unexpected problems. Upgrade programs will allow you to trade in your equipment for updated or more recent models at a sharply discounted cost when compared to new equipment. Maintenance plans include preventive maintenance appointments to have professionals come and do a full inspection on all parts of your equipment, and are able to catch small issues before they become large problems.

Figure 2.4.1: Equipment Maintenance

5. Secure and protect equipment with a shelter or cabinet that meets equipment specifications, local and state codes, and protection needs. Fiberglass shelters are recommended by experts for many reasons. These shelters are pound for pound stronger than steel, can be virtually maintenance-free and with an excellent shelter manufacturer and installer, they can be designed to accommodate any specifications. You can custom-engineer a shelter that is durable enough to withstand extreme temperatures, hurricane-force winds and all other types of weather, and should be able to resist damage from chemicals, water, impact, and the damaging rays of the sun. The importance of protecting and securing your oil and gas equipment should not be underestimated.

Describe the Key Features of Prime Movers

In the energy industry, pumping units, compressors, coolers, and other forms of related equipment are driven by prime movers. The most common prime movers in the oil and gas industry are natural gas turbines and reciprocating engines. Steam turbines can also be used. Steam turbines are not common in field operations and are used primarily in plants; therefore, they are not discussed in this chapter. Electric motors are not considered “prime” movers and are discussed in the chapter on Electrical Systems. Each type of prime mover has unique characteristics that make it appropriate for an application on the basis of site conditions and fuel energy availability.

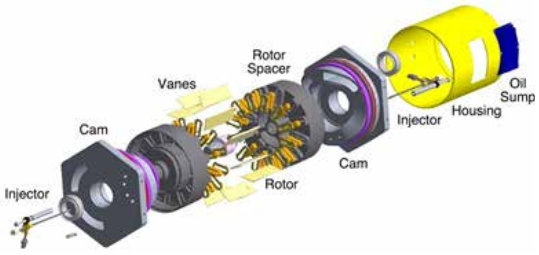


Figure 2.4.2: Prime Mover and its components

Types of Prime Movers:

The common types of prime movers are –

- Natural gas turbines
- Reciprocating engines
- Steam turbines
- Electric motors

Prime movers are often called "driving equipment" because they are the primary source of mechanical energy or power. The mechanical energy produced by the prime mover is transmitted to another machine or mechanism, such as a pump or air compressor, to do some form of useful work. The mechanism, or linkage, that transmits the mechanical power developed by the prime mover is called the drive.

Understanding of the Key Features of SRP Systems

SRP stands for Sulphate Removal Package. The SRP uses nano-filtration membranes to remove the sulphates from the seawater while leaving the other salts (sodium, chloride etc.) substantially unaffected, thus maintaining the stability and permeability of the formation clays.

Figure 2.4.3: Sulphate Removal Package at the site of work

How does SRP work?

- The membranes are typically configured in an SRP with a "2-array, brine staged" arrangement
- With this arrangement, the seawater feed is introduced to the first array of membranes which allows 50% of the feed to pass through the membrane material with the sulphate being rejected on the membrane surface
- The 50% reject water (or brine) is then fed to the second array of membranes where again 50% passes through as low sulphate water
- The two flows of low sulphate water are blended to give an overall recovery of 75% with the remaining 25% of increased sulphate reject being safely discharged overboard without endangering the environment

Benefits of Sulphate Removal

- Reduces seawater ion concentration from around 2,500 ppm to less than 50 ppm (at temperatures of < 24ºC).
- Significantly reduces sulphate scale precipitation in production wells
- Reduces the quantity of scale inhibitor required down-hole and in topsides equipment
- Eliminates economic and operational impacts resulting from scaling in the reservoir
- Increases productivity index by limiting pipe constriction due to scaling
- Assists in maintaining reservoir permeability by limiting formation plugging caused by scaling
- Prevents well souring by controlling sulphate reducing bacteria (SRB) which in turn reduces equipment corrosion problems and the equipment required for scrubbing, removal, and handling of hydrogen sulphide
- Reduces safety hazards associated with hydrogen sulphide
- Has an additional safety benefit by reducing scale and thus the potential of naturally occurring radioactive material which can be attached to the scale
- Meets the stringent design and environmental criteria related to offshore platforms

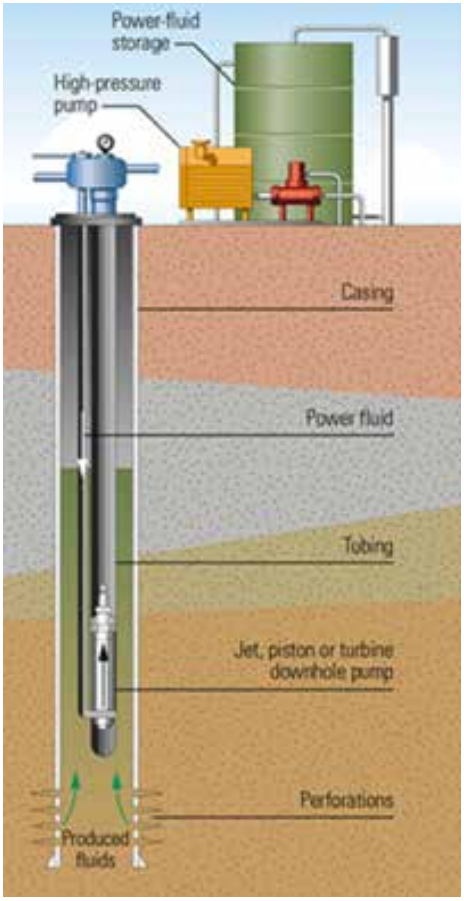
Describe the Key Features of Gas Lift Systems

Artificial lift is a process used on oil wells to increase pressure within the reservoir and encourage oil to the surface. When the natural drive energy of the reservoir is not strong enough to push the oil to the surface, artificial lift is employed to recover more production.

Beam Pumping: It engages equipment on and below the surface to increase pressure and push oil to the surface. Consisting of a sucker rod string and a sucker rod pump, beam pumps are the familiar jack pumps seen on onshore oil wells.

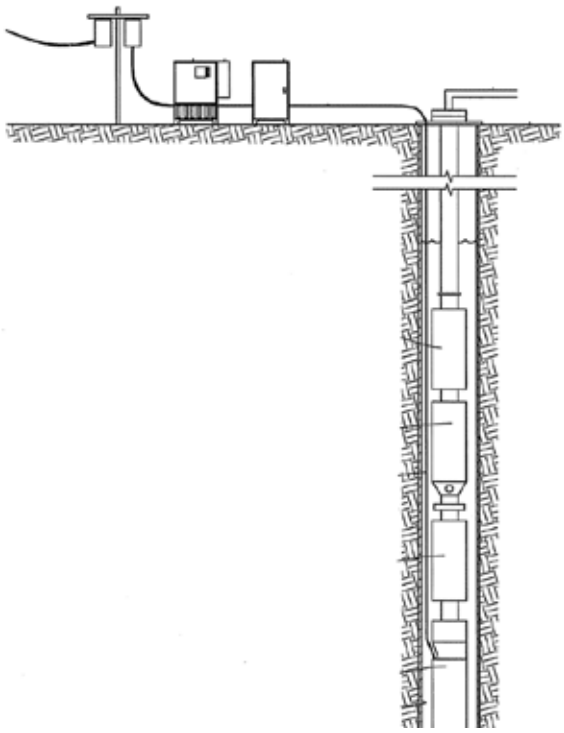
- Above the surface, the beam pumping system rocks back and forth. This is connected to a string of rods called the sucker rods, which plunge down into the wellbore
- The sucker rods are connected to the sucker rod pump, which is installed as a part of the tubing string near the bottom of the well
- As the beam pumping system rocks back and forth, this operates the rod string, sucker rod and sucker rod pump, which works similarly to pistons inside a cylinder. The sucker rod pump lifts the oil from the reservoir through the well to the surface
- Usually pumping about 20 times a minute, the pumping units are powered electronically or via the gas engine, called a prime mover
- In order for the beam system to work properly, a speed reducer is employed to ensure the pump unit moves steadily, despite the 600 revolutions per minute the engine achieves

Hydraulic Pumping: Another artificial lift pumping system, hydraulic pumping equipment applies a down-hole hydraulic pumps, rather than sucker rods, which lift oil to the surface. Here, the production is forced against the pistons, causing pressure and the pistons to lift the fluids to the surface. Similar to the physics applied in waterwheels powering old-fashion gristmills, the natural energy within the well is put to work to raise the production to the surface.



- Hydraulic pumps are generally composed of two pistons, one above the other, which are connected by a rod that moves up and down within the pump
- Both the surface hydraulic pumps and subsurface hydraulic pumps are powered by power oil or clean oil that has been previously lifted from the well
- The surface pump sends the power oil through the tubing string to the subsurface hydraulic pump installed at the bottom of the tubing string, the reservoir fluids are then sent up a second parallel tubing string to the surface

Electric Submersible Pumping: Electric submersible pump systems employ a centrifugal pump below the level of the reservoir fluids. Connected to a long electric motor, the pump is composed of several impellers or blades, that move the fluids within the well.



- The whole system is installed at the bottom of the tubing string. An electric cable runs the length of the well, connecting the pump to a surface source of electricity
- The electric submersible pump applies artificial lift by spinning the impellers on the pump shaft, putting pressure on the surrounding fluids and forcing them to the surface
- A mass producer, electric submersible pumps can lift more than 25,000 barrels of fluids per day

Gas Lift: Gas lift injects compressed gas into the well to re-establish pressure, making it produce. Even when a well is flowing without artificial lift, it many times is using a natural form of gas lift.

- The injected gas reduces the pressure on the bottom of the well by decreasing the viscosity of the fluids in the well. This, in turn, encourages the fluids to flow more easily to the surface. Typically, the gas that is injected is recycled gas produced from the well
- With very few surface units, gas lift is the optimal choice for offshore applications. Occurring down-hole, the compressed gas is injected down the casing-tubing annulus, entering the well at numerous entry points called gas-lift valves
- As the gas enters the tubing at these different stages, it forms bubbles, lightens the fluids and lowers the pressure

When a well is drilled to tap the oil and gas to the surface, it is a usual phenomenon that oil and gas comes to the surface vigorously because of the energy stored in them. Over a long period of production, the decay of energy takes place and at one point, the existing energy is found insufficient to lift the desired quantity of oil to the surface. From that point onwards, manmade efforts are required to lift oil and this is known as Artificial Lift.

What is Artificial Lift?

When a self-flowing well stops to flow or is unable to deliver the desired quantity of oil to the surface, the additional energy is supplied either by injecting compressed gas or by mechanical means.

- Suppose a well which can deliver the required quantity of oil on to a certain height in the well, say 500 Mts. from surface subsequently Artificial Lift equipment help to lift the required quantity of liquid from 500 Mts. to the surface

Purpose of Artificial Lift

The purpose of Artificial is to –

- Create steady low pressure or reduced pressure in the well bore against the sand face
- Allow the well fluid to come into the well bore continuously

In other words maintaining a desired and steady low pressure against the sand face, which is called f**lowing bottom hole pressure**, is the fundamental basis for formulating any Artificial Lift installation.

Sucker Rod Pumping system or SRP is widely used as a mean of commercial artificial lifting of oil and gas.

Advantages of Sucker Rod Pumping System (SRP)

- Suitable for moderate to low flow rates
- Flexibility in handling varied flow rates
- Low capital cost
- Moderate operating cost
- Efficiency ranges from 50 - 60%
- Excellent reliability

SRP consists of three major units:

1. Surface pumping unit
2. Sucker rods
3. Sub-surface pump

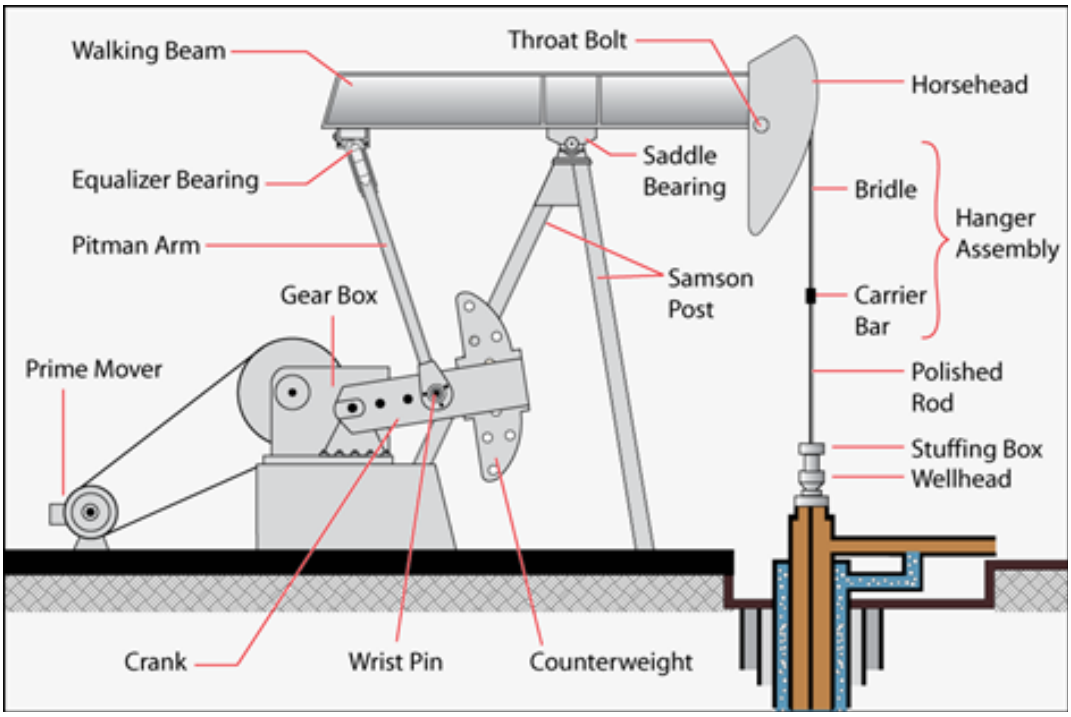
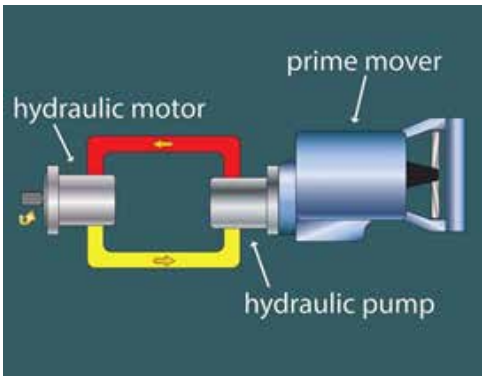


Fig 2.4.4: Components of an artificial pump

Components of SRP System



Prime Mover

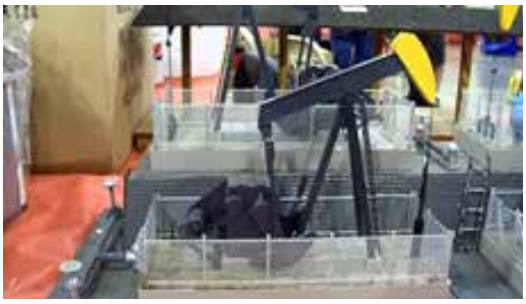
Gear Reducer

Crank Arm

Pitman

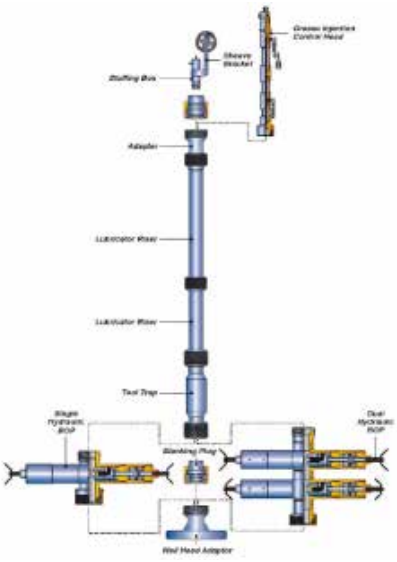
Counter Weight

Samson Post



Walking Beam

Horse Head



Wireline Hanger

Carrier Bar

API Pumping Unit Designation Depends On:

- Pumping unit geometry
- Max. Torque capacity of gear reducer
- Type of gear reducer
- Unit structural capacity
- Max. Polished rod stroke length

Types of prime mover used:

- Electric engine
- Internal combustion gas engine

Selection of prime mover depends on:

- Availability of gas/power at well site
- Capital cost
- Operating cost
- Service life
- Energy cost

Types of sub-surface pump

- Insert or rod pump
  - Commonly used pump
  - Barrel, plunger, travelling and standing valve form integral parts of sub-surface assembly
  - Runs as an unit on the sucker rod string

- **TUBING PUMP**
  - Suitable for pumping large liquid volumes
  - Useful for inclined wells
  - Working barrel is run as a part of the tubing

Different types of API pumps and their advantages and disadvantages

Type of API Pump	Advantages	Disadvantages
Stationary Barrel Top Anchor Rod Pump	Recommended for sandy wells	• Due to top anchor position, barrel outside is at suction pressure and inside is exposed to hydrostatic pressure of liquid column in the tubing large pressure • Difference across wall can burst the barrel
Stationary Barrel Bottom Anchor Rod Pump	Barrel outside is at hydrostatic pressure of liquid column in tubing pressure difference across the wall is much less making pump less prone to mechanical damage, thus, it can be used to greater depths	• During intermittent operation, sand or other particles settle on the top of plunger, preventing smooth pulling of pump

Knowledge of the key features of rotating equipment and tools and Outline typical maintenance requirements of rotating equipment and tools

Static and rotating equipment form an essential part of the oil and gas infrastructure depends on the reliability and quality of these tools. Rotating equipment is the general classification of mechanical components that add kinetic energy to a process in order to move material.

Figure 2.4.5: Sample of a rotating equipment used in the oil and gas industry

Some of the common rotating equipment used in oil and gas industry are –

- Centrifugal pumps
- Vacuum pumps
- Steam turbines
- Gas turbines
- Gearboxes
- Mixing gear

1. Centrifugal Pump

- Centrifugal pumps convert the rotational kinetic energy of the axis of the pump to hydrodynamic flow of the fluid
- When the fluid enters the pump through the inlet, the axis rotates vigorously. The rotational movement of the fluid creates a hydrodynamic force inside the pump which helps it to pull the fluid to a particular direction
- In case of oil and gas industry, the hydrocarbon fluid is pumped from the depth of the well through the pumps

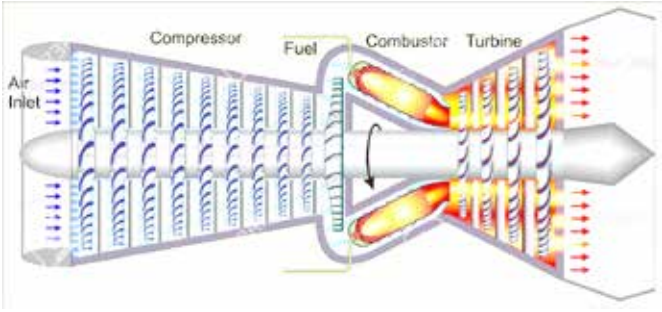
2. Vacuum Pump

- Vacuum pump works on the same principle as the positive displacement pump
- To increase output, several vacuum pumps can be connected in a series or parallel connection
- In vacuum pumps, the gas load enters the pump through the inlet and passes out of the exhaust (exiting point) creating a vacuum inside
- The speed of passing of the gas load can be regulated externally

3. Steam Turbine

- A steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft
- A steam turbine is a form of heat engine that derives much of its improvement in thermodynamic efficiency from the use of multiple stages in the expansion of the steam
- The thermal energy contained in the steam is converted to the mechanical energy by expansion through the turbine. The expansion takes place through a series of fixed blades (nozzles), that orient the steam flow into high-speed jets

4. Gas Turbine



- A gas turbine, also called a combustion turbine, is a type of internal combustion engine
- Gas turbine allows atmospheric pressure to enter the body
- The air then is mixed with fuel by spraying
- This creates a high-temperature, high-pressure flow inside the body which further moves towards the shaft
- Due to the flow of the air (ignited by fuel) produces a shaft output (this is based on the theory of combustion)
- The shaft is attached to the compressor which generates the final output

Gearbox is often referred to as the transmission system as it regulates the power inside a system. A gearbox is a rotating tool which is indispensable in the hydrocarbon industry.

Know-how of the key features of transmission systems and components: Outline typical maintenance requirements of transmission systems and components

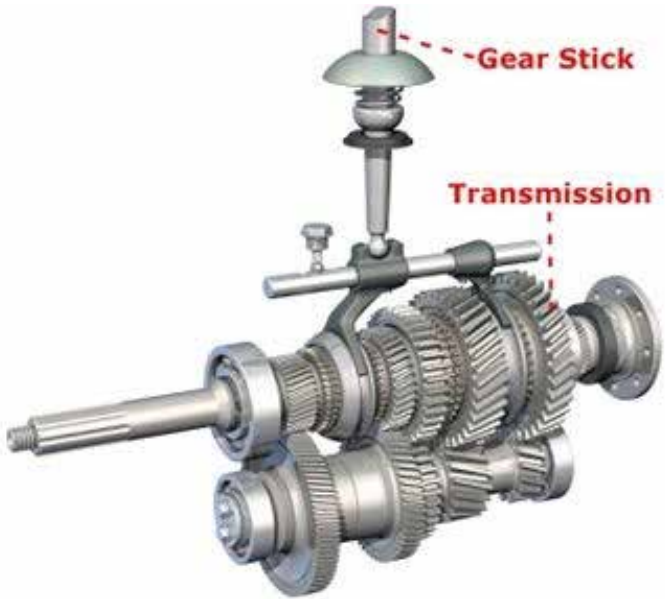


Figure 2.4.6: Gearbox: often referred to as the transmission system

A transmission is a machine in a power transmission system, which provides controlled application of the power. Often the term transmission refers simply to the gearbox that uses gears and gear trains to provide speed and torque conversions from a rotating power source to another device.

Features of Gearbox (Transmission System):

- Transmission adapts the output of the internal combustion engine to the drive wheels. As discussed in the table above, the gearbox helps to adapt the output of the gas turbine
- Such engines need to operate at a relatively high rotational speed, which is inappropriate for starting, stopping, and slower travel
- The transmission reduces the higher engine speed to the slower wheel speed, increasing torque in the process
- Transmissions are also used on pedal bicycles, fixed machines, and where different rotational speeds and torques are adapted
- Often, a transmission has multiple gear ratios (or simply "gears") with the ability to switch between them as speed varies. This switching may be done manually (by the operator) or automatically
- Directional (forward and reverse) control may also be provided
- The output of the transmission is transmitted via the driveshaft to one or more differentials, which drives the wheels

Unit 2.5 Oil & Gas Production Processes (Onsite Training)

Unit Objectives

At the end of this unit, you will be able to:

- Analyze the oil and gas production process
- Identify oil and gas equipment
- Evaluate preventive measurements
- Prioritize record-keeping and reporting
- Estimate the HSE requirements

Understand Preventive Maintenance Requirements

Oil and gas industry employs few of the most gigantic machines, operating on a 24 by 7 basis. The production platforms deal with some of the most tedious and delicate processes and equipment, which need utmost care. If we consider the rough and harsh atmosphere along with these facts, it becomes obvious how significant preventive measurements are in this industry.

We have already discussed the process and equipment in the previous units. It has been discussed that on Sundays at oil rigs, a meeting is held regarding the safety and preventive maintenance to ensure the healthy and steady production. Here we will discuss the preventive maintenance in the hydrocarbon industry.

Figure 2.5.1: Importance of Preventive Maintenance

Approximately 80% of industry investment is spent on maintaining and repairing malfunctioning equipment and engineering systems. Application of well-designed preventive maintenance procedures provides about 50% cost savings.

Traditional methods for implementing maintenance procedures are time-consuming and expensive. In many cases, maintenance tasks are not totally effective because of scheduling constraints, human error, safety restrictions, environmental hazards, and in some cases equipment inaccessibility.

The main goals of preventive maintenance are:

- To make it possible for equipment to operate reliably, safely, and optimally in a specified environment
- To perform scheduled industrial inspection and maintenance tasks on a regular basis to prevent equipment downtime or failure
- To anticipate possible equipment failure and to regularly perform inspections, calibrations, lubrication, parts replacement, and other activities that will prevent equipment downtime or failure
- To minimize the cost of operating the equipment
- To promptly respond to equipment malfunctions or failure incidents that require maintenance and/or repair while safeguarding the safety of maintenance personnel and technicians

Now, the process and application of preventive maintenance differ from sector to sector, based on the type of service or product they offer. For example, the preventive maintenance in a textile sector will not be exactly the same to that of the hydrocarbon sector. In the oil and gas sector, mainly three kinds of maintenance measurements prevail. They are –

Preventive Maintenance

Preventive maintenance performs planned, periodic and specific tasks to keep equipment in good working order. Normal maintenance tasks involve

- Inspections
- Lubrication
- Checking for oil or gas leakage and wear

The purpose of preventive maintenance is to take precautionary and proactive steps to forestall or reduce the probability of equipment malfunction or failure.

Corrective Maintenance

Corrective maintenance necessitates repair or downtime to return malfunctioning or failed equipment to its operational condition. **This is not a desirable type of maintenance.** It could be avoided or minimized by performing preventive maintenance

Predictive Maintenance

Predictive maintenance uses

- Measurements
- Signal processing
- Reliability engineering to estimate the useful lifetime of the equipment

This type of maintenance supplements preventive maintenance, and it requires close collaboration with equipment vendors.

Traditional maintenance programs for the oil and gas industry involve manual tasks that have many disadvantages. Some of these disadvantages are the following:

- Industrial inspections of long pipelines can take a long time. This task requires much manpower and transportation of tools, and it could become a logistic nightmare. Furthermore, pipelines require constant monitoring because they are expected to provide safe transport of petroleum products over remote and possibly hostile and unsafe environments

- Sometimes, severe weather conditions make it difficult, unsafe and sometimes impossible to perform urgently needed maintenance tasks
- It is often difficult for maintenance personnel to spot defects such as cracks in mechanical components when the defects are in inaccessible areas

However, with the advancement of technology, it has become hassle-free and comparatively easier to perform preventive maintenance.

The use of drone technology will vastly improve upon manual preventive maintenance and industrial inspections. The following steps will eliminate disadvantages associated with traditional manually based maintenance tasks.

1. Invest in drone surveillance of pipelines. Drones can reliably and safely inspect large stretches of pipelines in much shorter time and lower inspection costs than human inspection. In certain projects, drone services reduce project costs and inspection time by 90%
2. Use drone services technology to increase the frequency of preventive maintenance. Leakages in pipelines can be detected by sensors mounted in a drone. The exact location of leaks will be reported by a drone equipped with GPS technology
3. Use drones to inspect and transmit images of mechanical equipment that need replacement due to wear, cracks or malfunction. Drones can take detailed, accurate images of equipment even in locations that are inaccessible to humans
4. Use drones to increase the frequency of inspections that are required for preventive maintenance. Apart from significant savings in manpower and insurance costs, frequent drone inspections will reduce the likelihood of equipment failure or malfunction
5. Work with drone vendors to equip drones with robotic tools that can perform simple maintenance tasks such as lubrication and cleaning
6. Train maintenance personnel to upgrade their skills and training to include drone-based preventive maintenance

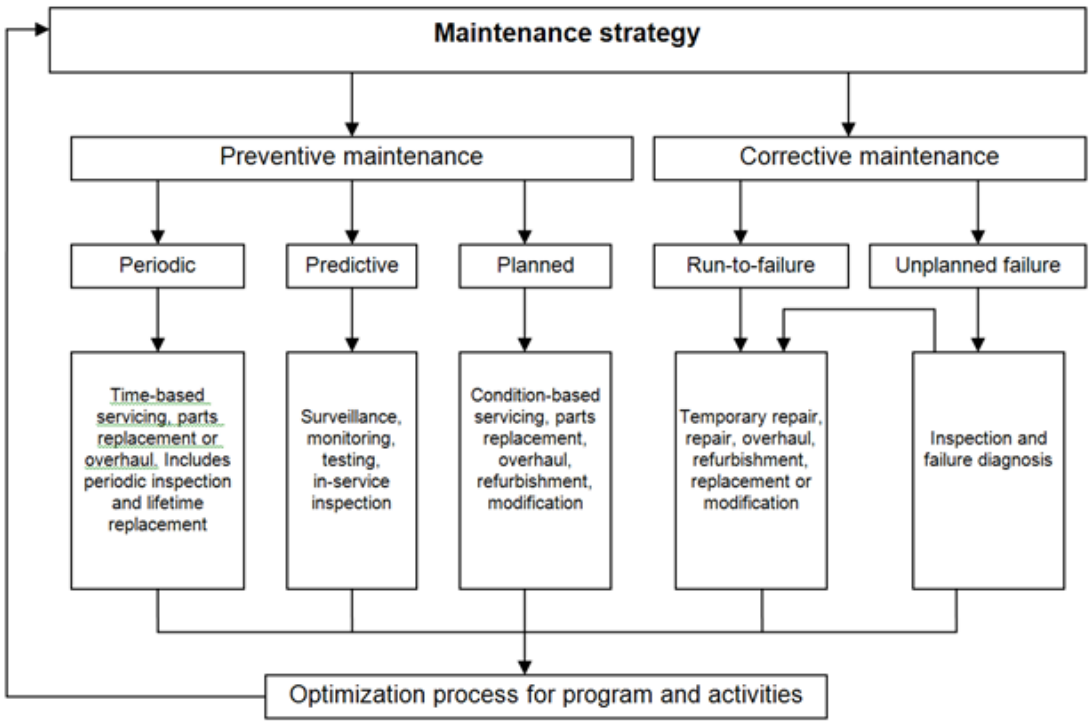


Figure 2.5.2: A brief outline of the preventive maintenance and corrective maintenance

Understand the HSE Requirement

Health, Safety and Environmental (HSE) Management is an integral and essential part of the way business is done and is considered an equal part of the wider system for the management of the business.

Hazards in Oil and Gas industry can be divided into two broad categories:

- Safety and Injury Hazards
- Health and Illnesses Hazards

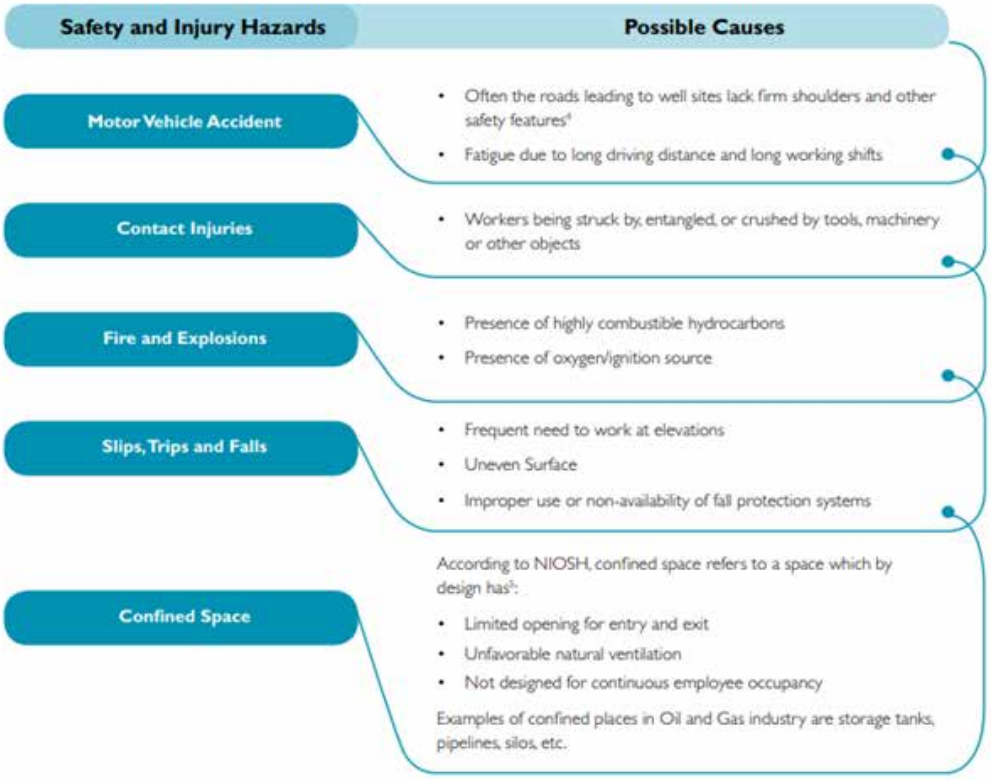


Figure 2.5.3: Various types of hazards and their possible causes

Workers in Oil and Gas industry are generally susceptible to following agents which lead to various health and Illnesses hazards:

- Chemical hazards (toxic, corrosive, carcinogens, asphyxiates, irritant and sensitizing substances)
- Physical hazards (noise, vibration, radiations, extreme temperature)
- Biological hazards (virus, parasites, bacteria)
- Ergonomic hazards (manual handling activities, repetitive motions, awkward postures)
- Psychosocial hazards (overwork, odd working hours, isolated sites, violence)

Understand the Emergency Response Roles and Responsibility

How to Respond to an Emergency Situation

An **Emergency** can be defined as "a serious, unexpected, and often dangerous situation requiring immediate action." Responding to an Emergency situation, while working at the site, involves the following steps:

Describe the associated risks and implications for people, equipment and the environment

- One must remain calm and composed during an emergency situation because stress during an emergency complicates things and confuses a person.
- One must critically and rationally think and evaluate the severity of the emergency and determine, what requires to be done on immediate basis.
- One must look for additional help by calling up the emergency toll free number, which would help the caller reach an official or 'dispatcher'.
- The emergency dispatcher aims at providing immediate and appropriate help, depending on the nature and degree of emergency.
- One must help the dispatcher by answering his / her questions and providing the dispatcher with the accurate location and nature of emergency.
- It is recommended that one should call from a GPS equipped phone, so that the dispatcher is able to track the location, even if the caller is unable to speak.
- One must determine the nature of the emergency, i.e. if it is a medical, mental health or behavioural emergency.
- One must assess the immediate threats, for example, in case a person is severely injured from a running machine, the machine must be turned off immediately to prevent others from getting hurt as well.

Identify potential hazards in a workshop environment

- Extremely high casualties must be reported to the Occupational Health and Safety Committee (OHSC).
- One must move farther from the emergency spot and help others do the same.
- Evacuation Plans must be adopted and Escape Routes must be taken.
- Secondary Hazards must be eliminated or mitigated, at least. For example, a car accident involves the risk of a violent explosion and fire outbreak resulting from spilled fuel.
- One must help the other victims and take appropriate measures to help the specially abled ones.
- One must never feel guilty if nothing can be done to help the others.
- Once the emergency team arrives, it must be provided with all required and relevant information.
- In case nothing can be done to mitigate the severity of the situation, one must provide support to the others by comforting them, inquiring about their medical history, noting events as they occur, etc. These information may prove crucial for the emergency response team.
- A First Aid kit must be used, wherever applicable.
- One must try reviving a seemingly unconscious victim by rubbing the chest, pinching the earlobes, providing Cardiopulmonary Resuscitation (combination of chest compression and artificial respiration)
- One must avoid moving a severely injured victim and provide only the basic first aids.
- Only the emergency services can properly handle and move such victims.

Identify relevant emergency requirements for a maintenance workshop

- First Aid is an emergency care or treatment given to an ill or injured person before regular medical aid can be obtained.
- Before administering First Aid to a victim, one must check the category and degree of emergency and then apply the techniques duly.
- Stop and look at the scene and the person before responding.
- Ask yourself the following questions:
  - Is the scene safe for you to enter?
  - What happened exactly?
  - What is the casualty?
  - What is the category and nature of the emergency?
  - Is the accident fatal for the victim?
  - Is anyone else available at the place to help?
- Do the following if the victim is conscious and injury is not fatal:
  - Ask for the victim's consent to administer first aid.
  - Put on appropriate PPE, if possible.
  - Interview the victim to ask basic medical questions, so that accurate information may be provided to the Emergency Medical Team, once it arrives.
  - Conduct a thorough check for undetected injuries.
  - Administer appropriate care and technique.
- If the victim is unconscious, try reviving the person by addressing him / her, rubbing shoulders, hands or the sole of feet.

Fetch the AED and use it, along with Artificial Respiration.

Communicate and work effectively as part of a team for maintenance tasks: Understand the record keeping and reporting instructions

- As an important part of the emergency management procedure, any workplace must elect a Safety Committee, which comprise responsible and senior people from all departments and teams.
- This committee would act as the legislative body, the authority and the first point of contact for reporting any hazard, potential risks / threats and emergency situations at the entire workplace.
- This committee would also be responsible for conducting training sessions, safety audits and drills, to help all employees prepare themselves for emergency and unprecedented situations.
- The list of the committee members, their designations and job titles, as well as contact numbers must be listed and circulated among all staff members.
- The Safety Committee must comprise important members from the following departments:
  - Supervisor / Manager / Team Lead from each project
  - Security Services
  - Reception / Front Desk
  - Building Operations and Maintenance team
  - Emergency Medical Services
  - Counselling and Psychological Services team
- This list must be put up for easy display at prominent parts of the workplace, in the form of an Emergency Escalation Matrix and must be updated regularly.
- Furthermore, this list must be mandatorily included in every First Aid kit available in the workplace premises, so that a person treating a victim with first aid techniques may summon additional help and report the accident.

Unit 2.6 Health and Safety in Production and Maintenance

Unit Objectives

At the end of this unit, you will be able to:

- Identify the safe working practices
- Estimate the risk associated to a job and the procedure to minimize it
- Prioritize clean and tidy work place to avoid mishaps

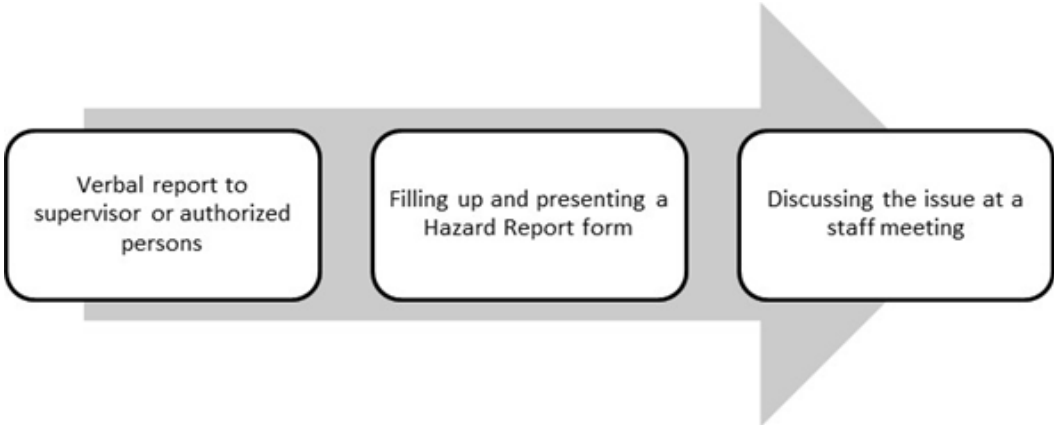
Describe safe working practices for working in a maintenance workshop and describe the operation of safety documentation and procedures

Every organization, from every industry, has a standard reporting protocol, comprising the details of people in the reporting hierarchy as well as the guidelines to be followed to report emergencies. However, the structure of this reporting hierarchy varies between organizations, but the basic purpose behind the reporting procedure remains same.

The general highlights of the Organizational Reporting Protocol, commonly known as the 6Cs, are:

- **Communicate First**
  - The first source of information during emergency is the preferred source.
  - Crises situations are time-bound and hence it is important to communicate promptly.
- **Communicate Rightly**
  - Distortion of information due to panic must be avoided.
  - Proper, accurate information must be provided to concerned authorities and thiis can save lives.
- **Communicate Credibly**
  - Integrity and truthfulness must never be forgotten during emergencies.
- **Communicate empathetically**
  - One must wear the shoes of the victims while communicating emergencies.
- **Communicate to instigate appropriate action**
  - Communicating to the right authorities help in taking the necessary action.
- **Communicate to promote respect**
  - Communicating with the victims with respect help in earning their trust and thus eases the disaster management process.

Hazards and potential risks / threats can be identified and then reported to supervisors or other authorized persons in the following ways:



While identifying and reporting a hazard / potential threat / potential risk, one must describe the following:

Names (And Job Titles If Applicable), and Where To Find, All The People Responsible For Health And Safety In A Workplace: Names and location of documents that refer to health and safety in the workplace

Part A: To be completed by the Worker

Details Required:

- Name of Worker
- Designation
- Date of filling up the form
- Time of incident / accident
- Supervisor / Manager Name
- Work Location / Address
- Description of the hazard / what happened (Includes area, task, equipment, tools and people involved)
- Possible solutions to prevent recurrence (Suggestions)

Part B: To be completed by the Supervisor / Manager

Details Required:

- Results of Investigation (Comment on if the hazard is severe enough to cause an injury and mention the causes of the incident / accident)

Part C: To be completed by the Supervisor / Manager

Details Required:

- Actions taken / Measures adopted (Identify and devise actions to prevent further injury, illness and casualty)

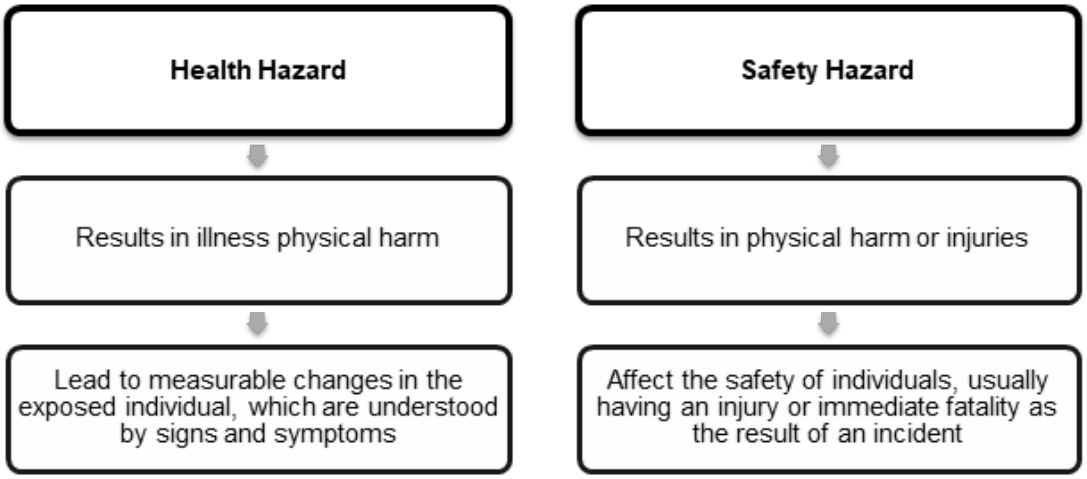
Type of API Pump	Advantages	Disadvantages

Describe measures that could be taken to minimise the risks

- Any job role and any occupation in this world has some hazards, in varying severity, associated with it. These are called **Occupational Hazards**.
- Occupational Hazard can be defined as "a risk accepted as a consequence of a particular occupation".
- According to the Collins English Dictionary, it is defined as "something unpleasant that one may suffer or experience as a result of doing his or her job".
- Occupational Hazards are caused by the following:
  - **Hazardous Working Ambience**
    - Unsafe and unguarded machinery and tools
    - Hazardous and unmonitored processes
    - Inappropriate and inadequate ventilation
    - Inappropriate and inadequate illumination
    - Inappropriate and unsafe dress
  - **Hazardous Behaviour and Acts**
    - Using unsafe and unguarded machinery and tools
    - Neglecting safety guidelines while working
    - Ignoring the Instruction Manual or Directions for Use
    - Unsafe lifting, loading, staging, assembling and installing
    - Not adopting the prescribed ergonomic postures
    - Handling Personal Protective Equipment (PPE) and Safety Devices dysfunctional

Common Health and Safety Hazards

- On the basis of effects on individuals, Occupational Hazards can be broadly categorized into: **Health** and **Safety Hazards**.
- Examples of Health Hazards are:
  - Carcinogenic factors
  - Corrosive
  - Toxic
  - Irritant
  - Factors that may lead to chronic and adverse effects on one's health
- Examples of Safety Hazards are:
  - Spills on floors
  - Tripping hazards like loose cords and cluttered workplace Working from high or raised areas like ladders, cranes, scaffolds, rooftops etc.
  - Unsafe and unguarded machinery and their moving parts
  - Electrical hazards like live wires, lack of earthing, loose cables, frayed cords, wet and poorly insulated devices, etc.
  - Inadequate space



Risk Control Strategies

Once the hazards are identified and the severity of the associated risks assessed, the risks must be controlled and mitigated using appropriate strategies and programs. The various popular Risk Control Strategies are:

- **Risk Defence -** This involves implementing safeguards and protection methods to eradicate or lessen uncontrolled risk. Ex - Using Personal Protective Equipment (PPE) while encountering hazardous operations.

- **Risk Avoidance -**This involves averting a particular risk by discontinuing a given operation or process and replacing it with a safer option. Ex - An explosive chemical can be replaced with a non-explosive or less explosive one.

- **Risk Transfer -**This strategy involves transferring risks to other related areas in order to distribute the chances of loss equally or proportionately, so that one particular area does not get affected. Ex - In Financial Management for an organization, its funds are invested into multiple projects involving varying degrees of risks, so that the losses (if any) incurred with one investment option can be offset with the profits earned from the remaining. This is called "Risk Distribution or Transfer". Purchasing an Insurance policy against a probable accident is also another good example.

- **Risk Mitigation -** This strategy calls for reducing the impact of risks in a given operation or process, in case the vulnerable areas of the process get affected.

- **Risk Retention -** Under this strategy, the risk associated with a given process is accepted and retained in the organization. The organization takes appropriate measures, in advance, to compensate for and finance the loss associated with the risk. This strategy typically involves two aspects - Risk Retention with prior knowledge and Risk Retention without prior knowledge. Ex - In Accounting, an organization keeps provision for Loss and Bad Debts (amounts, which cannot be retrieved form debtors). This is similar to buying an insurance against a probable Accident.

- **Risk Elimination -** This strategy can be implemented by adopting suitable measures to curb the severity of a given risk. This can be accomplished by fixing a vulnerability or weakness in the organization that exposes the organization and its operations to the risk. Compensatory control systems are set up to either mitigate the probability of the weakness, at its very root, or lessening the severity of its impact.

Take Part in A Tool Box Talk

Toolbox talks are a way to ensure all workers are participating in safety activities, and have an opportunity to discuss hazards/controls, incidents and accidents.

As part of the Health and Safety at Work Act, employers must provide employees the opportunity to regularly engage in health and safety discussions.

Usually, on Sunday meetings, the Toolbox Talk is brought up. The site members should participate in the programme to ensure and enhance the prospects of healthy and safe work space. The meeting has some fixed, predetermined topics, which are analyzed and evaluated in the programme. The goals of Toolbox talks are –

- Schedule the meeting
- Set the scene for the meeting — keep it real and be positive
- Follow an agenda
    - Inform workers of changes to company procedures
    - Identify new hazards and review existing hazards
    - Develop/review hazard controls
    - Discuss/review accident and incident data
    - Discuss the work programme for the day/week ahead
    - Have company leaders talk about the business direction or a particular topic

- Discuss any new equipment on site
- Provide a short training session

- Close the meeting
- Record meeting notes

Find a template for toolbox talks below:

Company | Site Name

Site Briefing/Toolbox Meeting

This document is a companion document to the site inspection checklist

Site-Specific Briefing

Project Information

Site name | Office location

Who is running this meeting?

Name | Company | Date

Agenda items

Agenda items | Theme of the week

Health and safety issues

Site activities/ safe work practices/ incident reports and investigations discussed

Issues raised from site safety inspection | Actions | By who and when

Issues outstanding from previous briefings | Actions | By who and when

Employee-raised issues | Actions | By who and when

Positive safe-action observations | Actions | By who and when

Incidents or injuries | Actions | By who and when

Figure 2.6.1: Toolbox Talks (page 1)

Figure 2.6.2: Toolbox Talks Template (page 2)

Use Correct Manual Handling Techniques for Maintenance Tasks

Almost every occupational setting requires some form of manual handling. Space limitations, varied nature of the activity, and the reluctance to make substantial investment in mechanised/automated equipment are some of the reasons for not avoiding or reducing manual handling Invariably, the abilities of individuals to perform these activities, either frequently or occasionally are exceeded, resulting in severe chronic or acute injuries.

There is now substantial international acceptance of both the scale of manual handling hazards and methods of prevention. Modern medical and scientific knowledge stresses the importance of an ergonomic approach to remove or reduce the risk of manual handling injury.

- Ergonomics is sometimes described as “fitting the job to the person rather than the person to the job”
- The ergonomic approach, therefore, looks at manual handling as a whole. It takes into account a range of relevant factors including the nature of the task, the load, and the work environment
- An effective way of managing manual handling in the workplace is to develop a manual handling management programme (MHMP)
- The programme should not be considered in isolation but should be considered as a part of the overall system for managing health and safety.
- A programme such as this will be made up of a number of key elements, which include:

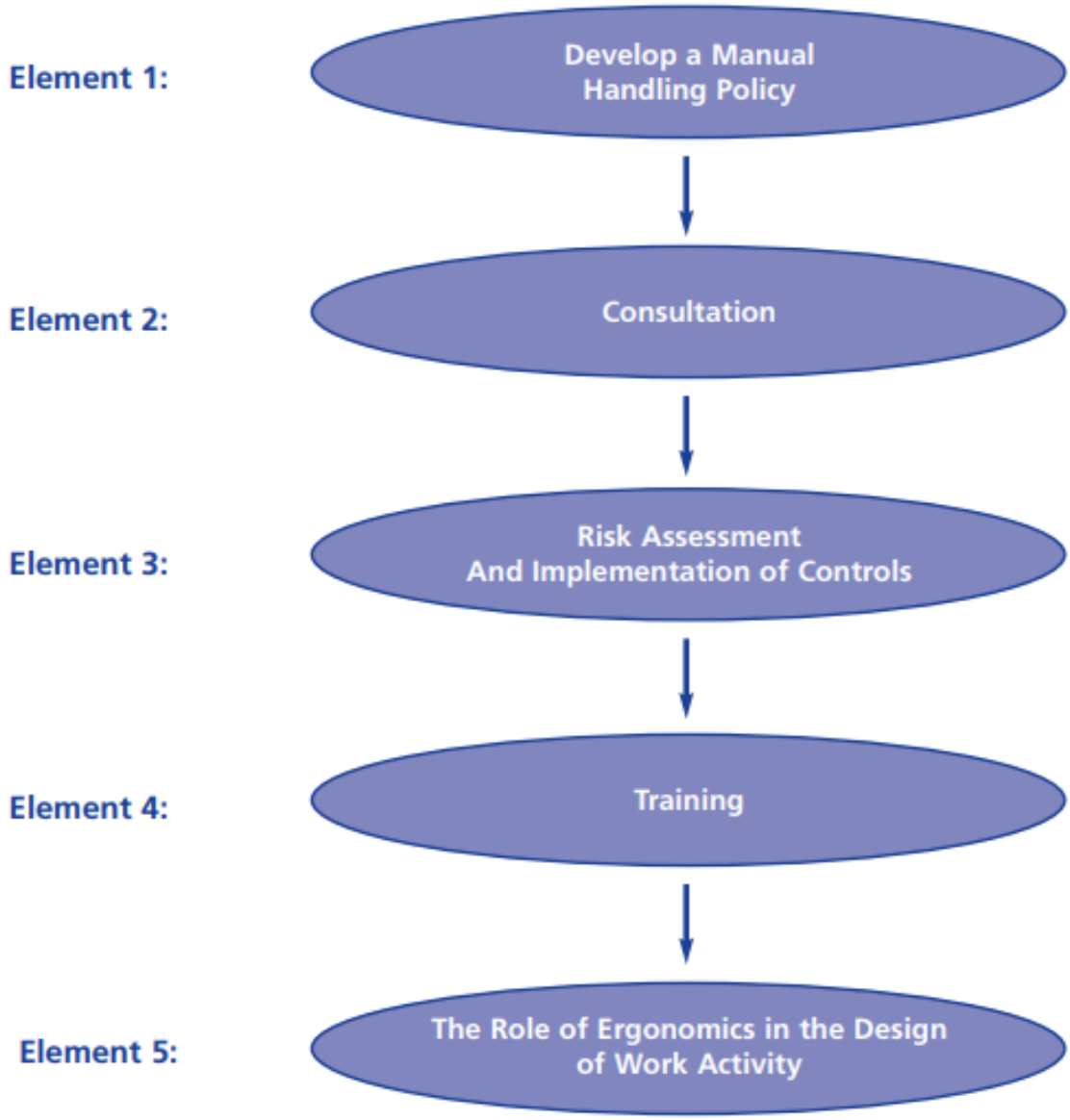


Figure 2.6.3: Flowchart of the Manual Handling Management Programme (MHMP)

Select and us the correct personal protection equipment for maintenance tasks

Protective clothing/equipment for specific tasks

Disposable Mask

Corded Earplugs

Grey Durastreme (Eye Protection)

Peak Hard Hat

Specialised Gloves

Redcoat Plus

Oil Grip

Perfect Cutting Nit

Skeleton Glove

Welding and Fabrication

Welder Gloves

Supereight Shield

Tigerhood Classic (fibre metal)

Fibre-Metal Welding Helmet

Rigging

Rigger Boot

Nitri Task KL

Optema

Fibre-Metal Supereight Cap

Maintain the workspace in a clean and tidy manner and dispose of waste

- **Handle materials, machinery, equipment and tools safely and correctly**
  - Workers should never carry tools up or down a ladder in a way that inhibits grip.
  - Tools should be hoisted up and down using a bucket or strong bag, rather than being carried by the worker.
  - Tools should be carefully handed over from one worker to another and must never be tossed. Pointed tools should be passed either in their carrier or with the handles toward the receiver.

- Workers carrying large tools or equipment on their shoulders should stay alert of clearances, while turning and manoeuvring around the workplace.
- Pointed tools, such as chisels and screwdrivers, should never be carried in a worker's pocket. Recommended ways to carry them are:
- In a toolbox, pointed down in a tool belt or pocket tool pouch
- In the hand with the tip always held away from the body
- Tools should be put away when not in use. Leaving tools unattended on an elevated structure such as a scaffold poses a significant risk to workers below. This risk increases in areas with heavy vibration.

- **Use correct handling procedures**

  Lack of knowledge in correct handling procedure can lead to Musculoskeletal Disorders. Handling involves lifting, lowering, pushing, pulling and carrying. Correct handling techniques involve:
  - Lifting, by taking into consideration:
    - Nature of load
    - Individual capacity
    - Environmental condition
  - Reduce the amount of twisting and stooping while handling things manually
  - Do not lift from floor level or above shoulder height, especially for heavy loads
  - Adjust storage areas to mitigate the need to execute such motions
  - Consider how you can mitigate transporting load across distances
  - Evaluate the weight to be carried and identify if the worker can move the load safely or needs assistance
  - Identify if the load can be broken down into smaller, lighter components

- **Maintain tools equipment and consumables**
  - It is essential that in order to keep tools, equipment and consumables in good working condition, they must be subjected to periodic maintenance.
  - The frequency of maintenance depends upon the following factors:
    - The manufacturer's instructions and recommendations
    - The intensity and degree of use
    - The physical working conditions like temperature, humidity, weathering, etc.
    - The severity of potential risks and threats arising from unprecedented but likely malfunction

- **Use cleaning equipment and methods appropriate for the work to be carried out**
  - Cleaning tools and equipment must be selected according to the nature of task, surface and the required intensity of cleaning.
  - Delicate surfaces must not be treated with strong and corrosive cleaning agents like acids and alkalis.
  - On the contrary, surfaces that require intensive cleaning cannot be treated with mild cleaning agents.
  - Cleaning equipment, especially the powered ones, come with Instruction Manuals, which not only explain the steps involved in using the, but also comprise Precautionary Measures, Dos and Don'ts of handling them.
  - For example, Vacuum Cleaners must never be used on wet surfaces.

- **Ensure safe and correct handling of materials, equipment and tools**
  - Supervisors must inspect the on-going tasks in the work area to ensure safe and correct handling of materials, equipment and tools.
  - Surprise Audits must be conducted from time to time to ensure that all safety measures, like ergonomic procedures and safe handling of powered tools, are being adhered to by the workers.
  - Checklists and inspection sheets must be maintained at the workplace to keep a track of the maintenance and audit schedules.
  - Workers must refer to SOPs from time to time, to ensure that they do not deviate from the safety protocols in handling materials, equipment and tools.

- **Store cleaning equipment safely after use**
  - Cleaning tool and agents, which fall under the same category, must be kept and stored together.
  - Cleaning agents must be stored in a cool, dry place in containers of compatible materials.
  - Flammable liquids and gases must be stored in pressure-safe containers with appropriate labels on.
  - Such flammable substances must be stored in secluded and well-ventilated places, at least 50 feet away from sources of heat or flame.
  - Places for storing chemicals must contain a book of all MSDS sheets.
  - Chemical cleaning agents must be stored in secure shelve or in a locked cupboard.
  - Sharp equipment must be stored in sheaths or designated racks.
  - Powered equipment must be turned off, when not in use.

Unit 2.7 Basic Engineering Communications

Unit Objectives

At the end of this unit, you will be able to:

- Differentiate the types of signal
- Analyze analog and digital signals
- Evaluate the basic logic gate

Meaning and Importance of Engineering Communications

Advances in technology are improving capabilities of analyzing diverse information sources such as –

- Audio (speech, acoustics, music)
- Image (video, multimedia, medical scans)
- Medical signals (heart rate, blood pressure, brain activity)
- Remote sensing data (geophysical, radar, sonar)

Examples of systems that manipulate signals are speech recognition, video streaming, cellular networks and medical scans such as MRI.

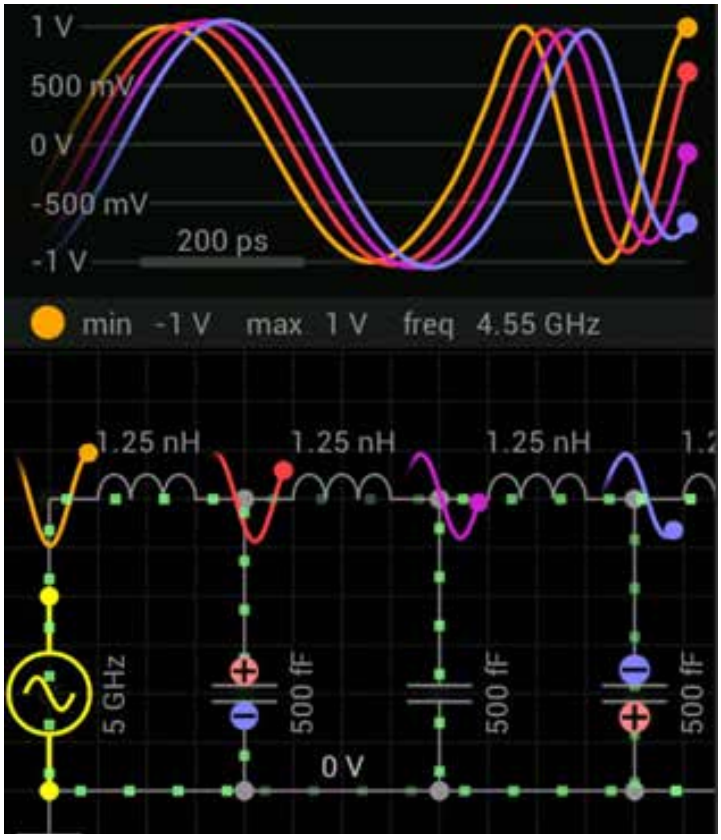


Figure 2.7.1: Signal, system and transmision – the pillars of modern Engineering Communication

The disciplines of signal and image processing are concerned with the analysis and synthesis of signals and their interaction with systems. In communications, the objective is to transfer information (signals) from one or many sources to one or many destinations, which requires the design of transmission schemes (e.g., modulation and coding), receivers, and filters.

The Signal Systems and Communications area covers the fundamentals of analog and digital signals and systems, the mathematical tools for the analysis of deterministic and random signals, and applications to digital signal processing, digital image processing, and digital/analog communications.

What is Signal? What is Signal Processing?

- Signal processing concerns the analysis, synthesis, and modification of signals, which are broadly defined as functions conveying "information about the behavior or attributes of some phenomenon"
- In a communication system, a transmitter encodes a message to a signal, which is carried to a receiver by the communications channel
- A typical role for signals is in signal processing. A common example is signal transmission between different locations

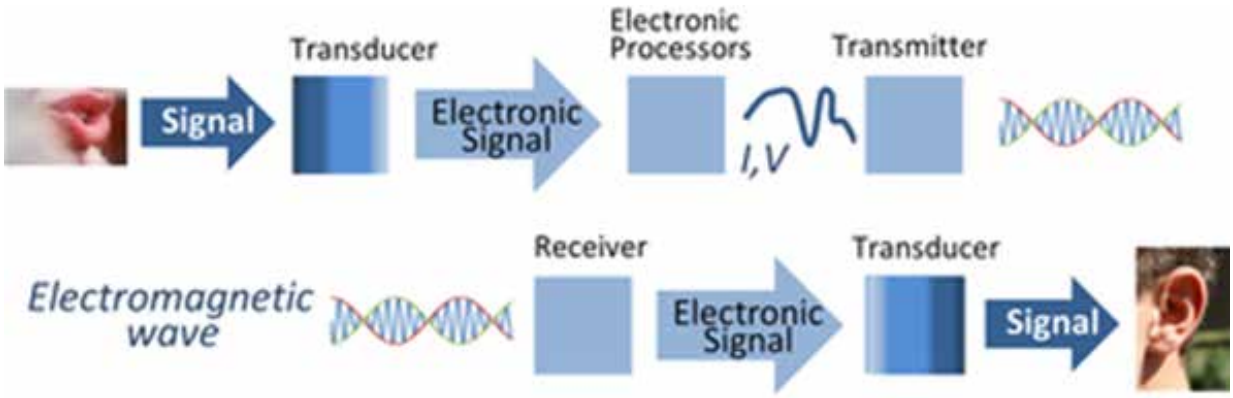


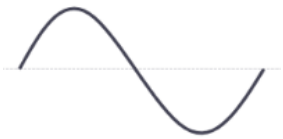
Figure 2.7.2: Signal processing

Types of Signal

Two main types of signals encountered in practice are

- Analog
- Digital

A. Analog Signal



Analog Signal

- An analog signal is any continuous signal
- An analog signal uses some property of the medium to convey the signal's information
- Any information may be conveyed by an analog signal
- The physical variable (like air pressure, light, temperature) is converted to an analog signal by a transducer

B. Digital Signal

Digital Signal

- A digital signal is a signal that is constructed from a discrete set of waveforms of a physical quantity
- A logic signal is a digital signal with only two possible values
- a digital signal may be considered to be the sequence of codes represented by physical quantity
- Digital signals often arise via sampling of analog signals, for example, a continually fluctuating voltage on a line that can be digitized by an analog-to-digital converter circuit

Differences Between Analog and Digital Signals

Basis For Comparison	Analog Signal	Digital Signal
Basic	An analog signal is a continuous wave that changes over a time period.	A digital signal is a discrete wave that carries information in binary form.
Representation	An analog signal is represented by a sine wave.	A digital signal is represented by square waves.
Description	An analog signal is described by the amplitude, period or frequency, and phase.	A digital signal is described by bit rate and bit intervals.
Range	Analog signal has no fixed range.	Digital signal has a finite range i.e. between 0 and 1.
Distortion	An analog signal is more prone to distortion.	A digital signal is less prone to distortion.
Transmit	An analog signal transmits data in the form of a wave.	A digital signal carries data in the binary form i.e. 0 nad 1.
Example	The human voice is the best example of an analog signal.	Signals used for transmission in a computer are the digital signal.

Understanding the Components of a Basic Digital Circuit

Digital Signal Processing or DSP manipulates different types of signals with the intention of filtering, measuring, or compressing and producing analog signals. digital signal information is translated into binary format where each bit of data is represented by two distinguishable amplitudes. Digital signals are represented as square waves.

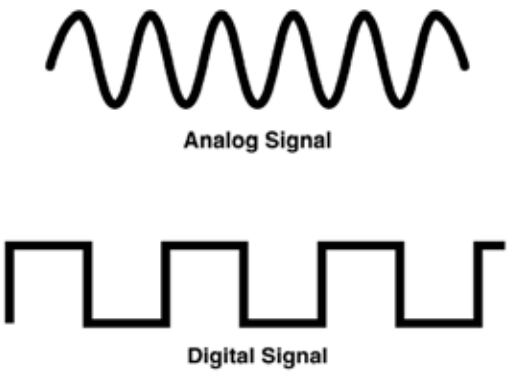


Figure 2.7.3 Analog Signal Wave vs. Digital Signal Wave

A DSP contains 4 key components:

- **Computing Engine:** Mathematical manipulations, calculations, and processes by accessing the program, or task, from the Program Memory and the information stored in the Data Memory.
- **Data Memory:** This stores the information to be processed and works hand in hand with program memory.
- **Program Memory:** This stores the programs, or tasks, that the DSP will use to process, compress, or manipulate data.
- **I/O:** This can be used for various things, depending on the field DSP is being used for, i.e. external ports, serial ports, timers, and connecting to the outside world.

Below is a figure of what the four components of a DSP look like in a general system configuration.

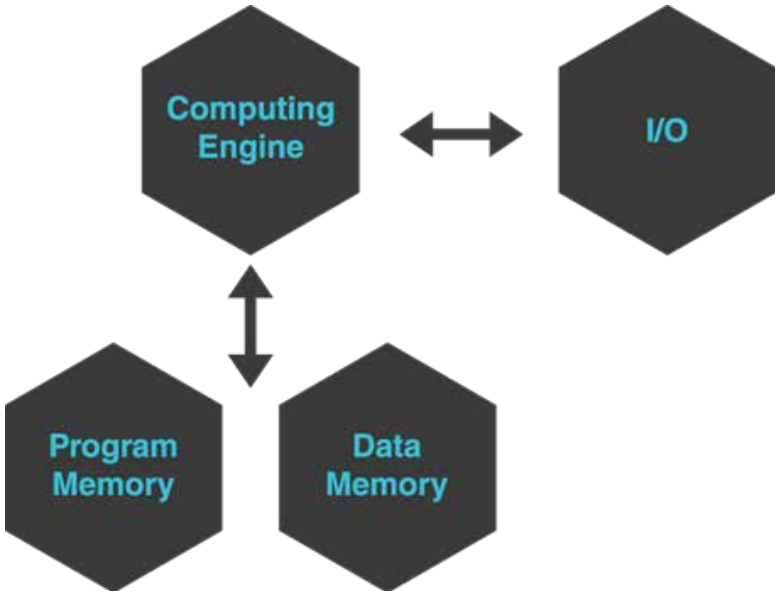


Figure 2.7.4: Four components of digital signal

Binary Logic and Basic Logic Gates (AND, OR, XOR, NOR, NAND, etc.)

Binary logic refers to the classical propositional two-valued logic, also called Boolean logic in engineering.

- Boolean algebra is the branch of algebra in which the values of the variables are the truth values true and false, usually denoted 1 and 0 respectively
- Instead of elementary algebra where the values of the variables are numbers, and the prime operations are addition and multiplication, the main operations of Boolean algebra are the conjunction and denoted as "Λ", the disjunction or denoted as "V", and the negation not denoted as "¬"

Whereas in elementary algebra expressions denote mainly numbers, in Boolean algebra they denote the truth values false and true. These values are represented with the bits (or binary digits), namely 0 and 1. They do not behave like the integers 0 and 1, for which 1 + 1 = 2, but may be identified with the elements of the two-element field GF(2), that is, integer arithmetic modulo 2, for which 1 + 1 = 0. Addition and multiplication then play the Boolean roles of XOR (exclusive-or) and AND (conjunction) respectively, with disjunction xVy (inclusive-or) definable as x + y + xy.

Basic Operations:

The basic operations of Boolean algebra are as follows:

- AND (conjunction), denoted xΛy (sometimes x AND y or Kxy), satisfies xΛy = 1 if x = y = 1 and xΛy = 0 otherwise
- OR (disjunction), denoted xVy (sometimes x OR y or Axy), satisfies xVy = 0 if x = y = 0 and xVy = 1 otherwise
- NOT (negation), denoted ¬x (sometimes NOT x, Nx or !x), satisfies ¬x = 0 if x = 1 and ¬x = 1 if x = 0

x	y	$x \wedge y$	$x \vee y$
0	0	0	0
1	0	0	1
0	1	0	1
1	1	1	1

x	$\neg x$
0	1
1	0

Figure 2.7.5: Truth Table (Output against the inputs and operations)

Unit 2.8 Basic Numerical Skills

Unit Objectives

At the end of this unit, you will be able to:

- Analyze basic arithmetic operations
- Interpret fraction and percentage

Importance of Numerical Skills for the said Job Role

Numerical reasoning ability is one of the most basic skill areas, one that exists in small children well before they are taught mathematics in school. Numerical reasoning tests, also known as data interpretation or numerical critical reasoning tests, involve evaluating situations and drawing conclusions from the data provided to assess one or several of the following:

- Critical thinking ability
- Basic or general arithmetic operations
- Ability to perform estimates
- Ability to analyze graphs and other data
- Level of speed in making analyses or assessments
- Level of concentration in solving problems

Figure 2.8.1: Basic Numerical Skill

Numerical reasoning is a higher-order thinking skill and an important factor in assessing work performance. Usually, numerical thinking skills are measured using one or several of the following methods:

- Arithmetics
- Graph interpretation
- Manipulating data
- Patterns and relevant information
- Table interpretation

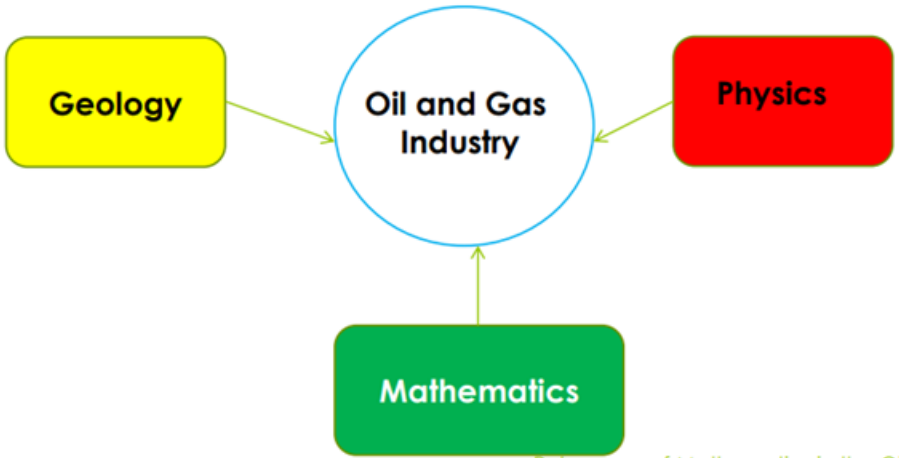


Figure 2.8.2: Oil and Gas industry – a combination of different disciplines

Relationship between Mathematics and the Oil and Gas Industry

- Mathematics is used for example to estimate the volumes of oil and gas in reservoirs to optimise performance of wells and pumps that get the oil and gas to the surface, to improve the quality of the fossil fuel projects, and to minimise vessel transportation and final delivery costs
- Philip Emeagwali said ''my mathematics came from oilfields''. He further stated that ''I invented 36 partial derivatives and used them to reinvent nine partial differential equations that can be used by the petroleum industry to recover oil
- His equations were the most advanced and the most useful form of calculus which he invented by borrowing the algebraic formula, force equals mass times acceleration (F=ma)

Facts to Note

- The Oil industry is the largest single user of mathematical programming
- Operations research branch of maths helps organise the production to maximise output or minimise cost
- Emeagwali discovered a fundamental error in the equations used by oil companies like Exxon Mobil, Shell, etc., namely four forces exist inside every petroleum reservoir; yet Exxon Mobil equation had summed only three forces. He further created new mathematics by correctly summing all four forces, namely:
  - Pressure
  - Viscosity
  - Gravity
  - Inertia
- Mobil later invited him in a letter dated March 19, 1990 to help the company in reservoir simulation. This is an important mathematical discovery that helps produce more oil (Phillip Emagwali, June 1996)

Understanding Basic Arithmetic Operations

- **Addition:** Addition is the most basic operation of arithmetic. In its simplest form, addition combines two quantities into a single quantity, or sum. For example, say you have a group of 2 boxes and another group of 3 boxes. If you combine both groups together, you now have one group of 5 boxes.

  Example: 2 + 3 = 5

- **Subtraction:** Subtraction is the opposite of addition. Instead of adding quantities together, we are removing one quantity from another to find the difference between the two. Continuing the previous example, say you start with a group of 5 boxes. If you then remove 3 boxes from that group, you are left with 2 boxes.

  Example: 5 – 3 = 2

- **Multiplication:** Multiplication also combines multiple quantities into a single quantity, called the product. In fact, multiplication can be thought of as a consolidation of many additions. Specifically, the product of x and y is the result of x added together y times. For example, one way of counting four groups of two boxes is to add the groups together:

  2 + 2 + 2 + 2 = 8

  However, another way to count the boxes is to multiply the quantities:

  2 × 4 = 8

  Example: 2 × 4 = 8

- **Division:** Division is the inverse of multiplication. Rather than multiplying quantities together to result in a larger value, you are splitting a quantity into a smaller value, called the quotient. Again, to return to the box example, splitting up a group of 8 boxes into 4 equal groups results in 4 groups of 2 boxes.

  Example: 8 ÷ 4 = 2

The Basic Arithmetic Properties

- **Commutative Property**

  The commutative property describes equations in which the order of the numbers involved does not affect the result. Addition and multiplication are commutative operations:

  2+3 = 3+2=5

  5x2 = 2x5 =10

  Subtraction and division, however, are not commutative.

- **Associative Property**

  The associative property describes equations in which the grouping of the numbers involved does not affect the result. As with the commutative property, addition and multiplication are associative operations:

  (2+3)+6=2+ (3+6) =11

  (4x1)x2 =4x (1x2) =8

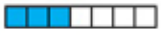
  Subtraction and division are not associative.

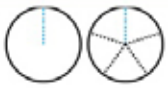
- **Distributive Property**

  The distributive property can be used when the sum of two quantities is then multiplied by a third quantity.

  (2+4)x3=2x3+4x3=18

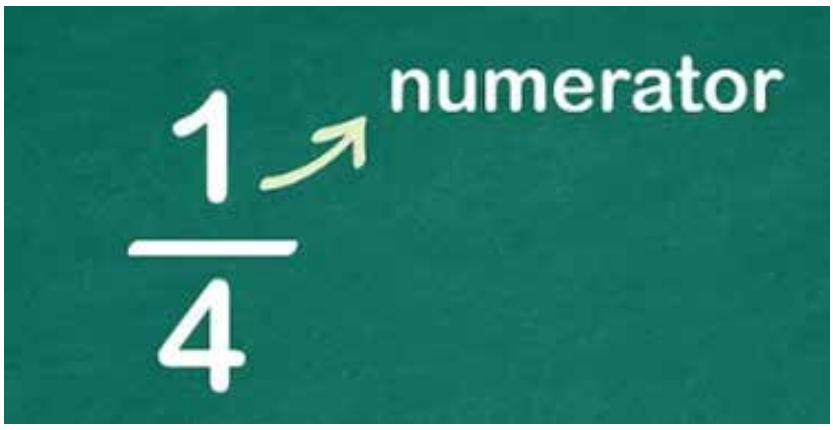
Understanding Fractions

Fractions are formed when we have a WHOLE that is divided into EQUAL parts.	
A whole is divided into **two** equal parts. ONE part is one half.  $\frac{1}{2}$	A whole is divided into **six** equal parts. ONE part is one sixth.  $\frac{1}{6}$
A whole is divided into **ten** equal parts. ONE part is one tenth.  $\frac{1}{10}$	Four parts are colored, and the whole has four equal parts. **Four fourths.**  $\frac{4}{4}$
Three parts are colored. There are seven equal parts. **Three sevenths.**  $\frac{3}{7}$	Two parts are colored, and the whole has five equal parts. **Two fifths.**  $\frac{2}{5}$

How to draw pie models		
 Halves: split the circle with a straight line.	 Thirds: draw lines at 12 o'clock, 4 o'clock, and 8 o'clock.	 Fourths: First draw halves, then split those like a cross pattern.
 Fifths: Draw like a man doing jumping jacks.	 Sixths: First draw thirds, and then split those.	 Eighths: First draw fourths, and then split those.

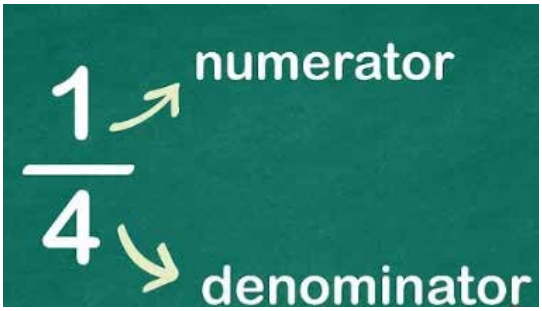
A step by step guide to the Fraction

1. **Identify the numerator.**



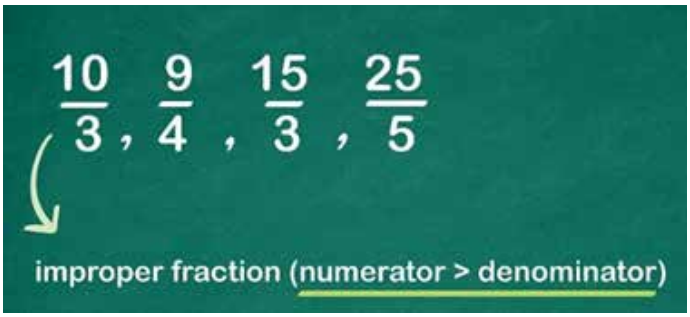
- A fraction is always written with one number on top of a line and another number underneath that line
- The numerator of a fraction is the top number. It is the “part” of the “whole” that you are talking about.

2. Identify the denominator.



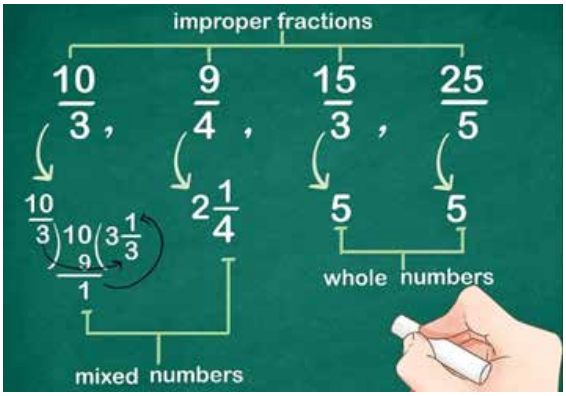
- The denominator is the bottom number of the fraction and represents the "whole"
- It is the number of parts the whole is divided into. To remember the denominator think "down"-ominator

3. Recognize an improper fraction.



- A fraction is considered improper if the numerator (the top number) is larger than the denominator (the bottom number)
- When working with fractions, you never want to write a final solution as an improper fraction
- Always remember to simplify it into a mixed or whole number

4. Simplify improper fractions into mixed or whole numbers.



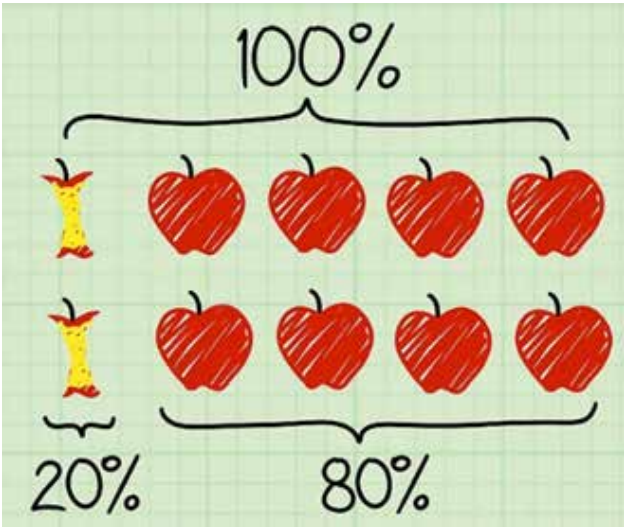
- To simplify an improper fraction, first divide the numerator by the denominator. For example, for the fraction 10/3, divide 10 by 3
- 3 goes into 10 three times (3 x 3 = 9), but there will be a remainder of 1
- Write the remainder as a fraction of the original denominator. With a remainder of 1 the fraction of the mixed number will be 1/3
- The mixed number of 10/3 is 31/3
- Note, not all improper fractions will be mixed numbers; some will simplify into whole numbers. For example: 25/5 simplifies to 5

Understanding Percentage

The term “percent” in English comes from the Italian per cento or the French pour cent, which literally mean per hundred.

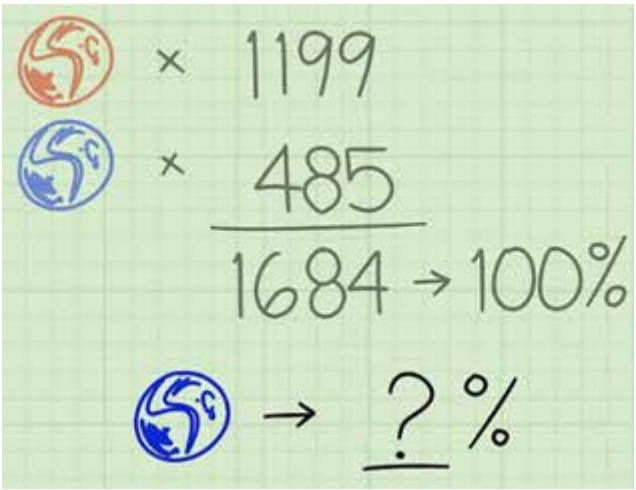
A step by step guide to the Percentage

1. **Know what a percentage is.**



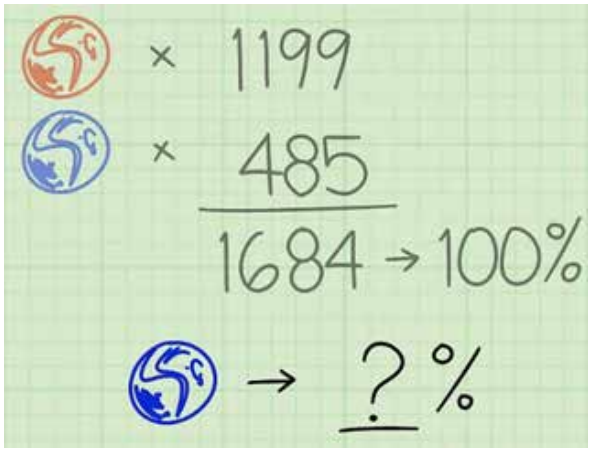
- A percentage is a way to express a number as a part of a whole
- To calculate a percentage, we look at the whole as equal to 100%
- For example, say you have 10 apples (=100%). If you eat 2 apples, then you have eaten 2/10 × 100% = 20% of your apples and you are left with 80% of your original apples

2. **Determine the value of the whole.**



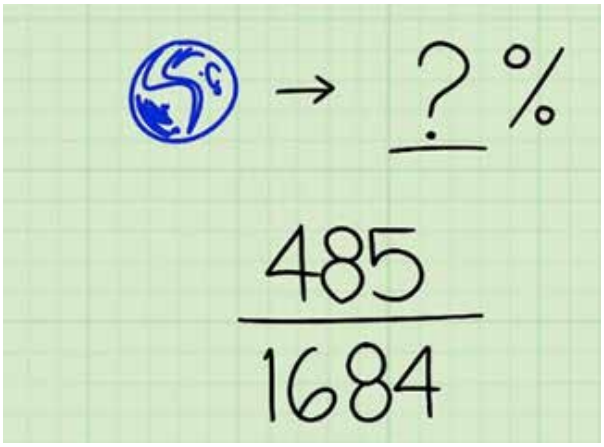
- For instance, let’s say we have a jar containing 1199 red marbles and 485 blue marbles, making it 1684 marbles in total
- In this case, 1684 makes up a whole jar of marbles, and will be set equal to 100%

3. **Find the value that you want to turn into a percentage.**



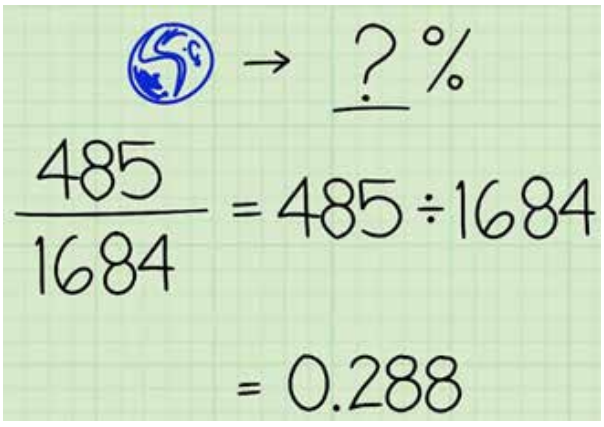
- Let's say we want to find out the percentage of the jar that is taken up by the 485 blue marbles

4. **Put the two values into a fraction.**



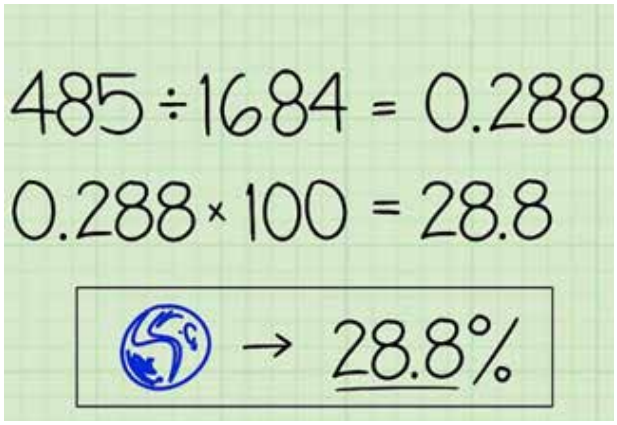
- In our example, we need to find out what percent 485 (number of blue marbles) is of 1684 (total number of marbles)
- Therefore the fraction in this case is 485/1684

5. **Convert the fraction into a decimal.**



- To turn 485/1684 into a decimal, divide 485 by 1684. This comes to 0.288

6. Convert the decimal into a percent.



- Multiply the result obtained in the step above by 100
- For this example, 0.288 multiplied by 100 equals 28.8 or 28.8%

Unit 2.9 Physical Science and Basic Properties of Materials

Unit Objectives

At the end of this unit, you will be able to:

- Analyze the basic property of materials
- Identify the basic organic compounds

Whatever we see around us are some form of material. The material refers to the entity of something – be it solid, liquid or gas. In fact, materials can be found in these three stages. However, there are some materials which are semi-solid, known as viscous material. For example, adhesives, resin are viscous material – not ideally solid or liquid.

On the basis of the constituent material(s), matters are classified into two broad categories –

- Element
- Compound

Type of Object	Description	Example
Element	• When a matter is made up of only one material, it is called element • This refers to the fact that the elements are made up of only ONE constituent material • Elements can be solid, liquid or gas • The smallest particle of the element which contains all the properties of the element are referred to as ATOM • Atoms of the same element can conjugate to form compound • The abbreviation of the elements are known as SYMBOL	• Sodium (Na) • Potassium (K) • Oxygen (O) • Bismuth (Bi) • Fluorine (F) • Neon (Ne) • Uranium (U) • Copper (Cu) • Zinc (Zn) • Calcium (Ca) • Sulphur (S) • Nitrogen (N) • Carbon (C) • Platinum (Pt) • Iron (Fe)
Compound	• When a matter is made up of conjugation of two or more elements, it is called compound • Compounds can be solid liquid or gas • The smallest particle of a compound that contains the properties of the compound is known as MOLECULE • The molecules of the compound take part in the chemical reactions and form different compound(s) • The abbreviated form of representing a molecule is known as FORMULA	• Water (H_2O) • Sodium Chloride (NaCl) • Potassium Cyanide (KCN) • Sulphur dioxide (SO_2) • Nitric Acid (HNO_3) • Ferrous oxide (FeO) • Zinc sulphate ($ZnSO_4$) • Sulphuric acid (H_2SO_4) • Hydrochloric acid (HCl) • Carbon dioxide (CO_2)

Basic Properties of Materials

- **Physical properties of matter-** Matter is made up of particles which are very small in size. Everything around us is made up of tiny pieces or particles. The particles of matter are constantly moving (they are in motion). The particles which make up matter are atoms and molecules.
- **Interchange in states of matter-** Matter can change its state in solid, liquid or gas depending upon the type of matter.
- **Diffusion-** The mixing of a substance with another substance due to the motion or movement of its particles is called diffusion. It is one of the properties of materials. The diffusion of one substance into another substance goes on until a uniform mixture is formed. Diffusion takes place in gases, liquids and solids.
- **Latent heat-** Latent heat is the heat energy which has to be supplied to change the state of a substance. Latent heat does not increase the temperature of a substance. But latent heat has to be supplied in order to change the state of a substance. Latent heat can be of fusion or of vaporization.
- **Sublimation-** The changing of a solid directly into vapours on heating and of vapours into solid on cooling is known as sublimation. When these solid substances are heated, their particles move quickly and they separate completely to form vapour (or gas). Similarly when these vapour (or gas) is cooled, these particles slow down so quickly that they become fixed and form a solid.
- **Evaporation-** The process of conversion of a liquid into vapour (or gas) at its boiling point is called evaporation. Some particles in liquid always have more kinetic energy than the others. So, even when a liquid is well below its boiling point, some of its particles have enough energy to break the forces of attraction between the particles and escape from the surface of the liquid in the form of vapour. Thus the fast moving particles of a liquid are constantly escaping from the liquid to form vapour or gas. Temperature, surface area of liquid, humidity, and wind speed are factors that affect evaporation. Evaporation causes cooling effect.

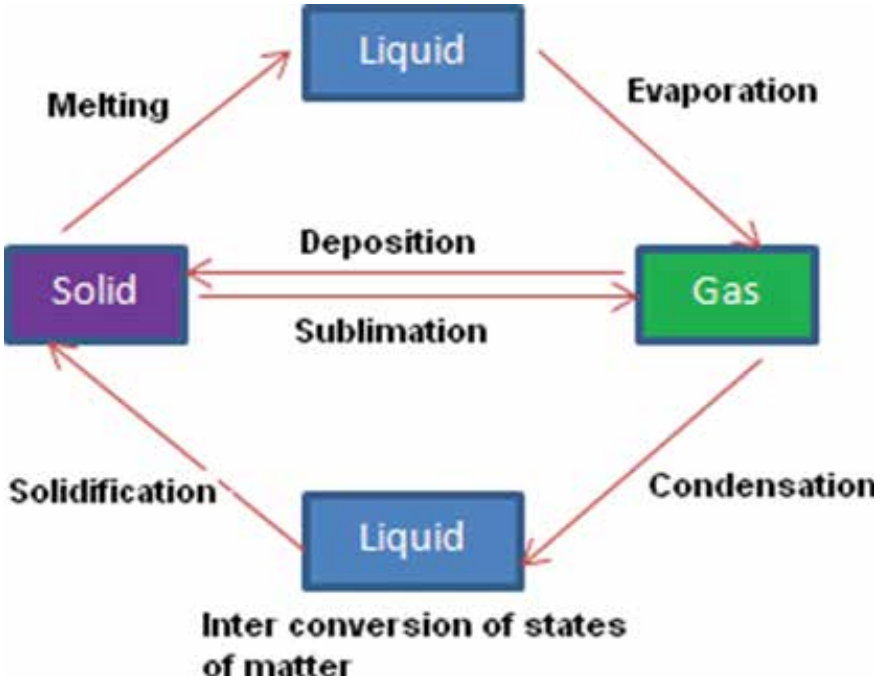


Figure 2.9.1: Physical Properties of materials

- **Effect of Change of Pressure –** The physical state of matter can also be changed by increasing or decreasing the pressure to it. Gases can be liquefied by applying pressure and lowering temperature. When high pressure is applied to a gas, it gets compressed, and when in addition to it we lower its temperature, it gets converted into liquid. So, we can also say that gases can be turned into liquids by compression and cooling.

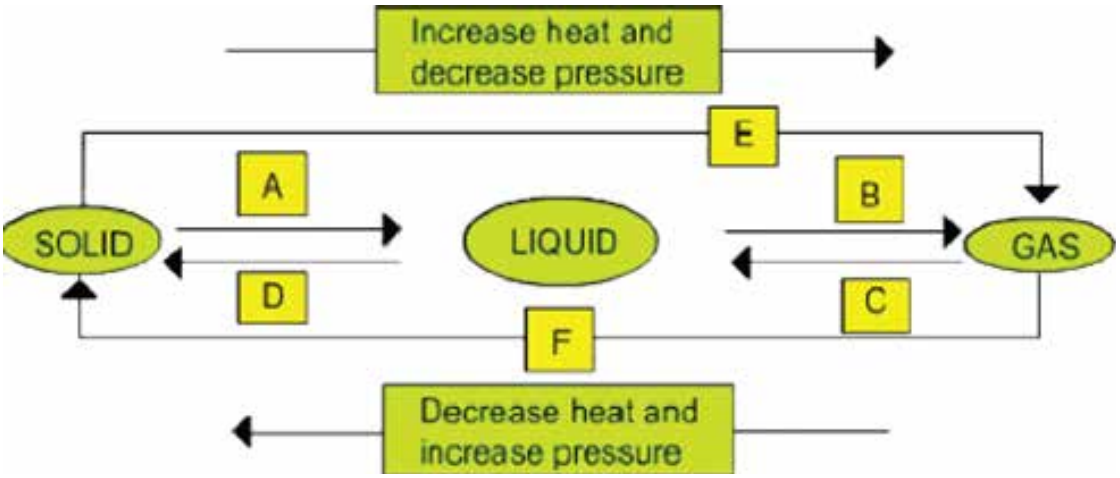


Figure 2.9.2: Effect of pressure and temperature on materials

Oil Processing Gasses

	Type of gas	Pyrolysis	Catalytic cracking	Petroleum-associated gas	Natural gas
Percentage of Gasses by Volume	C5+	2-3	5-12	3	-
	N2+CO2	-	-	10	1.4
	C4H8	-5	5-6	-	-
	C4H10	0.2	42-46	8	0.05
	C3H6	7-8	6-11	-	-
	C3H8	0.5	16-20	17	0.15
	C3H4	16-18	3	20	-
	C2H6	5-7	3-5	42	0.4
	CH4	5-7	10	-	98
	H2	12	5-6	3	-

Non-hydrocarbons

- **Normally occurring radioactive materials**

  The presence of these materials can be seen in drilling mud, drilling deposits, and crude oil. Its radioactive level is low.

- **Naphthenic acids**

  These are organic acids whose corrosive nature can be seen when the temperature exceeds 232 °C.

- **Carbon dioxide**

  During the distillation process, bicarbonates from a stream or crude get decomposed, finally leading to the emission of carbon dioxide.

- **Inorganic Salts**

  Certain crude oils are present in the crude oils. Some of them are:

  - Calcium chloride
  - Magnesium chloride
  - Sodium chloride
- **Trace metals**

  In crude oils, small amount of metals like vanadium, arsenic, iron, nickel, and copper are found.
- **Nitrogen compounds**

  Nitrogen acts as basic compounds in the crude oil (in lighter fractions). There are instances where trace metals are also found.
- **Oxygen compounds**

  In variable amounts in crude oils oxygen compounds are found. Some of them are:

  - Carboxylic acids
  - Ketones
  - Phenols
- **Sulphur and sulphur compounds**

  In the form of H2S, sulphur is seen to be present in crude oils and natural gasses. The other compounds consist of:

  - Polysulphides
  - Sulphides
  - Mercaptans
  - Thiols

Hydrocarbons

- **Naphthenes**

  Formula: CnH2n

  These are hydrocarbon groupings that appear as saturated ring type. In simple words, they are cyclic and have a light structure. The predominating naphthenes with 5 & 6 carbon atoms are mono-cycloparaffins. Those with 2 rings are dicycloparaffins (heavier).
- **Aromatics**

  These are hydrocarbon compounds that have unsaturated ring type (cyclic). The aromatic compound that has fused double rings is naphthalenes. The heavier fractions of aromatics that are found in crude oils have 3 or more fused aromatic rings. These are highly complex and are known as polynuclears.
- **Paraffins**

  Formula: CnH2n+2

  These have aliphatic molecules (saturated chain type hydrocarbon). The lighter chain paraffin molecules (straight) are found in paraffin waxes and gasses. The chain paraffin molecules that are branched have higher octane numbers.

Summary

- Oil and gas wells produce crude oil, which is a mixture of various materials. Generally, the mixture contains –
  - Hydrocarbon Gas
  - Condensate or Oil
  - Water with Dissolved Mineral
  - Large amount of Salt
  - Other Gases such as Nitrogen, Carbon dioxide, Hydrogen sulphide etc.
  - Reservoir Dirt
  - Sand
  - Corrosion Wastes
- Measurement is the process of determining the magnitude of and quantifying a physical parameter
- Units of measurement are of many types: System International (SI) and the Centimeter - Gram - Second (CGS), Meter- Kilogram- Second (MKS), Foot- Pound- Second (FPS)
- Maintenance of the equipment is a significant part of the routine
- Preventive maintenance performs planned, periodic and specific tasks to keep equipment in good working order. Normal maintenance tasks involve
  - Inspections
  - Lubrication
  - Checking for oil or gas leakage and wear
- Workers in Oil and Gas industry are generally susceptible to following agents which lead to various health and Illnesses hazards:
  - Chemical hazards (toxic, corrosive, carcinogens, asphyxiates, irritant and sensitizing substances)
  - Physical hazards (noise, vibration, radiations, extreme temperature)
  - Biological hazards (virus, parasites, bacteria)
  - ergonomic hazards (manual handling activities, repetitive motions, awkward postures)
  - Psychosocial hazards (overwork, odd working hours, isolated sites, violence)
- The Signal Systems and Communications area covers the fundamentals of analog and digital signals
- In a communication system, a transmitter encodes a message to a signal, which is carried to a receiver by the communications channel
- Binary logic refers to the classical propositional two-valued logic, also called Boolean logic in engineering

Notes

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GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

HSSC
HYDROCARBON SECTOR
SKILL COUNCIL

3. Occupational Health and Safety (OHAS)

Unit 3.1: Occupational Health and Safety

Unit 3.2: Hazards and Its Effects and Risk Assessment

Unit 3.3: Safe Working Practices

Unit 3.4: Use of Different Types of Personal Protective Equipment (PPE)

Unit 3.5: Various Types of Fire Fighting Equipment & Its Uses In Different Conditions

Unit 3.6: Risk Management and Reporting

Unit 3.7: Standard Operating Procedures in Oil and Gas Safety W.R.T. Occupational Health & Safety

HYC/N0102

Key Learning Outcomes 

After attending the session, you will be able to:

1. Identify the occupational hazards
2. Evaluate the risks associated with the job role of a production assistant
3. Analyze safe working practices
4. Prioritize the personal protective equipment (PPE)
5. Evaluate the fire fighting process
6. Assess the risk management and reporting
7. Analyze the standard operating process in the oil and gas industry

Unit 3.1 Occupational Health and Safety

Unit Objectives

At the end of this unit, you will be able to:

- Analyze the health and hazard of the job role

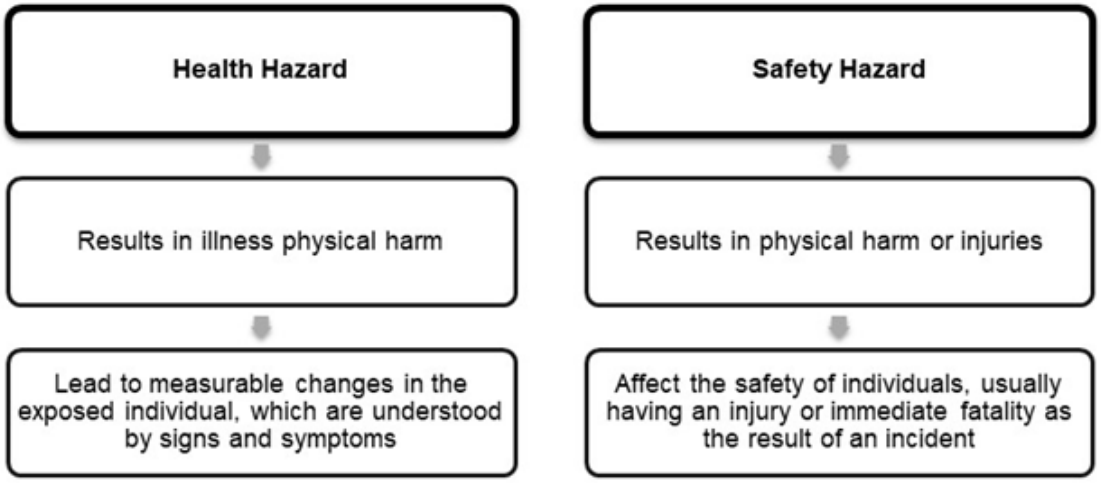
Occupational Health Hazards for the Said Job Role

- Any job role and any occupation in this world has some hazards, in varying severity, associated with it. These are called **Occupational Hazards**.
- Occupational Hazard can be defined as "a risk accepted as a consequence of a particular occupation".
- According to the Collins English Dictionary, it is defined as "something unpleasant that one may suffer or experience as a result of doing his or her job".
- Occupational Hazards are caused by the following:
  - **Hazardous Working Ambience**
    - Unsafe and unguarded machinery and tools
    - Hazardous and unmonitored processes
    - Inappropriate and inadequate ventilation
    - Inappropriate and inadequate illumination
    - Inappropriate and unsafe dress
  - **Hazardous Behaviour and Acts**
    - Using unsafe and unguarded machinery and tools
    - Neglecting safety guidelines while working
    - Ignoring the Instruction Manual or Directions for Use
    - Unsafe lifting, loading, staging, assembling and installing
    - Not adopting the prescribed ergonomic postures
    - Handling Personal Protective Equipment (PPE) and Safety Devices dysfunctional

Common Health and Safety Hazards

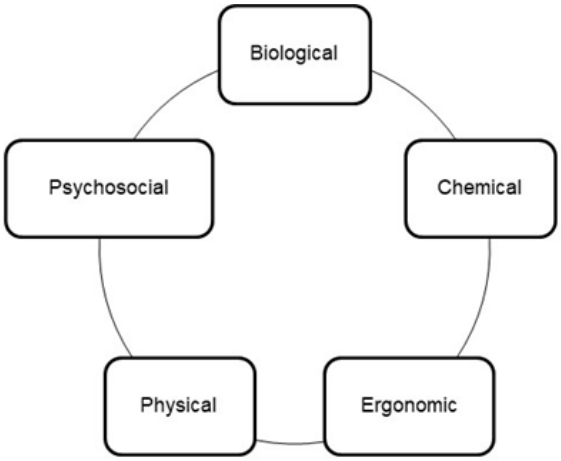
- On the basis of effects on individuals, Occupational Hazards can be broadly categorized into: **Health** and **Safety Hazards**.
- Examples of Health Hazards are:
  - Carcinogenic factors
  - Corrosive
  - Toxic
  - Irritant
  - Factors that may lead to chronic and adverse effects on one's health
- Examples of Safety Hazards are:
  - Spills on floors
  - Tripping hazards like loose cords and cluttered workplace Working from high or raised areas like ladders, cranes, scaffolds, rooftops etc.
  - Unsafe and unguarded machinery and their moving parts

- Electrical hazards like live wires, lack of earthing, loose cables, frayed cords, wet and poorly insulated devices, etc.
- Inadequate space



Other Categories of Hazards

- Apart from the ones mentioned above, Hazards can also be categorized on the basis of the Source of Energy.
- The types of hazards, according to the Source of Energy, are:



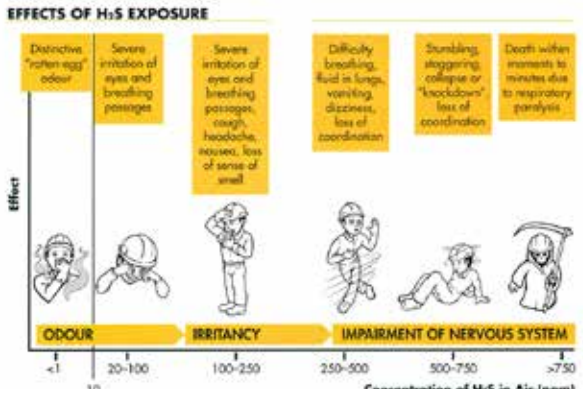
- **Biological -** These hazards are associated with working with animals, plants and their products, as well as contagious or infectious materials. Examples are:
  - Body fluids like Blood, Saliva, Sweat and Semen
  - Bacteria, Fungi and Viruses
  - Insect bites
  - Human and animal waste
- **Chemical -** These hazards occur, if, the inherent properties of materials pose harm to animal life, property or the environment as a whole. Severity of chemical hazards depends on the dosage and amount of the harmful components in a given chemical.

- Typical examples are:
- Chemicals in unlabelled container
- Various types of cleaning products, chemical agents, solvents, solutions, paints, acids, etc.
- Vapours and fumes resulting from welding and gas cutting operations, as well as from strong solvents and solutions
- Harmful gases like CFCs, Acetylene, Carbon Monoxide, Sulphur Monoxide, Propane, Helium
- Insecticides and pesticides

- **Ergonomic -** These hazards occur, when the nature of work, body postures and working conditions exert strain on one's body. Common examples are:
  - Inappropriately set up workstations and seats
  - Frequent lifting by inappropriate techniques
  - Repetitive and exhaustive movement
  - Exertion of excessive force
  - Excessive mechanical vibration
- **Physical -** These hazards result from natural disasters, like earthquakes, floods, storms, etc., which cause massive loss of life and property. The hazardous factors are generally:
  - Radiation
  - Noise
  - Dust and Debris
  - Extreme temperatures (extremely high or low)
- **Psychosocial -** These hazards mainly result from stress in one's social and professional life. These include:
  - Excessive workload
  - Violence at workplace
  - Sexual Harassment
  - Lack of respect at workplace
  - Lack of flexibility at workplace
  - Poor work relations
  - Grapevine gossips

Identify job-site hazardous work and state possible causes of risk or possible accidents in the workplace

1. Hydrogen Sulphide



Oil and gas wells can release hydrogen sulphide and expose workers to hydrogen sulphide gas.

The three best practices to help prevent injury and death are:

- Active monitoring for hydrogen sulphide gas
- Good planning
- Training programs for workers

2. Silica

Workers might be exposed to respirable crystalline silica during processes that use sand, such as hydraulic fracturing.

3. Noise

Oil and gas workers can be exposed to harmful noise levels during equipment operation.

4. Diesel Particulate Matter

Diesel engines power a variety of machinery, vehicles, and equipment on a drilling site. Workers might be exposed to harmful levels of diesel particulate matter during the operation of these engines.

5. Hazardous Chemicals

Workers, who use hazardous chemicals during work processes, especially during hydraulic fracturing, might be exposed to hazardous by-products of oil and gas drilling.

- The degree of potential hazard depends on individual chemical properties and toxicity, but possible hazards include chemical burns from caustic substances and inhalation of toxic vapours
- All employers with hazardous chemicals in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately
- Establishing effective engineering controls and work practices can reduce potential worker overexposures.

6. Temperature Extremes

Well-site workers are exposed to extreme temperatures and should take precautions to stay safe.

Unit 3.2 Hazards and Its Effects and Risk Assessment

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate the risk assessment matrix

The Risk Assessment Matrix

- It is a good industrial practice to assess the severity and likeliness of risks, before undertaking a particular project or assignment.
- This can be successfully understood from a Risk Assessment Matrix or Risk Matrix.
- Risks can be assessed from the below parameters:
  - **Severity:** Negligible, Marginal, Critical and Catastrophic
  - **Likeliness:** Rare, Unlikely, Possible, Likely and Certain

	Negligible	Marginal	Critical	Catastrophic
Certain	High	High	Extreme	Extreme
Likely	Moderate	High	High	Extreme
Possible	Low	Moderate	High	Extreme
Unlikely	Low	Low	Moderate	Extreme
Rare	Low	Low	Moderate	High

	Negligible	Marginal	Critical	Catastrophic
Certain	Stubbing Toe			
Likely		Fall		
Possible			Car Accident	
Unlikely			Plane Crash	
Rare				Tsunami / Earthquake (Richter scale of 8 and above)

The Risk Management Process

- Hazards indicate the presence and severity of potential risks and threats.
- Risk Management can be defined as the estimation and evaluation of risks, followed by the formulation of strategies to mitigate or avoid their adverse effects on a system.
- The steps involved in the Risk Management process are:
  - **Step 1.** Identify and define the risk
  - **Step 2.** Analyze the risk in terms of likelihood and consequence
  - **Step 3.** Assess and rank the risk in terms of severity
  - **Step 4.** Treat the risk via Risk Response Planning
  - **Step 5.** Monitor, track and review the risk

In the Gas and Oil Industry, the general risk management process involves these important steps.

1. **Planning**
   - Recognise the individuals participating in the process of risk management
   - Collecting all the relevant Oil and Gas Industry related safety and health information
   - As per the requirements in legal or business, understanding and defining the workflows and strategies
2. **Identifying the Risks**
   - Recognise issues and hazards related to health and safety within workplace. This can be done via thorough inspection of the work area and going through the ill-health records, previous accidents, and much more
3. **Evaluating the Risk**
   - Ranking the different types of risks on the grounds of severity
   - Establishing the types of injuries that one may receive at the workplace
   - Recognising the different precautionary measures that are taken place at the workplace and which of the aspects went wrong
   - Assessing the different types of hazards that one can identify from the identified hazards or issues
4. **Recording the Risks**
   - To define various controlling measures related to regulatory purposes, internal review, audit, etc. and recording all the findings related to risk assessment
5. **Controlling the Risks**
   - Out the various preventive measures and implement those to minimise or eliminate accident or incident related risks
6. **Assessment Follow On**
   - Re-evaluate the control measures or preventive measures' efficiency
   - Make sure that all the control measures that are implemented are in use and all of them are effective
7. **Review and Monitor**
   - Monitor carefully, keep an eye on all the risks and update the assessments for those risks

Inspect For Faults, Set Up and Safely Use Steps and Ladders in General Use

Inspect For Faults

It is important to inspect every safety device and elevating device. The inspection and testing process requires to be determined by the prescribed standards and via a qualified person.

The prescribed standards state that the inspection criteria are met:

- Once every year
- After any changes are made to any safety devices or elevating devices
- Before the attachment of thereto to the elevating devices

Inspect for faults, set up and safely use steps and ladders in general use

- Trestles and steps ladders are the common equipment that is seen in work sites in oil and gas companies.
- It is important that technicians do not use metal ladders.
- It is to be maintained that when using ladders to reach higher areas for installation or storing equipment, the loading should be at zero degrees (straight).
- One should avoid side loading when standing on a step ladder

- Overreaching should be strictly avoided while standing on the ladder
- Light tools and materials should be carried

Here are few images to show the correct way to use ladders.

Figure 3.2.1: Tying the extension ladder and ensuring that it at least 3 feet higher than the supporting point

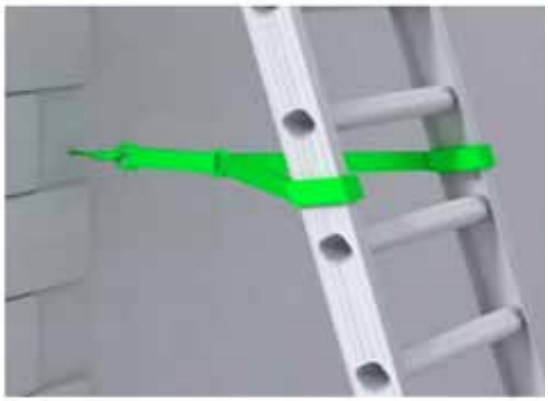


Figure 3.2.2: Tying the ladder near the base

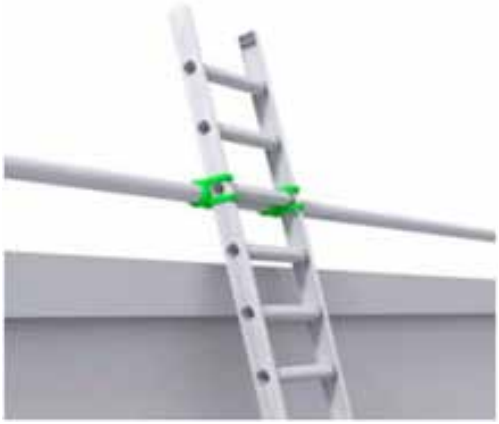


Figure 3.2.3: Tying the ladder above the stiles to work on and not gaining access

Figure 3.2.4: Ensuring that both the legs are on the same platform (step) with the knees supported to the stepladder and availability of handhold

Figure 3.2.5: Taking the help of stand-off devices to get a strong resting point.

Figure 3.2.6: Not following 3 point contact and overreaching an area

Figure 3.2.7: Following 3 point contact and not overreaching the work area

Figure 3.2.8: Right 1 in 4 angle shown with the help of a ladder

Unit 3.3 Safe Working Practices

Unit Objectives

At the end of this unit, you will be able to:

- Identify the type of risk and take measurements accordingly
- Inspect faults, set up and safety equipment
- Demonstrate general health and safety practices

Availability of First Aid box & Accessories: State location of general health and safety equipment in the workplace

Every company has the provision of first aid box. As you have already read about the types of injuries that technicians can receive in their field of work, it is imperative for the companies to have appropriate first aid accessories.

The basic first aid supplies and accessories that a first aid box should have are:

Splint

Elastic wraps

Latex gloves

Adhesive tape

Tweezers

Blanket

Scissors

Wound cleaning agent

Triangular bandages

Gauze roller bandage

Adhesive bandages

Gauze pads

Antiseptic cleansing wipes

Burn cream or gel

Eyewash liquid

CPR Kit

Administer appropriate first aid to victims where required eg. in case of bleeding, burns, choking, electric shock, poisoning etc.

In every organization, first aid is a mandatory. Especially, in the organizations that deal with different types of hand and power tools, first aid is a compulsory. In the following table, the symbols and their significance are discussed.

This is a general symbol for first aid. Generally, this sign is used to denote first aid room, first aid box.

This is the “First Aid Stretcher” symbol. In case of accidents, where the victim is unable to stand up on feet and walk, first aid stretcher is used.

This symbol signifies “Eye wash”.

This is a “Safety Shower” sign

This is the "Emergency Telephone" sign. In case of accidents, when the first aid is required on an immediate basis, this telephone is used.

How to Deal With an Accident Which Involves Human Life

- An accident, that may lead to the loss of human life, falls under the "Critical" and "Possible" categories of the Risk Assessment Matrix, as mentioned in section 3.2.2. Thus, considering the degree of severity, one may follow the below steps while dealing with an accident that involves the loss of human life:
- Turn off and stall the source of the accident. For example, in case a severe accident has occurred due to a running machine, the machine must be turned off and stopped first, to prevent other people from getting injured in the same manner.
- One must not panic and not allow anybody else to panic at the scene. Maintaining a calm and composed attitude is extremely crucial for bystanders.
- One must assess the severity of the accident and promptly decide if emergency services must be summoned.
- One must look over the accident scene carefully, to gather information for the emergency services personnel.
- One must take initiatives to keep the accident spot clear, so that the victim/s are not asphyxiated with lack of breathing air. Alarms may be raised, if possible, to notify and warn everyone else at the work area about the accident.
- Before approaching the victim for extending help and support, one must ensure that the spot and the victim's body is safe for one to touch and access. For example, in case of electrocution, the main power supply must be switched off before touching the victim's body.
- A seemingly unconscious victim may be revived to consciousness by rubbing the chest, artificial respiration or pinching the earlobes.
- Such a victim must be asked if he / she requires any assistance.
- One must provide the best possible assistance to the victim, before summoning emergency services.
- The victim must not be removed from the spot (unless there are imminent dangers like fire or electrocution) before the arrival of the emergency team.
- The legs of a victim in shock must be raised to mitigate the impact.
- One must use encouraging and comforting words to help the victim in reviving.

Administer Appropriate First Aid in Chemical Hazard

Chemical hazards are caused by toxic materials, which are poisonous. And being poisonous in nature, they can either be fatal or cause serious damages in case the preventive actions are not taken on time. Now, the exposure to chemicals can be in 3 forms.

They can be:

- Inhaled (entering the body through nose)
- Directly in contact with skin
- Ingested (consumed)

The symptoms, in this case, will be:

- Seizures
- Partial or complete loss of responsiveness
- Burning sensation
- Stomach Cramping with bouts of excruciating pain
- Nausea
- Vomiting (and in times with blood-stains)

Figure 3.3.1: Nausea

Now, where there are problem, their solutions come side by side. In such situations, the person giving first aid requires to be calm and take certain preventative actions.

Some of the essential actions are:

- Using insulated equipment
- Wearing protective clothing, goggles, masks, shoes and gloves
- Ensuring the place has enough ample ventilation

Remedial action

- The foremost thing that one should do is to provide immediate first aid. However, it is to be remembered that the victim should not be given any kind of fluid (water, milk) until doctors from Poison control unit gives a green signal.
- Aside from this, there are a few things a person can perform to the victim of toxic material exposure.
- Remove the victim from the toxic zone or vicinity
- Call for an ambulance
- Remove contaminated clothing
- Splash water in the eyes
- If ingested, do not try to make the victim puke (vomit)
- Wash their mouth with water
- In case the victim's breathing has stopped, give CPR (Cardiopulmonary resuscitation)
- In case of burning due to toxic material, apply burn gel or water gel on that area.
- Avoid any cream based or oil based lotion or ointment

Figure 3.3.2: CPR

Even though giving first aid is the right thing to do in the first place, it is also important that another of the electrician should report the incident to their supervisor.

Demonstrate How to Free a Person from Electrocution

Oil and gas companies are power with high voltage electricity. In addition to it, the drilling technician use tools that work on electricity. In such cases, there are chances that the individuals may receive an electric shock in these circumstances, it is important that another person free the electrocuted person on time.

Here the steps to free a person from electrocution.

Switch off the main power.

Don't touch the person who is electrocuted.

Try to remove the person from the electrical source with the help of non-conducting objects like stick, cardboard, bamboo, etc.

Lay the person in this position.

Perform and Organize Loss Minimization or Rescue Activity during an Accident in Real or Simulated Environments

For heavy bleeding

Stop bleeding

- Direct pressure must be applied to the cut or wound with a clean cloth, tissue, or piece of gauze, until bleeding stops.
- If blood soaks through the material, it is highly recommended not to remove it.
- More cloth or gauze must be put on top of it, and pressure must be continued.
- If the wound is on the arm or leg, the limb must be raised above the heart to help slow the bleeding.
- Hands must be washed again after giving first aid and before cleaning and dressing the wound.
- A tourniquet must not be applied unless the bleeding is severe and not stopped with direct pressure.

Figure 3.3.3: Pressure application to stop bleeding

Clean cut or wound

- The wound must be cleaned with soap and lukewarm water.
- To prevent irritation and burning sensation, the soap solution must be rinsed out of the wound.
- Hydrogen peroxide or iodine must not be used to clean or treat the wound since they are corrosive and can damage live tissues.

Figure 3.3.4: Clean cut or wound

Protect the wound

- Antiseptic cream or solution must be applied to the wound to reduce the risk of infection.
- Then, the wound must be gently covered with a sterile bandage.
- Till the wound heals, the bandage must be changed (dressed) daily to keep the wound clean and dry.

Figure 3.3.5 Protect the wound

Call the Emergency Helpline if:

- The bleeding is severe and deep
- You suspect Internal Bleeding
- Abdominal or Chest wound exists
- Bleeding continues even after 10 minutes of firm and steady pressure

For Burns

- Immediately put the burnt area under cold water for a minimum of 10 minutes
- If the burned area is covered, take clean scissors, cut and remove the fabric covering the area
- In case clothing is stuck to the burned area, leave it as it is
- Before sterile dressing application, remove jewellery (if any)
- It is better to leave the burned area open
- Do not apply any medication or ointment
- Breaking a blister – it is an absolute no-no!

Figure 3.3.6: Put Burnt Area under Water

For Broken Bones and Fractures

- **Protruding bone must be left alone**
  - If a bone has broken through the skin, it must not be pushed back into place.
  - The area must be covered with a clean bandage and immediate medical attention must be sought.

- **Bleeding must be stopped**
  - Steady and direct pressure must be applied with a clean piece of cloth for 15 minutes, and the wound must be elevated.
  - If blood soaks through, one must apply another cloth over the first and seek immediate medical attention.

- **Swelling must be controlled**
  - The RICE therapy must be applied to control and reduce swelling.
  - Rest the injured part by having the person stay off of it.
  - Ice must be applied on the area with the help of an ice pack or by wrapping the ice in a clean cloth. Ice must not be directly placed against the skin.

- Compress by wrapping the ankle lightly (not tightly) with an “ace” bandage or elastic ankle brace. Do not try to align the bones forcefully.
- Elevate the injured area above heart level.

- **Pain and inflammation must be mitigated**
  - One must have pain medication like Aspirin.
  - Aspirin must not be given to anyone aged 18 years or younger.

- **Encourage the person to support the injury with their hand, or use a cushion or items of clothing to prevent unnecessary movement**

- **Continue supporting the injury until help arrives**

- **A physician must be summoned at the earliest**
  - Call the doctor at the earliest. It is recommended not to take treatment in one’s own hands if the fracture is severe.

- **Follow up**
  - The doctor will examine and X-ray different parts of the leg.
  - The doctor may do a CT or CAT scan, or an MRI to determine if surgery is needed.
  - The doctor may align and set the broken bone back into place and immobilise the ankle with a splint, cast, or other device.
  - Surgery may be necessary to repair the break.

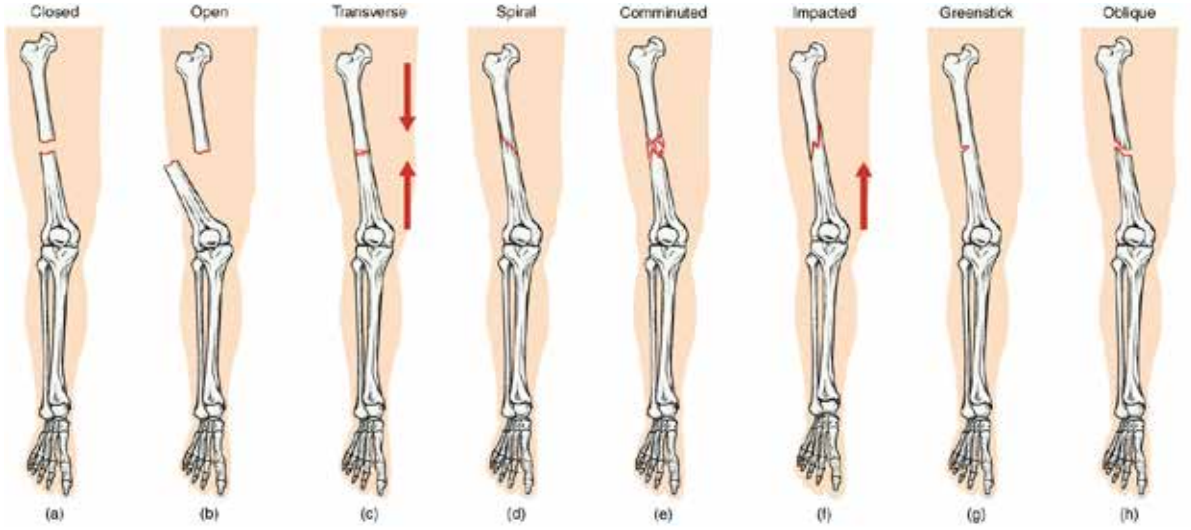


Figure 3.3.7: Broken Bones and Fractures

For Heart Attack/ Stroke

- Think FAST. Face: is there weakness on one side of the face? Arms: can they raise both arms? Speech: is their speech easily understood? Time: to call Emergency helpline
- Immediately call medical/ambulance helpline or get someone else to do it

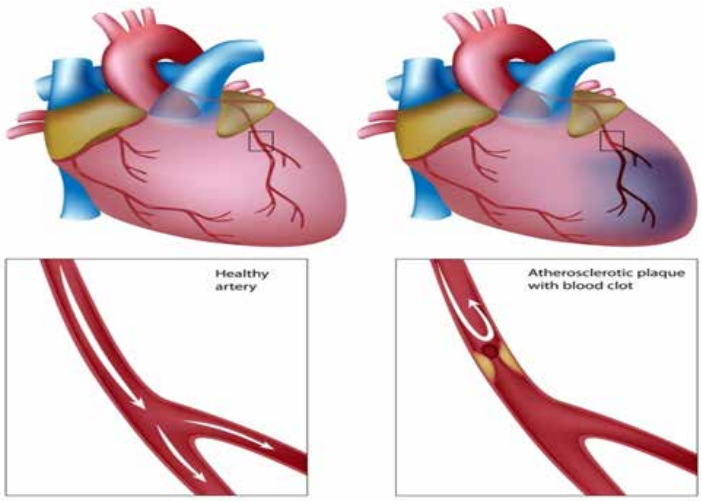


Figure 3.3.8: Anatomy of Heart Attack

For Head Injury

- Ask the victim to rest and apply a cold compress to the injury (e.g. ice bag)
- If the victim becomes drowsy or vomits, call Medical helpline or get someone else to do it

Use/Proper Utilization of Breathing Apparatus

Check the parts of the breathing apparatus thoroughly.

Check the bypass knob (red). Close it if you see it open. after this, press the reset button (area above bypass nob - black)

Inspect the face mask to see that it is undamaged.

Lift the cylinder ensuring that on the top the cylinder valve should be present.

The backplate of the cylinder should face the wearer.

Wear the breathing apparatus on the shoulder like a bag pack, and by the neck strap, hang the facemask

After wearing the breathing apparatus tighten shoulder straps and fasten the waist belt.

The cylinder valve should be opened slowly to inspect the pressure gauge.

Make sure that 80% of the cylinder is full.

Wear the mask slowly by resting your chin in the resting cusp and pull the head strap slowly over your head.

Pull the head straps for a snug but comfortable fit.

Breath in and normally to see if you can breathe normally or not.

Now insert a finger sidewise of the face mask for easy outward airflow.

Slowly close the cylinder valve without leaving the knob.

Be steady for 10 minutes and hold your breath or extremely slow to listen to any wheezing sound.

Also, check the pressure gauge for any dip in the pressure.

Normally Breathe to vent system

Listen for a whistle alarm while observing the pressure gauge at 55 bar (+/- 5 bar)

Carry out safe working practices while dealing with hazards to ensure the safety of self and others state methods of accident prevention in the work environment of the job role

A. Participate in emergency procedures

- **Raising Alarm:** Fire Alarms can either have a "Break Glass" or a "Pull / Push" mechanism. In the "Break Glass" system, the glass sheet must be forcefully hit with clenched fist. One must repeat the process till the glass breaks. In the "Pull / Push" systems, one must smash the glass first and then either pull down or push up the lever to raise the alarm.
- **Safe and efficient evacuation:** Appropriate evacuation procedures (already discussed in the previous chapter) must be adopted for general public and for specially abled persons. Specially abled persons must be helped to evacuate the place by providing them access to Wheelchairs and other aids.
- **Correct Assembly Point:** Proper instructions must be given to the workers about the location of and the directions to the correct assembly point in the workplace. Information about this must be provided during mock evacuation drills and training sessions as well.
- **Roll call:** Once everybody has evacuated the building / workshop and arrived at the Assembly Point, Roll call or Head Count must be done to ensure that nobody is left behind in the affected area. This must be done mandatorily to ensure that everybody within the premises is safe.
- **Correct return to work:** Evacuation must be conducted in a very organized, streamlined and noiseless manner. Likewise, everybody, who had evacuated the workplace, must return to his / her respective locations / positions / seats, following normal or emergency routes, depending on whether the situation has been restored to normal or not. Once everybody is back in place, another Roll call is conducted.

B. State methods of accident prevention in the work environment

One must stay aware and updated about the various methods of accident prevention in the work environment. Few of these are:

- **Training in health and safety procedures -** One must be trained in the industrial health and safety procedures through drills and training sessions. Apart from the procedures popular in the industry, every organization has its own set of procedures and protocols, laid down and standardized in the form of Standard Operating Procedures (SOPs).

- **Using health and safety procedures -** Ergonomic practices, use of PPE, hygiene and importance of good housekeeping practices must be promoted among workers.
- **Use of equipment and working practices-** Proper use, storage and maintenance of PPE, as well as medically recommended lifting, carrying and transporting practices must be taught and promoted among workers.
- **Safety notices, advice and instructions from colleagues and supervisors-** Workers must always keep their eyes open, so that they do not miss out safety notices, advice and instructions being circulated around them. Such safety notices, plans and instructions are often displayed for general public access at prominent and common places at workplace.

C. Check and ensure general health and safety equipment are available at work site

Workers must ensure the availability of general and safety equipment like Fire extinguishers, First aid equipment, safety instruments and clothing (Personal Protective Equipment) as well as safety installations like neon-enabled and glowing fire exits, exhaust fans, etc. All such equipment must be in good operating condition and must be periodically maintained.

D. Comply with restrictions imposed on harmful chemicals inside work area during working hours

Few hazardous chemicals in the workplace are recommended for restricted and expert use only. These chemicals must be stored in cool, dry and clean storage locations, in containers made of compatible materials and labelled with relevant Directions of Use, Precautionary Measures, Ingredients and Hazard Warnings.

Unit 3.4 Use of Different Types of Personal Protective Equipment (PPE)

Unit Objectives

At the end of this unit, you will be able to:

- • Identify the PPE and their usages

Use protective clothing/equipment for specific tasks like

- Cutting
- Welding
- Repairing in pipeline jobs
- Well operations
- Maintenance inside the installation
- Work conditions during day to day work and during emergency

General PPE

Disposable Mask

Corded Earplugs

Grey Durastreme (Eye Protection)

Peak Hard Hat

Specialised Gloves

Redcoat Plus

Oil Grip

Perfect Cutting Nit

Skeleton Glove

Welding and Fabrication

Welder Gloves

Supereight Shield

Tigerhood Classic (fibre metal)

Fibre-Metal Welding Helmet

Rigging

Rigger Boot

Nitri Task KL

Optema

Fibre-Metal Supereight Cap

Gas Detection

Sensepoint XCD

BW Clip

GasAlert MicroClip XL

GasAlert Extreme

Electrical Protection

Pro-Wear

Arc Flash Hood

Insulating Glove

AS1200 HRC2

Scaffolding Fall Protection

Falcon Self Retracting Life line

Revolution Vinyl Coated Harness

Air Core Derrick Harness

Miller H Design Harness

Specialised Clothing

Rinba Guardian Plus

Spacel Comfort Heavy

Essian Light

Specialised Footwear

Oliver Rigger Boot

Oliver Ankle Boot

Oliver Lace Up Shoe

Force(i)Xtrem

Respiratory Protection

Survivair Cougar

Fenzy X-PRO

Titan SCBA (NFPA)

Full Face Mask Dual Filter

Emergency Escape

SafEscape ELITE

Opengo

Evamasque

BioScape

Specialised Hearing Protection

Ear Muff

Helmet Mount Earmuffs

Noise Blocking Ear Muffs

QuietPro

Unit 3.5 Various Types of Fire Fighting Equipment & Its Uses In Different Conditions

Unit Objectives

At the end of this unit, you will be able to:

- Identify the types of fire
- Prioritize the fire extinguishing and evacuation process

Use the various appropriate fire extinguishers on different types of fires correctly

Various Sources of Fire

- Fire is the result of a reaction primarily involving oxidation of combustible substances.
- When oxidation of combustible substances takes place, heat and light are produced, leading to Fire.
- 3 things are essential for a fire to occur and these can be represented by 3 arms of a triangle.

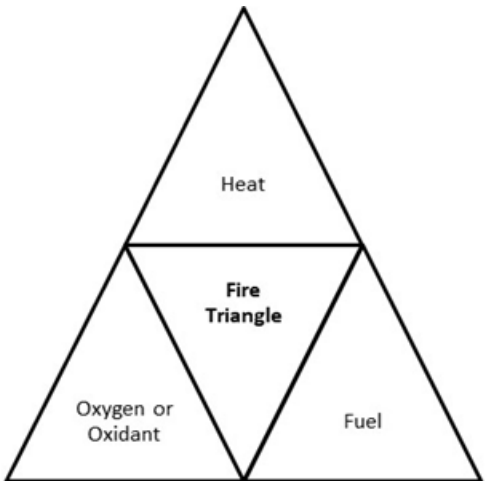


Figure 3.5.1: Fire triangle

Various Causes of Fire in the Workplace

The various causes of Fire in the workplace are:

- **Common Fire Hazards -** These include combustible and inflammable materials like waste paper, cardboards, wood, saw dust, hay, straw, liquid fuels, gas cylinders, etc.
- **Faulty Electrical Wiring -** This is one of the most common causes of fire outbreaks in the workplace. Faulty Electrical Wiring includes:
  - Outdated and frayed wires and cables
  - Misuse of portable heaters, which includes putting them extremely close to inflammable surfaces like upholstery, couches, chairs, desks, rugs and carpets
  - Misuse of Extension Cords by plugging in appliances into Extension Cords and not directly into outlets
  - Misuse of cords by letting them run under rugs (made of combustible fibre)
  - Removal of the Grounding Plug from a cord,in order to use it in a two-pronged electrical outlet

- Installation of lamps and light bulbs with a wattage specification, too high for the existing outlets

- **Faulty Electrical Equipment -** Short Circuit faults occur, whenthe circuit in an electrical apparatus allows a current to travel along an accidental path with NIL or extremely low resistance.
  - Short Circuit is caused by internal breakdown of equipment, resulting in the deterioration of insulation.
  - Short Circuit is also caused by insulation failure due to lightning surges, overloading of equipment due to overheating, physical damage, etc.

Depending on the source, fires can be classified into the following:

- **Class A:** fires involving solid materials such as wood, paper or textiles

Figure 3.5.2: Class A Fire

- **Class B:** fires involving flammable liquids such as petrol, diesel or oils

Figure 3.5.3: Class B Fire

- **Class C:** fires involving flammable gases like propane, butane, methane, etc.

Figure 3.5.4: Class C Fire

- **Class D:** fires involving combustible metals like sodium, magnesium, potassium, lithium, titanium, aluminium, etc.

Figure 3.5.5: Class D Fire

- **Class F:** fires involving cooking oils such as in deep-fat fryers

Figure 3.5.6: Class K Fire

Learning the Methods of Extinguishing Fire

The most common methods for extinguishing fire are:

- Cooling the Burning Material
- Cutting out the Oxygen Supply from the Fire
- Removing Fuel from the Fire
- Using a Flame Inhibitor (like Fire Extinguishers that chemically react with the burning material and extinguishes the fire)

Among the above, using Fire Extinguishers is the most popular method of extinguishing fires.

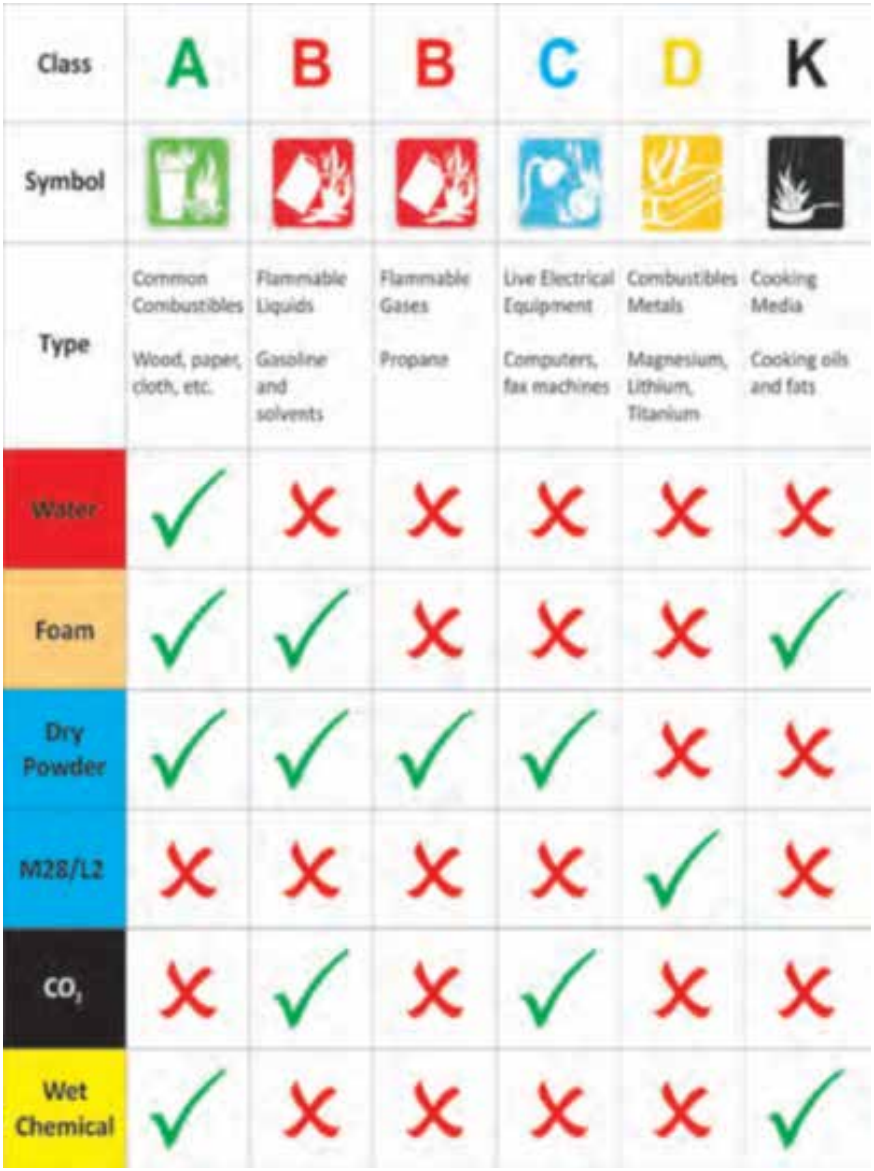


Figure 3.5.7: Fire Extinguishing Code

Follow appropriate procedure in case of a fire emergency

- **Dos**
  - Switch off the isolation switch to stop the electric supply. This will prevent the spreading of fire.
  - Use a wooden stick to switch off the isolation switch to protect yourself from an electric shock.
  - Check electrical sockets and switches to ensure there are no loose wires.
  - Use appropriate Fire Extinguishers to put out Fire.
- **Don'ts**
  - Do not place combustible items like cotton
  - waste - oil soaked cotton or oil, near the brazing or electrical points. These are highly inflammable and even a small spark may start a fire.
  - Do not keep the LPG cylinder's regulator switched on.
  - Do not use water on electrical fires.

Different Types of Fire Extinguishers and their Use

The main types of Fire Extinguishers and their uses are:

- **Water -** For extinguishing wood, cloth, plastics, coal, textile, paper and fires from other solid combustible materials

Figure 3.5.8: Water Extinguisher

- **Powder -** For extinguishing fires from solid combustible materials, liquid, gas and electrical sources

Figure 3.5.9: Dry Chemical Powder (DCP)

- **Foam -** For extinguishing fires from combustible solid and liquid materials

Figure 3.5.10: Foam Extinguisher

- **Carbon dioxide (CO2) -** For extinguishing fires from liquid and electrical sources

Figure 3.5.11: Carbon dioxide Extinguisher

- **Sand -** For extinguishing fires dry combustible substances like leaves, branches, pieces of wood etc.

Figure 3.5.12: Buckets of Sand

Identify and Follow Proactive and Reactive Fire Fighting SOP in Oil & Gas Production Facilities

In oil and gas production facilities, occurrence of fire-related accidents are common. However, such a reactive aspect can be avoided by proactive planning. Such planning can be made with the help of certain pointers.

- **Recognise the main reason for the cause and spread of fire**

  This can be identifies with the help of two questions.

  - What was the exact reason for the fire to start?
  - Are there any actions that the technicians can apply for the prevention of fire in the production facility?

- **Think and Act**

  It is better not to go with the first solution that comes to your mind. This is because in that state the mind of a person is full of panic. Instead of panicking and taking the decision, the best is to analyse the situation, consider all the aspects and then to take the appropriate actions.

- **Pre-planning is must**

  Instead of advising and encouraging the group of operators and technician to jump and rush to fire-fight, it is better to understand the entire situation and allocate the respective fire fighting task to the other members.

- **Step back when required**

  Fire fighting is not a child's play. Immediately taking certain measure to control fire in oil and gas production facilities can increase the problem instead of solving it. In such cases, it is better to call for professional help.

- **Evaluate properly**

  It is one of the most important aspects that should be followed by every company. Oil and gas production facilities are hazardous places as they have all the elements that can instantly rev up fire incidents. So it is important that after extinguishing the fire, proper inspection arrangements should be made so that there are no chances for the extinguished fire to re-ignite.

Perform Fire Evacuation Steps

Each organization having fitting, cutting and welding workshop should abide by EHS guidelines. It is especially for those companies that specify the Exit/Escape /Safety Evacuation Points in the workplace. This is important because assistant drilling technicians are exposed to various hazards and health issues in workplace.

EHS stands for Environmental Health and Safety. It is a discipline and department that studies and deploys the practical aspects of environmental protection and safety at work. In simple terms, it is what organizations and workshops must do to ensure that their activities do not cause harm to anyone.

The EHS mandates that there must be specific escape routes or safety evacuation points. This includes highly detailed plans or blueprint of the building which is comprehensible to anyone.

Each floor of the workshop or building must display its own Safety Evacuation Map. These are mainly applicable for cases of Fire outbreaks or natural calamities like Earthquake, Flood, etc.

The sequence of an Evacuation situation is:

- Detection
- Decision
- Alarm
- Reaction
- Movement to an area of refuge or an Assembly station
- Transportation

Figure 3.5.13 Fire Escape Plan

Carry out Evacuation of Casualty and Premises Tasks

Briefing and Guidance for Fire Fighters

There are basically 3 methods with the help of which people can be rescued from a building engulfed in a blazing fire. To ensure on-site reception, here are 2 of the important steps that we will discuss now. These come under the best safe lifting and carrying practices.

Conventional Technique

- This is a good method if there is an open area close by.
- The first rescuers will make the victim sit reach under their armpits and finally, grab their wrist.
- The other rescuer will cross the ankle (victim), pull up that person's legs on his shoulder.
- Finally, on the count of 3, both will lift the person up and move out.

Figure 3.5.14: Fast Strap

Fast Strap

- In case the victim is completely incapable of moving out of the fire zone. The rescuers should follow this method.
- One of the rescuers will place their knee between victim's shoulder and head.
- Pin the loop of webbing to the ground with the help of the knee. This acts as an anchor.
- With the non-dominant hand hold the other end of the webbing and make a loop.
- With steady hands pull the victim's hand in from the loop, tie it securely and finally clip the webbing loops

Figure 3.5.14: Fast Strap

Essentials for Smooth Evacuation

The following are essential to have a smooth evacuation during an outbreak:

- Clear passageways to all escape routes
- Signage indicating escape routes should be clearly marked
- Enough exits and routes should be present to allow a large number of people to be evacuated quickly
- Emergency doors that open easily
- Emergency lighting where needed
- Training for all employees to know and use the escape routes
- A safe meeting point or assembly area for staff
- Instructions on not using the Elevator during a fire

Special Evacuation Requirements For Specially Abled Persons

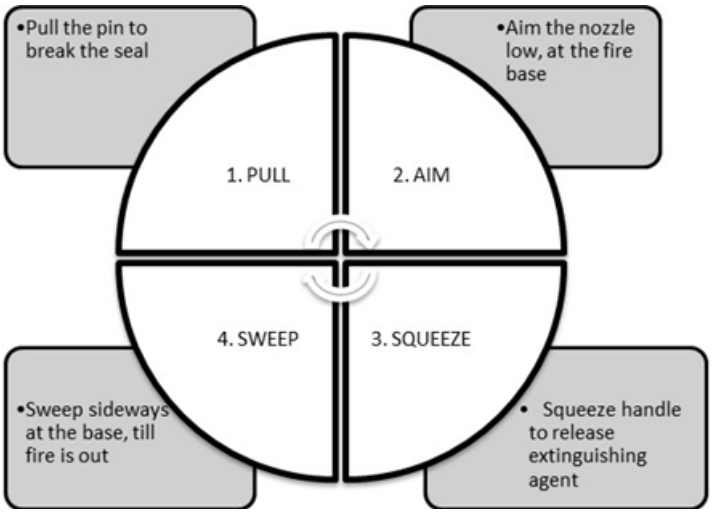
- **The Visually Impaired**
  - Announce the type of emergency
  - Offer your arm for help

- **With Impaired Hearing**
  - Turn lights on/off to gain the person's attention, or indicate directions with gestures, or write a note with evacuation directions

- **People with Prosthetic Limbs, Crutches, Canes, Walkers**
  - Evacuate these individuals as injured persons.
  - Assist and accompany to evacuation site if possible.
  - Use a sturdy chair, or a wheeled one, to move the person to an enclosed stairwell
  - Notify emergency crew of their location.

A. Demonstrate the correct use of a fire extinguisher

The method, in general, of using any fire extinguisher is defined by the P.A.S.S technique:



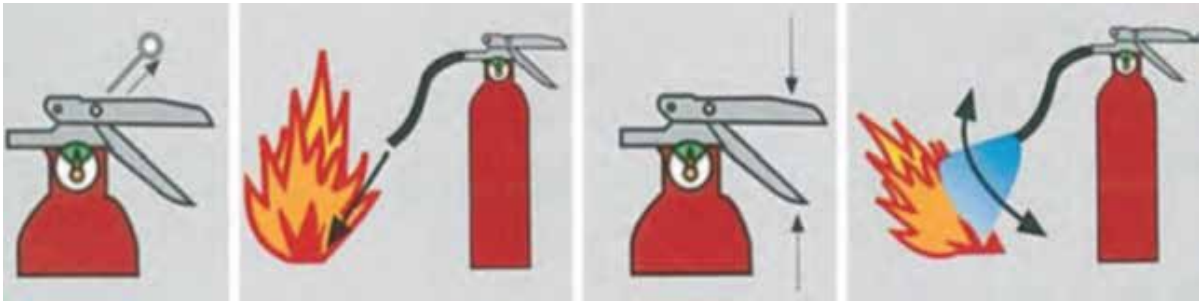


Figure 3.5.15: PASS Technique

B. Use the various appropriate Fire Extinguishers on different types of fires correctly

Water

- After ensuring that the extinguisher is full (by checking if the Pressure Gauge is pointing at the green area), the Safety Pin must be removed, which in turn would break the seal.
- For a fire spreading horizontally, the hose of the Water Extinguisher must be aimed at the base of the fire and the jet of water must be moved across the area of the fire.
- For a fire spreading vertically, the hose of the Water Extinguisher must be aimed at the base of the fire, thus moving the jet gradually upwards, following the direction of the fire.
- The lever must be gradually squeezed to discharge the extinguisher.
- The user must move closer to the diminishing fire, gradually, applying the extinguishing agent at the same time.
- The user must look out for any hot regions that may reignite.
- The user must note that Water Extinguishers are suitable for Class A fires only.
- Powder
- After ensuring that the extinguisher is full (by checking if the Pressure Gauge is pointing at the green area), the Safety Pin must be removed, which in turn would break the seal.
- For extinguishing fires from flammable solid materials, the hose of the Powder Extinguisher must be aimed at the base of the fire and moved gradually across the area of the fire.
- For extinguishing fire from spilled liquids, the hose of the extinguisher must be must be aimed at the near edge of the fire and moved with a brisk sweeping movement, thus driving the fire towards the far edge till all the flames have been put out.
- For extinguishing fire from flowing liquids, the hose of the Powder Extinguisher must be aimed at the base of the fire and be swept upwards, till all the flames have been put out.
- The lever must be gradually squeezed to discharge the extinguisher.
- The user must move closer to the diminishing fire, gradually, applying the extinguishing agent at the same time.
- The user must look out for any hot regions that may reignite.
- The user must note that Powder Extinguishers are suitable for Class A, B and C fires only.
- A Powder Extinguisher must be used differently, depending on the class of the fire it is being used on.

- **Foam**
  - After ensuring that the extinguisher is full (by checking if the Pressure Gauge is pointing at the green area), the Safety Pin must be removed, which in turn would break the seal.
  - For extinguishing fire from flammable liquids, the hose of the Foam Extinguisher must be aimed at a vertical surface near the fire and must never be sprayed directly at the fire, to prevent the fire from being pushed and spread to the surrounding areas.
  - For using Foam Extinguisher on live Electrical Fires, it must be tested to 35 kV, keeping a safe distance of 1 km.
  - For putting out fire from combustible solid materials, the hose must be aimed at the base of the fire, moving across the entire area of the fire.
  - Foam Extinguishers are suitable for both Class A and B fires. However, the technique of application differs for both the classes.
  - Foam Extinguishers help in putting out fires by accumulating a thick foam blanket across the entire surface of the fire.
  - This built-up foam blanket prevents re-ignition of fire.

- **CO2**
  - After ensuring that the extinguisher is full (by checking if the Pressure Gauge is pointing at the green area), the Safety Pin must be removed, which in turn would break the seal.
  - While putting out fire from flammable liquids, the hose of the CO2 extinguisher must be aimed at the base of the fire and briskly move across the area.
  - The user needs to ensure that the CO2 jet does not splash the burning liquid.
  - For extinguishing live electrical fire, the power supply must be switched off, if it is safe to do the same, and then, the hose must be aimed directly at the fire.
  - Adequate care must be taken to extinguish the fire completely, since reignition is possible while using CO2 extinguishers.
  - These extinguishers are suitable for using on Class B and E fires. However, the technique of application differs for both the classes.

- **Wet Chemical**
  - After ensuring that the extinguisher is full (by checking if the Pressure Gauge is pointing at the green area), the Safety Pin must be removed, which in turn would break the seal.
  - The heat source must be turned off.
  - The lance must be held at an arm's length from the body, thus maintaining a safe distance with the fire.
  - The nozzle, at this juncture, must be at least 1 m away from the source of fire.
  - The lever must be squeezed slowly to discharge the extinguishing agent.
  - The spray must be applied in gentle round movements, allowing the wet chemical to enter the fire gradually, thus preventing hot molten fats and oils from splashing on to the user.
  - The user must ensure that the entire fire has been extinguished, since wet chemical may instigate re-ignition.
  - These extinguishers are suitable to put out Class A, B and F fires.

Unit 3.6 Risk Management and Reporting

Unit Objectives

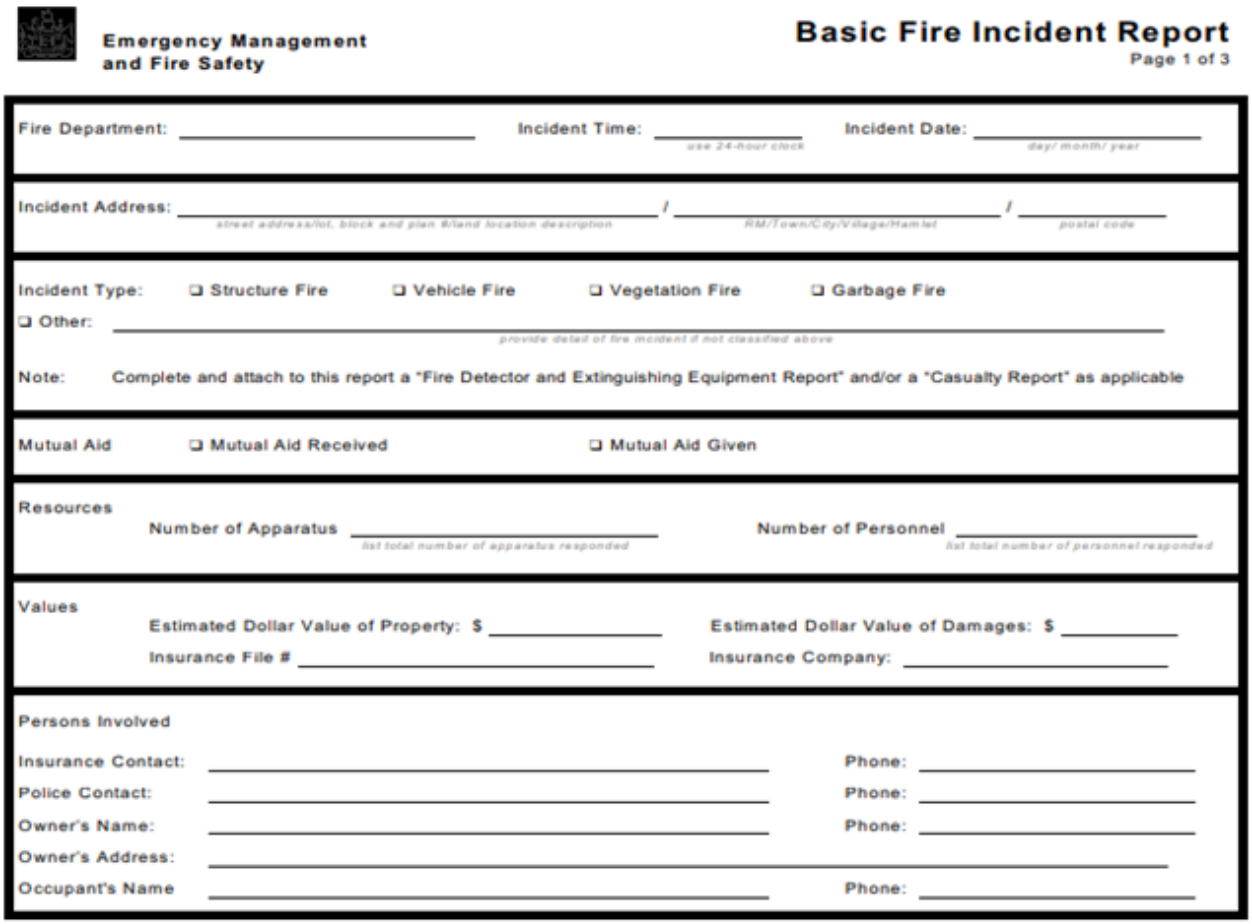
At the end of this unit, you will be able to:

- Analyze incident reports
- Evaluate safety around the workplace

Prepare Incident Reports

In the Oil and Gas companies, fire accidents are big threats. However, the companies take extra care to prevent the spread of fire. In case any fire accident takes place, it is important that the assistant drilling technician prepares a detailed incident report.

Here is a sample of how an incident report looks like.



Emergency Management and Fire Safety

Basic Fire Incident Report

Page 1 of 3

Fire Department: _____ Incident Time: _____ (use 24-hour clock) Incident Date: _____ (day/ month/ year)

Incident Address: _____ (street address/lot, block and plan #/land location description) / _____ (RM/Town/City/Village/Hamlet) / _____ (postal code)

Incident Type: ❑ Structure Fire ❑ Vehicle Fire ❑ Vegetation Fire ❑ Garbage Fire

❑ Other: _____ (provide detail of fire incident if not classified above)

Note: Complete and attach to this report a "Fire Detector and Extinguishing Equipment Report" and/or a "Casualty Report" as applicable

Mutual Aid ❑ Mutual Aid Received ❑ Mutual Aid Given

Resources

Number of Apparatus _____ (list total number of apparatus responded) Number of Personnel _____ (list total number of personnel responded)

Values

Estimated Dollar Value of Property: $ _____ Estimated Dollar Value of Damages: $ _____

Insurance File # _____ Insurance Company: _____

Persons Involved

Insurance Contact: _____ Phone: _____

Police Contact: _____ Phone: _____

Owner's Name: _____ Phone: _____

Owner's Address: _____

Occupant's Name _____ Phone: _____

Property Use

❑ Educational ❑ Mercantile / Business ❑ Storage
❑ Health Care / Detention ❑ Industry / Utility ❑ Outside or special property
❑ Residential ❑ Manufacturing

❑ Other _____
provide property use detail of the structure if not classified above

Number of buildings involved _____ Acres burned _____ Building height _____ Floor size _____
Total # of stories *Indicate ft² or m²*

Building Status

❑ Under Construction ❑ Under major renovation ❑ Being demolished
❑ Occupied ❑ Vacant and secured ❑ Undetermined
❑ Idle / Not routinely used ❑ Vacant and unsecured

❑ Other _____
provide details of building status if not classified above

Continued on Page 2

Emergency Management and Fire Safety

Basic Fire Incident Report

Fire Spread

❑ Confined to room of origin ❑ Confined to building of origin
❑ Confined to floor of origin ❑ Beyond building of origin

Mobile Property Involved

❑ None
❑ Not involved with ignition, but burned
❑ Involved with ignition, but did not burn
❑ Involved with ignition and burned

Mobile Property Type

❑ Passenger or road transport ❑ Aircraft
❑ Freight road vehicle ❑ Industrial, agriculture, construction
❑ Transport vehicle ❑ Miscellaneous
❑ Water vessel ❑ Unknown

Mobile Property Details

Make _____
Model _____
Licence number _____ Province _____ VIN _____

Ignition Factors

Area of Origin

provide detailed description of the primary use of the area where the fire started - also check below as applicable

- ❑ Means of egress >hallways, entrance areas, fire exits
- ❑ Storage areas >store rooms, closets, garages
- ❑ Transportation vehicle areas >passenger area, trunk, engine
- ❑ Assembly areas >theaters, community halls, living rooms
- ❑ Service areas >conduit, pipes, elevator shaft
- ❑ Outside areas >streets, parking lots, railway tracks
- ❑ Function area >bedroom, kitchen, office, dining room
- ❑ Service or equipment areas >mechanical rooms, cells
- ❑ Other areas >areas not otherwise listed
- ❑ Technical processing area >laboratories, operating rooms, stages
- ❑ Structural areas >attics, crawl spaces, exterior of walls
- ❑ Undetermined >area or origin cannot be determined

Heat Source

provide detailed description of the heat source which ignited the first object to burn - also check below as applicable

- ❑ Operating equipment >spark, ember, electrical arc, radiant heat
- ❑ Other open flame, smoker's materials >cigarettes, candles, match, lighter
- ❑ Other heat sources >multiple heat sources
- ❑ Hot smouldering object >heat of friction, molten material, welding
- ❑ Chemical, Natural heat sources >sunlight, spontaneous combustion
- ❑ Undetermined >heat source cannot be determined
- ❑ Explosives, fireworks >blasting agent, munitions, fireworks
- ❑ Heat spread from another fire >flame contact, radiant heat, embers

Item First Ignited

provide detailed description of the item first ignited - also check below as applicable

- ❑ Structural component >wall coverings, framing, floor coverings
- ❑ Adornment, recreational items, signs >Christmas trees, awnings, tents, toys
- ❑ Organic materials >agricultural crops, humans, animals
- ❑ Furniture, utensils >upholstery, cabinets, appliances
- ❑ Storage supplies >boxes, packing materials, pallets
- ❑ General materials >books, trash, dust, lint, tires, fertilizer
- ❑ Soft goods, wearing apparel >mattresses, linen, clothing, drapes
- ❑ Liquids, piping, filters >flammable gases / liquids, pipes, ducts
- ❑ Undetermined >item first ignited cannot be determined

Cause of Ignition

provide detailed description of the cause of ignition - also check below as applicable

- ❑ Intentional >misuse of heat source, incendiary fire
- ❑ Failure of equipment >equipment not functioning properly
- ❑ Cause under investigation >origin and cause not yet determined
- ❑ Unintentional >careless, reckless, accidental acts
- ❑ Act of nature >weather, floods, animal behaviour
- ❑ Cause undetermined >cause undetermined after investigation

Emergency Management and Fire Safety

Basic Fire Incident Report

Page 3 of 3

Factors Contributing to Ignition

provide detailed description of the factors that allowed heat source and combustible materials to come into contact/combine

- ❑ Misuse of materials >unsafe use or placement of heat source
- ❑ Design, Installation Deficiency >design, construction, installation faults
- ❑ Fire spread or control >exposure, rekindle, controlled burns
- ❑ Mechanical failure, malfunction >worn components, control failure, leak
- ❑ Operational Deficiency >collisions, unattended equipment
- ❑ Undetermined >ignition factors cannot be determined
- ❑ Electrical failure, malfunction >short circuit, arcing, equipment failure
- ❑ Natural condition >wind, flood, animal behaviour

Human Factors

provide detailed description of the human factors related to the fire - also check below as applicable

- ❑ Asleep >occupant(s) asleep at time of fire
- ❑ Possible mentally disabled >persons with permanent disabilities
- ❑ None >no persons involved
- ❑ Impaired by alcohol or drugs >impaired occupant(s) asleep or awake
- ❑ Physically disabled >permanent or temporary disabilities
- ❑ Unattended >persons requiring care left unattended
- ❑ Multiple persons >note number of persons above

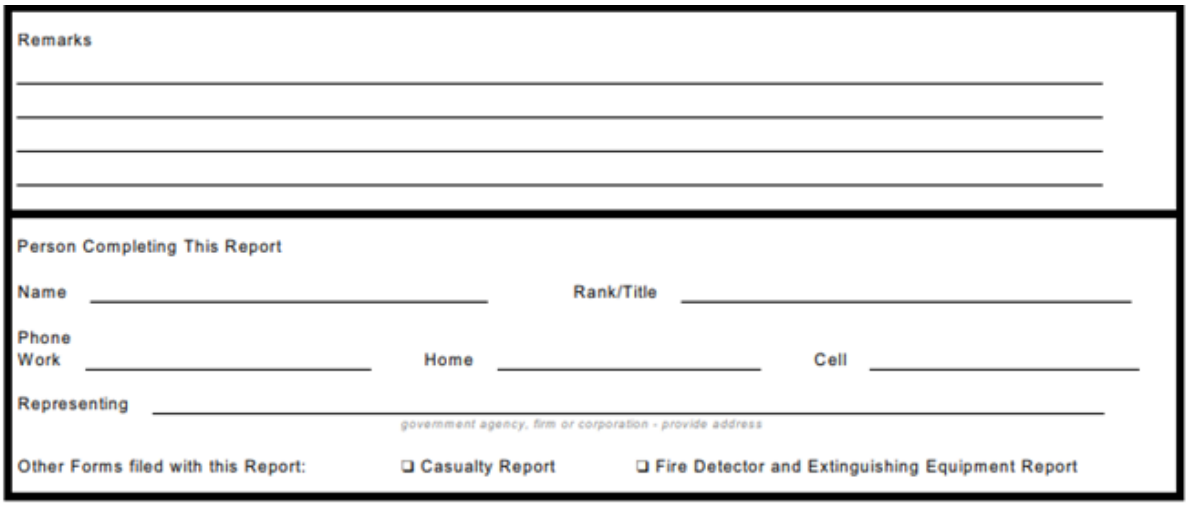
Equipment Involved in Ignition

provide detailed description of equipment involved in ignition - also check below as applicable

- ❑ Heating, ventilation, air conditioning >furnace, fire place, stove, water heater
- ❑ Commercial and medical equipment >vending machines, O2 equipment
- ❑ Electronic, other electrical equipment >computers, TVs, stereos, cash register
- ❑ Electrical distribution, lighting, power >distribution panels, outlet, lights
- ❑ Garden tools, agricultural equipment >combine, chain saw, milking machine
- ❑ Personal and household equipment >clothes dryer, curling iron, powered toys
- ❑ Shop tools and industrial equipment >power saw, welding torch, compressor
- ❑ Kitchen and Cooking Equipment >Coffee maker, microwave, dishwasher
- ❑ Other equipment involved in ignition >other equipment not listed, none

Brand or Make _____ Serial Number or other identification _____

Model _____ Year of manufacture _____



Remarks

Person Completing This Report

Name _____ Rank/Title _____

Phone
Work _____ Home _____ Cell _____

Representing _____
government agency, firm or corporation - provide address

Other Forms filed with this Report: ❑ Casualty Report ❑ Fire Detector and Extinguishing Equipment Report

Figure 3.6.1: Fire Incident Report (Picture Courtesy: http://www.publications.gov.sk.ca)

If such forms are not available, one should remember to include this information as the content.

- In the 1st section, you need to record the basic things related to the accident like:
  - Date of accident
  - Time
  - Specific location
  - Accounts of witnesses
  - Their names
  - Event that caused that accident
  - What other electricians were doing at that moment
  - Circumstances like PPE, materials, equipment, tool
  - Environmental conditions
  - Specific injuries
  - Person(s) who gave first aid
- In the 2nd section, it is mandatory to give a complete description including necessary details and relevant facts. The use of language should be formal.
- In the 3rd section, the person writing the content requires signing it with the current date.

P.S. It is essential that a photocopy of the written accident report be made before submission.

Work Safely in and Around Trenches, Elevated Places and Confined Areas

There are a number of risks associated with working around confined areas, elevated places and trenches.

Figure 3.6.2: Conditions of technicians working around confined areas (Picture Courtesy: https://www.labour.gov.hk)

In these areas, the dangers are related to poisonous vapours, fumes, leaks into trenches from old gas works, drowning, etc.

Figure 3.6.3: Conditions of technicians working around elevated areas (Picture Courtesy: https://www.labour.gov.hk)

In these areas, the dangers are related to rust formation in vessels and steel tanks, lack of oxygen, higher concentrations of dust in the form of flour silos, risk of trip and fall, electric shock, etc.

In order to work in these areas safely, the technicians should follow certain preventive measures.

- It is better to not enter in the confined spaces. However, for work purposes, it becomes mandatory for the assistant drilling technicians to work in such areas.

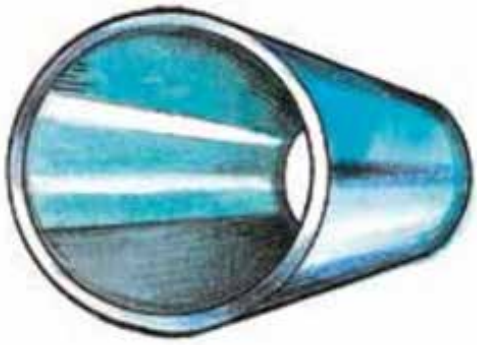


Figure 3.6.4: First example of confined space (Picture Courtesy: https://www.labour.gov.hk)

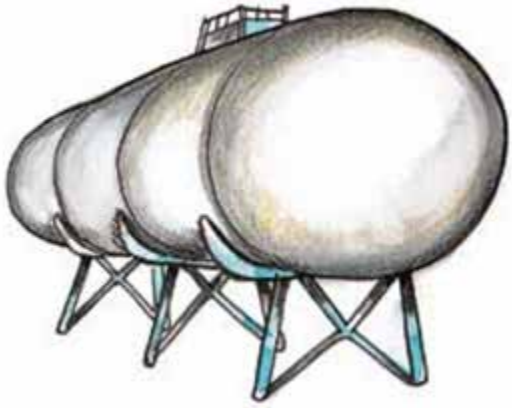


Figure 3.6.5: Second example of confined space (Picture Courtesy: https://www.labour.gov.hk)

- The technicians should check the depth of the trenches, entrance size of the confined areas and height of the elevated areas.

Figure 3.6.6: Technician in Dilemma – Didn't check the Entrance Size of the Confined Areas before Work (Picture Courtesy: https://www.labour.gov.hk)

- Before working in such areas, the technicians should modify those spaces.

Figure 3.6.7: Space modification by Assistant Drilling Technician (Picture Courtesy: https://www.labour.gov.hk)

- For the vessel's internal inspection, they can take the assistance of remote control monitors
- For cleaning operations, sampling and inspection, they can use appropriate tools from outside the space.
- The technician should be a competent person, and he or she should always make a checklist of the tasks that they are planning to do. It helps them to complete the work in a smooth and less exhaustive process.

Figure 3.6.8: Competent Technician (Picture Courtesy: https://www.labour.gov.hk)

- Testing the air around the work area to see if the enclosed area is free from flammable or toxic gasses. In case of less oxygen in elevated areas, technicians can carry breathing equipment with the help of such air testing method.

Figure 3.6.9: Testing the Air (Picture Courtesy: https://www.labour.gov.hk)

Ensure Emergency Preparation and Response

In oil and natural gas production companies, prior planning is an important aspect. In order to prevent emergencies, offshore operators take various precautions. It is the work of technicians and assistant technicians to analyse potential risks that can harm the work environment and the people working in that area.

When we talk about emergency response plan, we are basically talking about a detailed plan which helps the contractors and the workers during the time of emergencies. These plans provide training to the technicians how to react and take action regarding various emergencies.

Assistant production technicians require to be well prepared for emergencies like:

- Helicopter incidents
- Extreme weather
- Presence of icebergs or heavy sea ice
- Vessel collisions
- Aircraft damage
- Support vessel damages
- Offshore infrastructure damage
- Hazardous material spills
- Oil material spills
- Explosions
- Accidental fire
- Any well's control loss
- Diving emergencies
- Missing people or person
- Medical emergencies
- Serious injuries
- Fatalities

For an appropriate response, the assistant technicians should know how to tackle different types of offshore emergency situations.

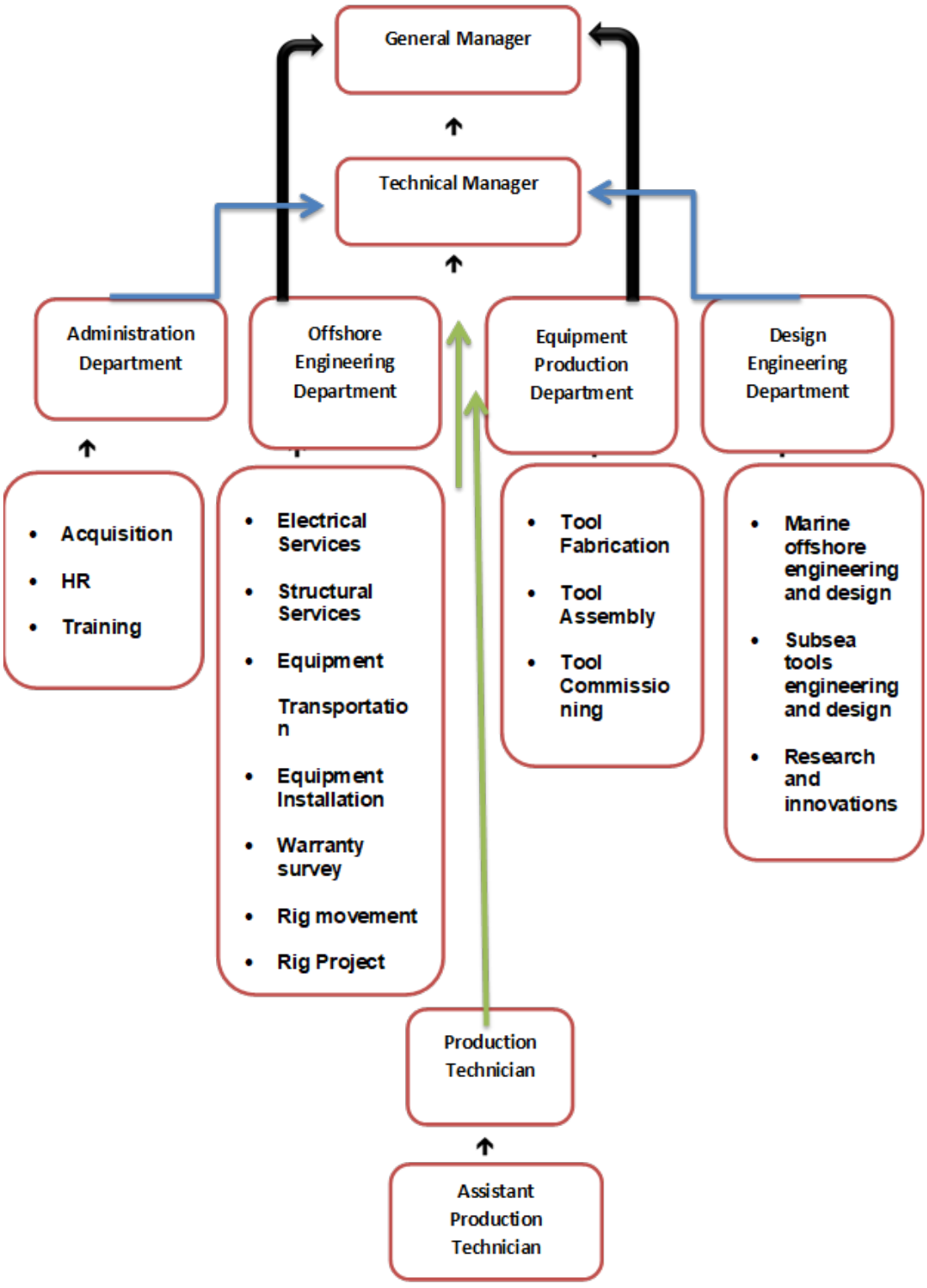
Figure 3.6.10: Hazardous material spills

In addition to this, oil and gas companies should create separate and interlinked teams. These are:

- Crisis Management Team that Crisis Manager leads
- Emergency Coordination Team that Emergency Coordinator leads
- Site Control Team that Site Controller leads

State the Name and Location of People Responsible For Health and Safety for the Workplace and Escalation Matrix

These are also the various categories of people that one is required to communicate and coordinate within the organization.



Unit 3.7 Standard Operating Procedures in Oil and Gas Safety W.R.T. Occupational Health & Safety

Unit Objectives

At the end of this unit, you will be able to:

- Analyse the standard operating procedure (SOP) in oil and gas industry

Identify common risks and safety SOP in Oil & Gas production area: Follow SOP in Oil & Gas Drilling Facilities

On a global level, the jobs in oil and gas industry are considered as highly dangerous tasks. To perform such difficult tasks, various safety measures are applied on a regular basis. Where the number of drilling rig installations have increased to approximately 70%, the size of workforce has also doubled with respect to the increase. Now with the boom in the industry, at present, approximately 27.6% of work related fatalities have been noted. This is a recent statistics (2017).

To prevent site related accidents like trips and falls, exposure to harmful environments, explosions and fire incidents, contact injuries and accidents due to highway vehicles, operators and drilling technicians (including assistants) should follow certain safety instructions. Some of the important ones are as follows:

- Before the work in the worksite starts, it is better to convey all the hazard specifics and work procedures to the crew.
- For better work efficiency and to lessen the chances of incidents, it is better to minimise overall confusions related to the drilling operations.
- It is imperative that the assistant drilling technicians is constantly communicated for the respective equipment and provided guidance for each step.
- For timely completion of the drilling work, it is better to streamline the task.
- First aid kits should be present at the worksite.

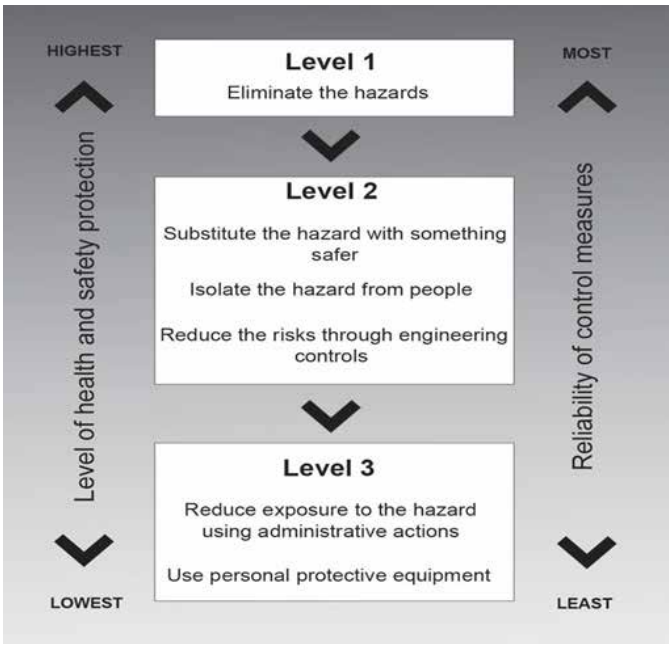


Figure 3.7.1: Safe Working Practices with the help of Risk Controlling Procedure

SOP or Standard Operating Procedures is developed for training operators and drilling technicians. In most cases, integration of Standard Operating Procedures are done through Systems Engineering Team.

Valuable guidance is offered through coordination with control systems. In simple words, SOPs ensures the provision of technical methods and guidance that helps in designing and operating facilities as per the current norms of the oil and gas production facilities.

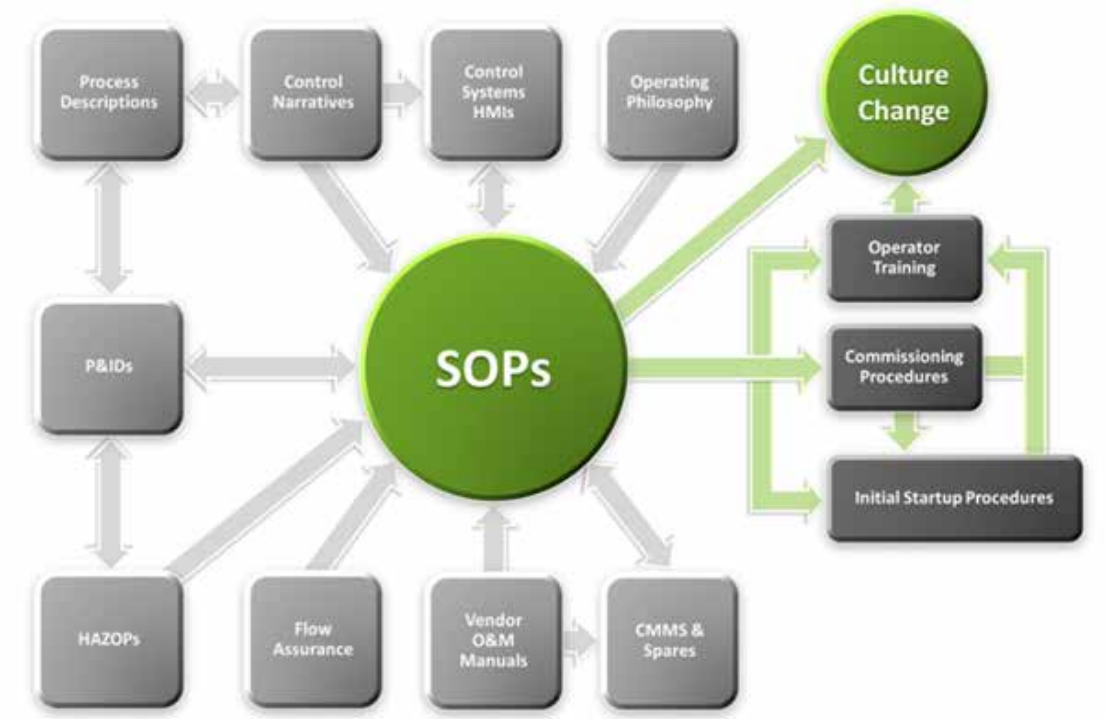


Figure 3.7.2: SOP in Oil & Gas Drilling Facilities

Summary

- In elevated areas, the dangers are related to rust formation in vessels and steel tanks, lack of oxygen, higher concentrations of dust in the form of flour silos, risk of trip and fall, electric shock, etc.
- SOPs ensure the provision of technical methods and guidance that helps in designing and operating facilities as per the current norms of the oil and gas production facilities
- While working with tools like drilling instruments, pipe fitters, sheet metal fabricators, etc., it becomes important that utmost care is taken for fire safety
- Hydrogen peroxide or iodine must not be used on cuts since they are corrosive and can damage live tissues
- Aspirin must not be given to anyone aged 18 years or younger

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

HSSC
HYDROCARBON SECTOR
SKILL COUNCIL

4. Working Effectively with Colleagues and Supervisor

HYC/N0102

Key Learning Outcomes 

After attending the session, you will be able to:

1. Identify the people to communicate and co-ordinate within the organization
2. Evaluate the importance of effective communication
3. Analyze the significance of teamwork
4. Prioritize the significance of team and individual contribution in success
5. Analyze the components of effective communication
6. Determine the key elements of active listening
7. Assess the value of active listening and effective communication
8. Identify the barriers of effective communication
9. Analyze the tone of pitch in assertive communication
10. Evaluate the importance of avoiding unprofessional language
11. Determine the aftermath of poor communication
12. Signify the ethical practice in the professional circle
13. Evaluate the importance of discipline
14. Identify the components of disciplined behaviour

Unit 4.1 Various categories of people that one is required to communicate and coordinate with in the organization

Unit Objectives

At the end of this unit, you will be able to:

- Identify the people within the organization for communication and co-ordination

Accurately Receive Information and Instructions from The Supervisor And Fellow Workers, Getting Clarification Where Required and Accurately Pass On Information To Authorized Persons Who Require It And Within Agreed Timescale And Confirm Its Receipt

Listening to the information attentively that you receive from your fellow workers and supervisor

↓

Grasping the content well

↓

Analysing the instructions that you are given

↓

Putting forth the queries regarding the provided information

↓

Clearing the doubts regarding the given task or instruction

An oil production technician must communicate and coordinate with peers and supervisors in the organization for smoother work flow. The elements of communicating effectively with peers / colleagues and supervisors are:

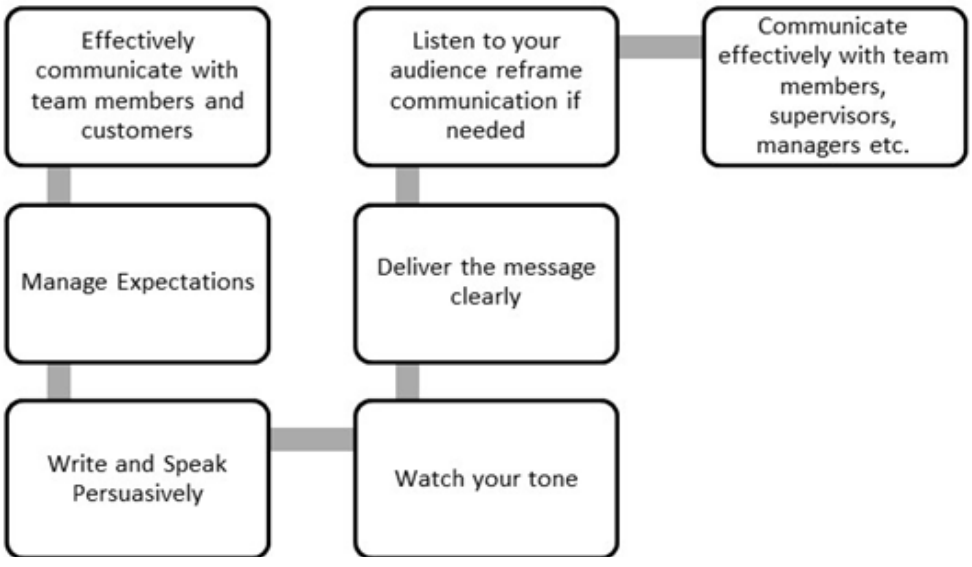


Figure 4.1.1: Effective communication to improve work flow

- **Coordinate and cooperate with colleagues to achieve work objectives**
  - Listen actively with minimal barriers
  - Build trust, but do not get too casual
  - Be aware of your tone
  - Watch your body language
  - Participate and coordinate
  - Ask questions to clarify
  - Discuss task lists, schedules and activities
  - Share best practices with peers

- **Effectively Communicate with Supervisors**

Tips to effectively communicate with supervisors:

- **Seek assistance from supervisor or any such appropriate authority as and when required**
  - One's supervisor is supposed to be one's mentor and guide at work.
  - Assistance and guidance must be sought from the supervisor whenever needed.
  - Ask questions to clarify doubts.

- **Ask questions and seek clarifications on work tasks whenever required**
  - Question must be asked to clarify doubt and to narrow down communication gaps with one's supervisor.
  - This must be done to get a clear idea about the responsibilities expected by one's supervisor.
  - Having a clear idea about one's tasks helps in fulfilling targets successfully.
  - Seek and obtain clarifications on policies and procedures, from the supervisor or other authorized personnel.
  - Address the problems effectively and report if required to immediate supervisor appropriately.
  - Identify and report any possible deviations to appropriate authority.
  - Receive instructions clearly from superiors and respond effectively on the same.
  - Accurately receive information and instructions from the supervisor related to one's work.

Unit 4.2 Importance of Effective Communication in the Workplace

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate the importance of passing on information

Give Information To Others Clearly, At A Pace And In A Manner That Helps Them To Understand

The foremost thing regarding giving clear information is respecting the audience. When you communicate and put forth the information to the listener, you should be clear about the message that you would be giving to them.

The next aspect is to stick to the instruction that you want to give to the workers working in the oil and gas facility.

Information exchange makes the process of imparting information smoothly. If the speaker knows what they want to convey, they should also know what the audience is grasping. This decreases the chance of confusion as the listener gets the opportunity to ask about the instruction or about correct selection of tools and clearing their doubts then and there.

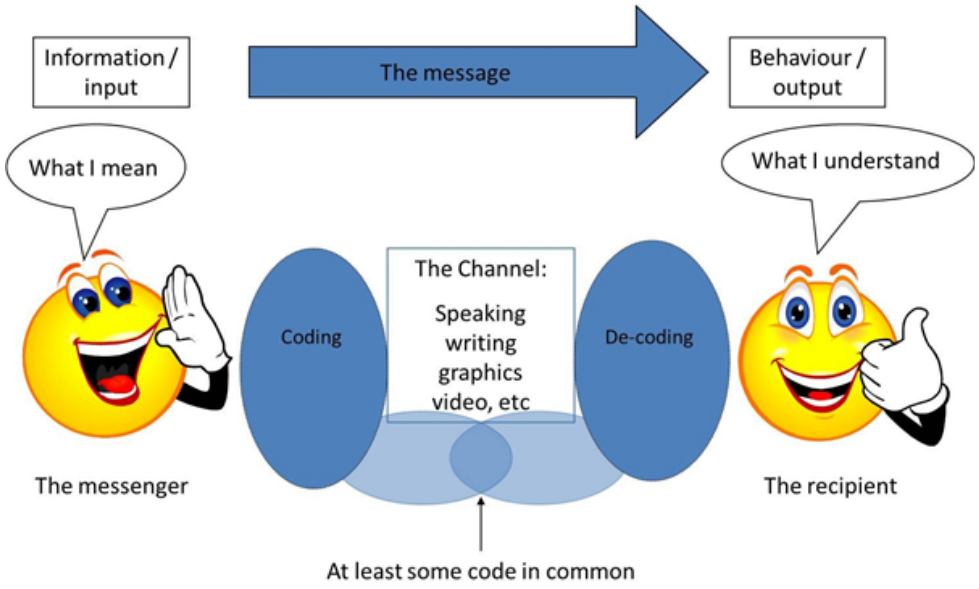


Figure 4.2.1: Clear information Exchange

A workplace is an area where people from different backgrounds and perspective come to work together. An individual working at a work place or work site doesn't work alone. He or she works with a team – colleagues, supervisor, trainer and others (as per requirement). In this case, good communication and mutual bonding make the workflow smooth and uninhibited. In fact, effective communication allows us to understand the problems that our colleagues are facing, and them to portray it clearly.

Effective communication

- **Ensures a positive attitude**
  - Communication amongst employees with a positive attitude ensures that change or the development is towards a prospective change (positive).
  - It also motivates the employees, thereby ensuring that they provide cost-effective, productive, and valuable services.

- **Ensures proper comprehension regarding strategy and goal accomplishment**
  - It gives the employees the correct perception regarding their work.
  - It also makes sure that the employees know how their work is directly influencing the profitability of the company
  - It gives employees the true impression of working as a team

- **Ascertain that everybody complies with the company's regulatory bodies**
  - Talking with colleagues and sharing information on any new updates on company policy or project ensures that everyone stays on the same page.
  - Added to this, this makes the team more responsive and positively engaged in the work.

Unit 4.3 Importance of Teamwork in Organizational and Individual Success

Unit Objectives

At the end of this unit, you will be able to:

- Estimate the effects of positive attitude in the workplace

Display Helpful Behaviour By Assisting Others In Performing Tasks In A Positive Manner, Where Required And Possible

T.E.A.M - Together Everyone Achieves More...

Team work is the actions of individuals, brought together for a common purpose or goal, which subordinate the needs of the individual to the needs of the group. In essence, each person on the team puts aside his or her individual needs to work towards the larger group objective. The interaction among the members and the work they complete is called teamwork. Team work is extremely important for the assistant **drilling** technician to accomplish his or her job responsibilities efficiently.

- The sum of the efforts undertaken by each team member for the achievement of the team's objective is called team work
- Every member of a team has to perform and contribute in his best possible way to achieve a common predefined goal
- Individual performances do not count in a team, and it is the collective performance of the team workers which matters the most

Figure 4.3.1: Benefits of Team Work

The essential components of Team work are:

- **Communication.** This is the essence of effective Teamwork. Effective communication provides understanding, interpretation and action. Ineffective communication leads to misunderstanding, misinterpretation, and either inaction or inappropriate action.
- **Active Listening.** There are two responsibilities here: That of the sender and that of the receiver. The sender must ensure that the message is clear and understood and the receiver must ensure that if the message is not clear that they ask for clarification.
- **Resolving Conflict.** People are different, and inevitably clashes of personality or other conflicts may arise. The conflict must be resolved, and people should use an effective, consistent approach to resolve it.
- **Team Diversity.** People come from different backgrounds, and this can present challenges and opportunities. People have to recognise and understand their own uniqueness and that of others and make allowances.
- **Team Motivation.** Motivation inspires commitment, innovation and teamwork. Team leaders and members need to be aware of the factors affecting motivation and techniques they can use to enhance and maintain motivation levels.

Consult With And Assist Others To Maximize Effectiveness And Efficiency In Carrying Out Tasks

To enhance the efficiency and effectiveness in carrying out tasks, it is better to follow and avoid certain pointers.

	Not Urgent	Urgent
Not Important	**Quadrant 1** Focus Quadrant of Quality Empowerment Building a relationship via Re-creation Clarifying the Values Prevention Preparation	**Quadrant 2** Manage Quadrant of Necessity Preparation Meetings or projects driven by deadlines Pressing problems crisis
Important	**Quadrant 3** Avoid Quadrant of waste Multiple popular activities Pressing matters Meetings (few) Certain types of reports and emails Interruptions due to phone calls	**Quadrant 4** Avoid Quadrant of Deception Escape Activities Time Wasters Unimportant Phone Calls Junk mails Busy work, Trivia

Unit 4.4 Various Components of Effective Communication

Unit Objectives

At the end of this unit, you will be able to:

- Identify the components of effective communication

There are basically 5 components of effective communication.

- **Active listening:** Active listening is the process by which an individual secures information from another individual or group.
- **Soothing:** When a person is angry, he or she will not listen to anything you say, even if you have logical points. During this time, the people just want others to hear them out.
- **Clarity:** Until and unless you communicate with clear words, there are chances that the listener may misunderstand the information. So it is advisable that you economise your point without muddling the information.
- **Personal responsibility and empathy:** Showing empathy shows your humane side and ensures others that you can understand their situation. This also makes the other person feel not threatened when they share any information with you. Personal responsibility and empathy ensure that colleagues have a better understanding amongst themselves.
- **Body language:** Positive body language indicates receptiveness and presents a welcoming image to others. This welcoming image or cordial approach ensures effective communication.

Figure 4.4.1: Components of Effective Communication

Unit 4.5 Key Elements of Active Listening

Unit Objectives

At the end of this unit, you will be able to:

- Verify the key elements of active listening

The various elements of active listening include:

- **Paying attention:** When your senior technician shares important information with you, he or she is basically asking for your undivided attention. Listening to a piece of information ensures that you can complete your work without any mistakes.
- **Body language shows that you are listening:** One of the best ways to show that you are paying attention to the speaker is by using certain gestures. Some of the gestures include:
  - Using certain verbal comments like “un huh”, “yes”, “ok” etc.
  - Facial expressions like a smile or seeing directly towards the speaker
  - Occasionally nodding to the sentences that the speaker is stating

Picture 4.5.1: Body language showing that you are listening

- **Offering feedbacks:** The main aspect of active listening is to understand what is being told to you and that you understand what you are being told. The understanding process includes thinking about what you are being told and reflecting on that information. In case there are confusions regarding the provided information, it is better to ask about it. Before going to the site, it is better to summarise the information and tell that to your senior or supervisor.

- **Deferring judgement:** When a person talks, interrupting that person several times can make him or her frustrated, and there are chances that he or she can miss a few important pointers. So it is better to allow the speaker to finish what he or she is speaking.

Display Active Listening Skills While Interacting With Others At Work

When displaying active listening skills while interacting with others at work, the technician requires following these points.

- The technician should face the speaker and maintain eye contact.
- The person should be attentive. However, they should be relaxed.
- The technician should keep an open mind.
- They should listen to the words and try to picture what the speaker is saying
- They should not interrupt nor impose their “solutions”
- They should wait for the speaker to pause to ask clarifying questions
- They should ask questions only to ensure understanding
- They should try to feel what the speaker is feeling
- They should give the speaker regular feedbacks

Figure 4.5.2: Active Listening Skills While Interaction

Unit 4.6 Value and Importance of Active Listening and Assertive Communication

Unit Objectives

At the end of this unit, you will be able to:

- Analyze the significance of assertive communication

Active Listening is the process by which an individual secures information from another individual or group.

Display active listening skills while interacting with others at work:

The steps involved in Effective and Active Listening are:

- Facing the speaker and maintaining an eye contact
- Attentively listen and comprehend the information given by the speaker
- Staying attentive yet relaxed
- Keeping an open, receiving mind
- Listening to the words and trying to visualize what the speaker is saying
- Never interrupting or imposing your "solutions"
- Waiting for the speaker to pause to ask clarifying questions
- Asking questions only to ensure understanding
- Communicate clearly on the issues being faced and clarify queries
- Trying to empathize with the speaker
- Providing the speaker with constructive feedback

Team Work is extremely crucial for successfully carrying out an assignment. An important aspect of effective team work is supporting co-workers facing problems, for ensuring smooth functioning of the assignment. Supporting a co-worker is vital because:

- **Confidence:** Going out of one's way to help and support co-workers will have a marked effect on their confidence and give them a sense of pride in their work, but it is likely to improve engagement, productivity and eagerness to maintain high standards at workplace.
- **Improved Communication:** If you are supportive and friendly towards a colleague, he/she will see you as an approachable person, hence marinating smooth communication and increasing productivity.
- **Team Spirit:** A supportive environment undoubtedly leads to a better working atmosphere. It helps in creating a sense of community and team spirit, which works as a reminder that everyone is striving towards one unified goal.
- **Support from a grateful co-worker, in return:** To repay your support and help, the colleagues, who you helped and supported, will help you in your work, as a token of gratitude.

Importance of Active Listening

- Reduces negative assumptions
- Innovative solutions
- Enhances Confidence
- Ensures better Learning
- Does not allow any conflicting issue to develop amongst colleagues
- Enhances Relationships
- Accuracy
- Better Productivity
- Trust formation
- Building respect amongst colleagues

Importance of Assertive Communication

- The job satisfaction level of an assertive person is higher
- With this form of communication, people can create honest relationships
- People can easily see better decision-making skills
- They can create win-win situations
- The communication amongst colleagues enhances or improves
- People using assertive communication can easily earn respect
- They can understand the feelings and problems of others
- They gain self-esteem and self-confidence

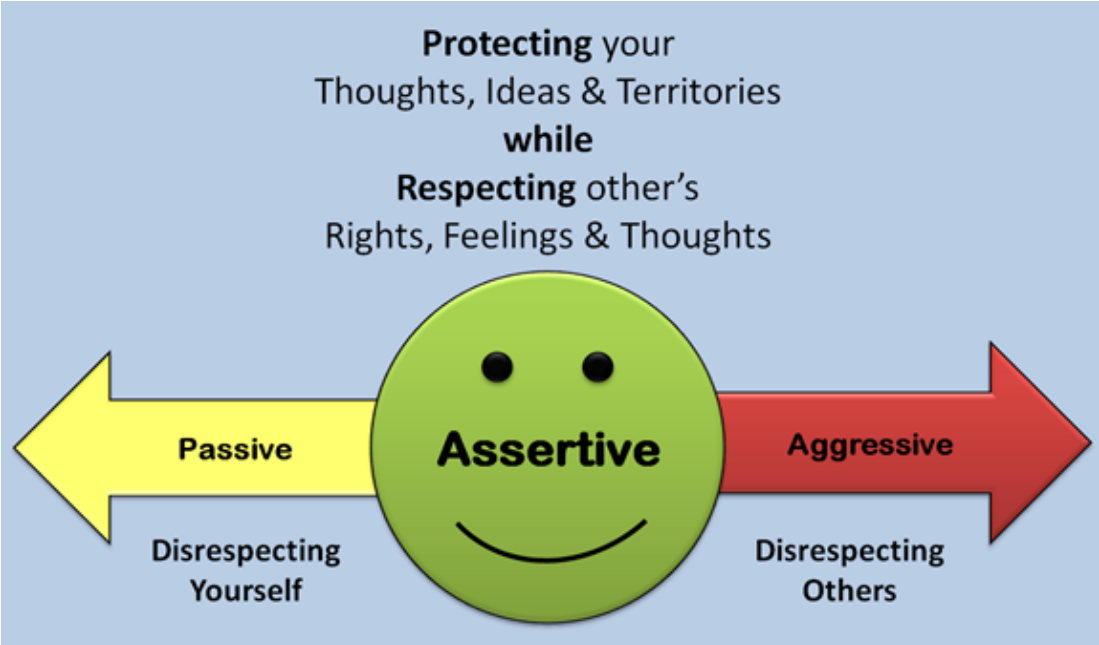


Figure 4.6.1: Assertive Communication

Unit 4.7 Barriers to Effective Communication

Unit Objectives

At the end of this unit, you will be able to:

- Assess the barriers of effective communication

An assistant production technician must acquire excellent and active listening skills so that he or she can communicate with the customer better and understand his / her problems easily. Understanding the problem implies that the job is half done. Below are the factors that hinder Effective and Active Listening.

Various types of Barriers are:

- Distractions
- Interruptions
- Lack of interest
- Noise
- Prejudice

The Potential barriers that hinder effective communication are:

- Use of Jargon and Technical terms
- Lack of attention, interest, distractions, or irrelevance to the receiver
- Differences in Perception
- Physical disabilities like Hearing Ailments or Impaired Speech
- Cultural and Language Differences and Unfamiliar accents

Figure 4.7.1: Barriers to Effective Communication

Expectations and Prejudices Leading To False Assumptions or Stereotyping:

This is a common phenomenon that one can often observe at workplaces. This is not about language differences. This is more about the difference in understanding and what a person wants to understand.

In most cases, it has been seen that people will not hear what is being said to them at that time. Rather, they often hear what they wish to hear. This leads to conflicts.

When a conflict arises, this gives birth to 3 factors.

- Prejudice
- Bias
- Stereotyping

If the conflict is greater at workplace, the stereotyping will be bound to be complex and distorted.

This again ensures that the prejudice and bias become deep-rooted in the minds of the workers.

The main role of prejudice, bias and stereotyping is:

- Make another person feel bad so that they lose their perspective, leading to the loss of patience and power
- Reinforce loyalty, disrespect and punish the person or people as opposition
- Discouraging others from empathising or supporting others and making the situation more complex

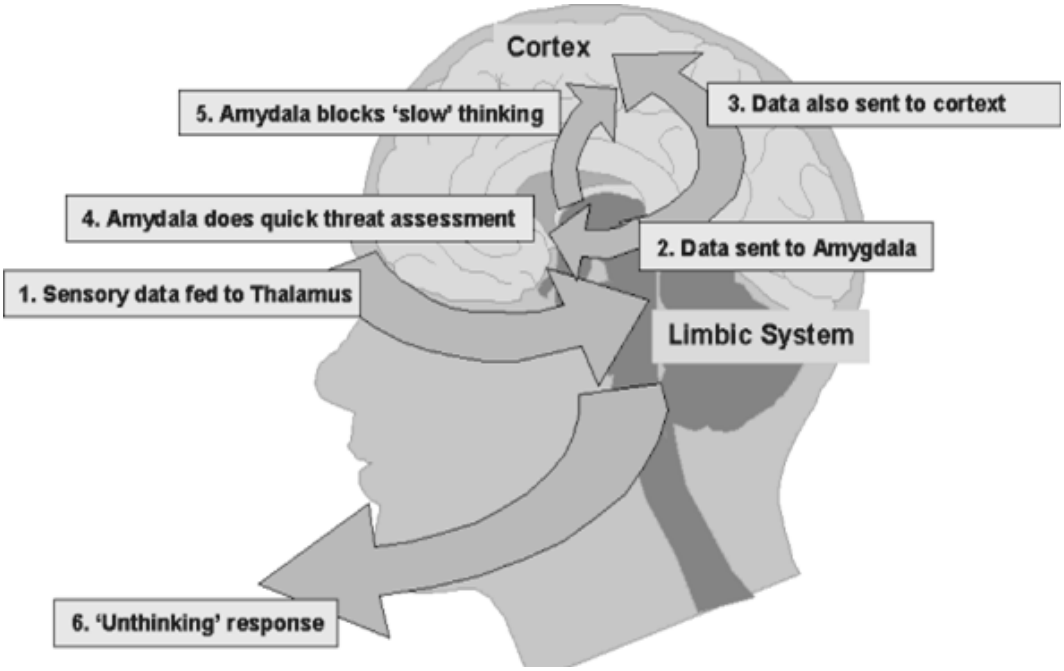


Figure 4.7.2: The Conflict Response

As the work of assistant production technician is purely technical, it is necessary for them not to conceive any pre-conceived notion. The technician needs to understand the fact that they being the assistants will have to work on specific work sites or projects which they may find uncomfortable. However, they need to understand the fact that many minor aspects of production in oil and gas industry are highly important.

Unit 4.8 Importance of Tone and Pitch in Effective Communication

Unit Objectives

At the end of this unit, you will be able to:

- Identify the proper tone and pitch in professional circle

Use Appropriate Tone, Pitch and Language to Convey Politeness, Assertiveness, Care and Professionalism

Tone and pitch are two of the main aspects of effective communication. The response of people depends on the tone and pitch of the person whom they are listening to.

As per the Department of Psychology, USA, a person having a deep voice is generally associated with dominant nature, leadership quality and higher. Such types of people are good communicators and show qualities like dynamism.

People who know where to use appropriate tone and pitch can manage the work easily without offending others.

For example:

- I didn't say that you removed my pen.

Meaning: I was implying that you took the pen of someone else.

- I didn't say that you removed my pen.

Meaning: The accusation was directed at someone else and not you.

This explains the intonation of the person who is communicating with others.

Language plays a pivotal role in fabricating the image of a person as a professional. The language we use on a regular basis is known as colloquial. However, professional language should not be affected by the colloquial. Here are some tips for the proper professional language:

- Show respect to the others while speaking
- Don't use colloquial terms. Colloquial terms may not be understood by all and thus, avoid using colloquial
- Refrain from using slangs in the workplace. This is highly unprofessional

Unit 4.9 Importance of Avoiding Casual Expletives and Unpleasant Terms While Communicating Professional Circles

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate the significance of the avoiding unpleasant terms while communicating

Every workplace has a number of rules and regulations and certain frameworks that are made to protect the employees from abuse. This abuse can also be in the form of unpleasant terms or casual expletives.

In most cases, employees think that swearing at the workplace does not matter as it only happens when they are stressed. In some other cases employees think that as the colleagues are not complaining about it, the management body does not know about and hence they can continue using expletives. However, organizational norms don't work like that.

There are a number of reasons that can answer why employees need to watch their tongue.

- **People feel bad and offended:** The person listening to the expletives not only feels bad but it also generates negative feeling against the speaker.
- **Showcasing self-centeredness:** Using unpleasant terns and cursing others definitely proves the fact that the speaker is not concerned what others think about him or her.
- **Lazy and ignorant:** Using profanity can make the user think himself or herself cool. However, it makes the person look ignorant, uneducated and uncivilised.
- **Creating a negative image:** Casual expletives create a negative image in the minds of other workers as well as the management.

Figure 4.9.1: Casual Expletives and Unpleasant Terms

Display Appropriate Communication Etiquette While Working

Effective Communication is a two-way information sharing process, which involves one party sending a message that is easily understood by the receiving party. An assistant drilling technician with effective communication skills can work more efficiently and earn customer appreciation more commonly.

Nowadays, Effective Communication is also possible via Smartphone and Computer, thanks to the advent of e-Mail, Chat and Social Media applications like Twitter, Facebook, and LinkedIn etc.

The essential components of building Effective Communication are:

- Oral / Verbal Communication
- Clarity & Concision
- Confidence
- Respect
- Right Medium
- Empathy
- Politeness
- Delivering precise information
- Non-verbal Communication
- Active Listening
- Open to Feedback

Below are the guidelines on appropriate communication etiquette:

- Listen actively
- Modify tone according to the receiver
- Watch the body language
- Think before speaking
- Take notes
- Act politely but firmly
- Maintain a positive attitude and smile

Unit 4.10 How Poor Communication Practices Can Disturb People, Environment and Cause Problems for the Employee, the Employer and the Customer

Unit Objectives

At the end of this unit, you will be able to:

- Identify the poor communication practices
- Evaluate the effect of poor communication

Interpersonal conflicts amongst the employees are one of the major concerns that lead to:

- Litigation
- Grievances
- Strained relationships
- Productivity loss
- Wasted employee time

To resolve personnel issues, it is important that one knows the correct method of interacting with colleagues, seniors and customers.

The essential components to communicate with Colleagues are:

- Effectively Communicating with Co-workers begins with Active Listening
- Build trust, but do not get too casual
- Be aware of your tone
- Watch your body language
- Participate and coordinate

The essential components to communicate with Seniors are:

- The tone of the communication
- Amicable but professional approach
- Knowing what you speak
- Thinking before you speak
- Building rapport, based on mutual trust and respect

A successful relationship can be built with Customers in the following ways:

- Communicating clearly, precisely and politely
- Value the customer and his / her views; the customer is the 'King.'
- Learning thoroughly about the customer
- Resolve service issues and concerns promptly
- Exceed customer's expectations through impeccable deals and service
- Stay in touch and update the customer on existing and upcoming deals and offers
- Empathize
- Stay honest in dealing with customer
- Negotiate fairly, politely but firmly

Unit 4.11 Importance of Ethics for Professional Success

Unit Objectives

At the end of this unit, you will be able to:

- Demonstrate time management skills
- Analyze expectation management

Demonstrate Time Management Skills

There is a common saying, **"Time is Money"**. Not only are there an abundance of reasons as to why time management is important, but there is a multiplicative benefit of time management.

- Implementing good time management methods allows you to accomplish more in a shorter period
- This leads to more free time, which leads to lower stress
- This again is helpful as it stretches your attention span, thereby helping you with increased work quality
- The result – Higher success ratio!

Each benefit of time management improves another aspect of your life, and it keeps going in a constant cycle.

Aspects of time management skills

- A person should set his or her goals beforehand. The person should have a prior idea regarding:
  - What do they want to achieve in their life?
  - Where would they want to see themselves 5 years down the line?
  - What do they see about themselves?
- As per the words of Ryan Deiss, a business can't be killed by a bad idea. But too many good ideas can easily kill businesses. People should know what is important for them at that point in time. Can their work wait for some time or is it important and urgent?

The others aspects are:

- Forgiveness
- Patience
- Record keeping
- Coordination and effective working style
- Stress management
- Coping skills
- Outsourcing
- Communication skills
- Proper planning
- Quick and correct decision making
- Self-motivation
- Self-awareness

Understand Expectation Management

The management ability of an organization to sustain a rewarding and long-term relationship with the stakeholders and clients after understanding the requirements and also analysing what they are expecting is known as Expectation Management.

Types of Clients under the sales process

- Amateur
- Complex
- Simple

i. Functional risk - Between Amateur and Complex Clients
ii. Financial risk - Between Complex and Simple Clients

Expectation Management Matrix

Expectation Factor	Expect to Give	Expect to Receive	Frustration Factor
Change	Observing and Responsiveness	Agreement or Renegotiation	Allowance for Change
Uncertainty	Resource Flexibility	Unspoken Assumption	Open Communication
Risk	Consequences	Agenda	Trust Index
Option	Value-Added	Premium	Value and Compound Cost
Bonus	Low Cost	Delight	Potential Cost of Exchange
Basic Deals	Value	Price	Terms of Exchange

Unit 4.12 Importance of Discipline for Professional Success

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate the importance of discipline for professional success

Discipline is not a technique or method but a way of life that teaches a person to live systematically and do everything on time. To attain success, it is important that people adopt and adapt to this style of living.

Here are some of the factors that states why it is important to lead a disciplined live for success.

- It helps a person to always stay focused towards his or her goals, activities and designated work.
- A disciplined life not only lessens the struggles of life but also attracts the admiration of others. This can be from their co-workers or stakeholder or clients.
- It makes the person look at the positive aspects of life. Instead of lazing around, discipline continues to build up the sense of enthusiasm and motivates the person to stretch their boundaries to attain success.

Display Helpful Behaviour by Assisting Others in Performing Tasks in a Positive Manner

- Ensuring that during recruitment process, correct factual personal data and correct information is provided to the candidates
- Helping co-workers or colleagues to understand the work in a better way so that they can complete their given work on time
- Discussing the adverse effects of sharing or stealing confidential company intellectual property or data unauthorised personnel
- Explaining the given task starting from the basics and then instructing them whenever they need it
- Ensuring a safe working environment for everyone regarding sexual harassment and taking quick actions if anybody is found guilty for the same
- Teaching the value of subordination, obedience and cooperation at work
- Helping people to work efficiently without idling at workplace
- Encouraging others to participate in training programs
- Ensuring that co-workers are focused towards their work
- Adhering to a disciplinary measure and not allowing the use of strong words, expletives (use of foul words), etc.

Unit 4.13 What Constitutes Disciplined Behaviour for a Working Professional Importance of Ethics for Professional Success

Unit Objectives

At the end of this unit, you will be able to:

- Analyze appropriate communication etiquette
- Demonstrate responsible and disciplined behaviour
- Evaluate the significance of commitment to work , adhering to SOPs and honesty

Display Appropriate Communication Etiquette While Working and Demonstrate Responsible and Disciplined Behaviour at the Workplace

It is important that a working professional leads a disciplined personal and professional life. Here are some of the important aspects that will demonstrate responsible and disciplined behaviors at the workplace that every professional should abide by.

- The workers should abide by the company rules, policies and regulations
- They should be compliant to the contract terms related to employment
- The professionals should be punctual to work
- In case the workers take leaves, it should be after taking permission
- Adherence to safety instructions that are set by the organization
- Fulfilling the given task effectively
- Ensuring that the company property is well maintained

Demonstrate Commitment to Work, Adhering to SOPs, Honesty etc.

- Codification of professional ethics can stem from the profession or organization.
- Following ethics in professional areas grounds the person. It makes the person more responsible and instils the sense of what is wrong and right.
- This also builds integrity and strengthens the trust of people on you.
- When a professional person shows the traits of strict ethics maintenance, they are indirectly advertising truthfulness and client confidentiality maintenance.
- People obeying ethical standards rarely come to the troublesome situation with the law, colleagues, employers and customers.
- Strict ethics maintenance ensures that people trust you, give you ample leadership opportunities, cooperation at work and support for your ideas.
- An organization that can sacrifice their profit in place of their ethics and values tends to attract goodwill, more clients and finally success.

Summary

- The foremost thing regarding giving clear information is respecting the audience
- The interaction among the members and the work they complete is called teamwork
- Team leaders and members need to be aware of the factors affecting motivation and techniques they can use to enhance and maintain motivation levels
- Ascertain that everybody complies with company's regulatory bodies
- It is advisable that you economise your point without muddling the information
- When a person is angry, he or she will not listen to anything you say, even if you have logical points
- If the conflict is greater at workplace, the stereotyping will be bound to be complex and distorted
- Before going to the site, it is better to summarise the information and tell that to your senior or supervisor
- People obeying ethical standards rarely come to troublesome situation with the law, colleagues, employers and customers
- Implementing good time management methods allows you to accomplish more in a shorter period
- As per the words of Ryan Deiss, a business can't be killed by a bad idea. But too many good ideas can easily kill businesses
- When workers or employees abide by organizational SOPs, the chances of errors decreases in mass product production

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

HSSC
HYDROCARBON SECTOR
SKILL COUNCIL

5. Employability & Entrepreneurship Skills

Unit 5.1 Market Study / The 4 Ps of Marketing / Importance of an IDEA

Unit 5.2 Business Entity Concepts: Basic Business Terminology

Unit 5.3 Basic Accounting Formulas

Unit 5.4 CRM & Networking

Unit 5.5 Business Plan: Why Set Goals

Unit 5.6 Procedure and Formalities for Bank Finance

Unit 5.7 Enterprise Management - An Overview

Key Learning Outcomes 

At the end of this module , you will be able to:

1. Define market study, the 4ps of marketing, the importance of an idea
2. Define business entity concepts
3. Define basic accounting formulas
4. Evaluate CRM and networking
5. Evaluate business plan
6. Define procedure and formalities for bank finance
7. Define enterprise management

Unit 5.1 Market Study / The 4 Ps of Marketing / Importance of an IDEA

Unit Objectives

At the end of this unit, you will be able to:

- Define terminations and splices
- Evaluate about tightening torques and right splice

Understanding Market Research

Market research is the process of gathering, analysing and interpreting market information on a product or service that are sold in that market. It also includes information on:

- Past, present and prospective customers
- Customer characteristics and spending habits
- The location and needs of the target market
- The overall industry
- Relevant competitors

Market research involves two types of data:

- Primary information - This is research collected by yourself or by someone hired by you.
- Secondary information - This is research that already exists and is out there for you to find and use.

Primary research

Primary research can be of two types:

- **Exploratory:** This is open-ended and usually involves detailed, unstructured interviews.
- **Specific:** This is precise and involves structured, formal interviews. Conducting specific research is more expensive than conducting exploratory research.

Secondary research

Secondary research uses outside information. Some common secondary sources are:

- **Public sources:** These are usually free and have a lot of good information. Examples are government departments, business departments of public libraries etc.
- **Commercial sources:** These offer valuable information but usually requires a fee. Examples of these are research and trade associations, banks and other financial institutions etc.
- **Educational institutions:** These offer a wealth of information. Examples are colleges, universities, technical institutes etc.

5.1.1 The 4Ps of Marketing

The 4Ps of marketing is:

- Product
- Price
- Promotion
- Place

Let's look at each of these 4 Ps in detail.

Product

A product can be:

- A tangible good
- An intangible service

Whatever your product is, it is important that we have a clear understanding of what we are offering. We should also know what its unique characteristics are before we begin the marketing process.

Some questions to ask:

- What does the customer want from the product/service?
- What needs does it satisfy?
- Are there any more features that we can add?
- Does it have any expensive and unnecessary features?
- How will customers use it?
- What should we call it?
- How is it different from similar products?
- How much will it cost to produce?
- Can it be sold at a profit?

Price

Once all the elements of product are established, the Price factor needs to be in consideration. The price of a product will depend on several factors such as profit margins, supply, demand and the marketing strategy.

Some questions to ask:

- What is the value of the product/service to customers?
- Do local products/services have established price points?
- Is the customer price sensitive?
- Should discounts be offered?
- How is your price compared to that of your competitors?

Promotion

Once you are certain about your product and your price, the next step is to look at ways to promote it. Some key elements of promotion are advertising, public relations, social media marketing, email marketing, search engine marketing, video marketing and more.

Some questions to ask:

- Where should you promote your product or service?
- What is the best medium to use to reach your target audience?
- When would be the best time to promote your product?
- How are your competitors promoting their products?

Place

According to most marketers, the basis of marketing is about offering the right product, at the right price, at the right place, and at the right time. For this reason, selecting the best possible location is critical for converting prospective clients into actual clients.

Some questions to ask:

- Will your product or service be looked in a store, online or both?
- What should you do to access the best distribution channels?
- Will you require a sales force?
- Which areas or niche are your competitors offering their products or services?
- Should you follow in your competitors' footsteps?
- Should you do something different from your competitors?

Importance of an IDEA

Ideas are the foundation of progress. An idea can be small or ground-breaking, easy to accomplish or extremely complicated to implement. Whatever be the case, the fact is that idea gives merit. Without ideas, nothing is possible. Most people are afraid to speak out their ideas, out for fear of being ridiculed. However, if you are an entrepreneur and want to remain competitive and innovative, you need to bring your ideas out into the light.

Some ways to do this are by:

- Establishing a culture of brainstorming where you invite all interested parties to contribute
- Discussing ideas out loud so that people can add their ideas, views, opinions to them
- Being open-minded and not limiting your ideas, even if the idea who have seems ridiculous
- Not discarding ideas that you don't work on immediately, but instead making a note of them and shelving them so you can revisit those later.

5.1.2 Tips

- Keep in mind that good ideas do not always have to be unique.
- Remember that timing plays a huge role in determining the success of your idea.
- Situations and circumstances will always change, so be flexible and adapt your idea accordingly.

Unit 5.2 Business Entity Concepts: Basic Business Terminology

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate basic Business Terminologies
- Definitions of those terminologies

If you aim to start and run a business, it is crucial that you have a good understanding of basic business terms. Every entrepreneur should be well versed in the following terms:

- **Accounting:** A systematic method of recording and reporting financial transactions.
- **Accounts payable:** Money owed by a company to its creditors.
- **Accounts Receivable:** The amount a company is owned by its clients.
- **Assets:** The value of everything a company owns and uses to conduct its business.
- **Balance Sheet:** A snapshot of a company's assets, liabilities and owner's equity at a given moment.
- **Bottom Line:** The total amount a business has earned or lost at the end of a month.
- **Business:** An organisation that operates with the aim of making a profit.
- **Business to Business (B2B):** A business that sells goods or services to another business.
- **Business to Consumer (B2C):** A business that sells goods or services directly to the end user.
- **Capital:** The money a business has in its accounts, assets and investments. The two main types of capital are debt and equity.
- **Cash Flow:** The overall movement of funds through a business each month, including income and expenses.
- **Cash Flow Statement:** A statement that shows money entering and exiting a business during a specific period.
- **Contract:** A formal agreement to do work for pay.
- **Depreciation:** The degrading value of an asset over time.
- **Expense:** The costs that a business incurs through its operations.
- **Finance:** The management and allocation of money and other assets.
- **Financial Report:** A comprehensive account of a business' transactions and expenses.
- **Fixed Cost:** A one-time expense.
- **Income Statement (Profit and Loss Statement):** Shows the profitability of a business during a period.
- **Liabilities:** The value of what a business owes to someone else.
- **Marketing:** The process of promoting, selling and distributing a product or service.
- **Net Income/Profit:** Revenues minus expenses.
- **Net Worth:** The total value of a business.
- **Payback Period:** The amount of time it takes to recover the initial investment of a business.
- **Profit Margin:** The ratio of profit, divided by revenue, displayed as a percentage.
- **Return on Investment (ROI):** The amount of money that a business gets as a return from an investment.
- **Revenue:** The total amount of income before expenses are subtracted.
- **Sales Prospect:** A potential customer.
- **Supplier:** A provider of supplies to a business.

- **Target Market:** A specific group of customers at which a company's products and services are aimed.
- **Valuation:** An estimate of the overall worth of the business.
- **Variable Cost:** Expenses that change in proportion to the activity of a business.
- **Working Capital:** Calculated as current assets minus current liabilities.
- **Business Transactions:** There are three types of business transactions. These are:
  - **Simple Transactions –** These usually are single transactions that take place between a vendor and a customer. For example: Buying a cup of coffee.
  - **Complex Transactions –** These transactions go through some events before they can be completed. For example: Buying a house.
  - **On-going transactions –** These transactions usually require a contract. For example - Contract with a vendor.

Unit 5.3 Basic Accounting Formulas

Unit Objectives

At the end of this unit, you will be able to:

- Define basic accounting terminologies
- Evaluate the formulas of those accounting terminologies

Take a look some important accounting formulas that every entrepreneur needs to know.

1. **The Accounting Equation:** This is the value of everything a company owns and uses to conduct its business.

   Formula: Assets = Liability + Owner's Equity

2. **Net Income:** This is the profit of the company.

   Formula: Net Income = Revenues – Expenses

3. **Break-Even Point:** This is the point at which the company will not make a profit or a loss. The total cost and total revenues are equal.

   Formula: Break-Even = Fixed Costs/Sales Price – Variable Cost per Unit

4. **Cash Ratio:** This tells us about the liquidity of a company.

   Formula: Cash Ratio = Cash/Current Liabilities

5. **Profit Margin:** This is shown as a percentage. It shows what percentage of sales is left over after the business pays all the expenses.

   Formula: Profit Margin = Net Income/Sales

6. **Debt-to-Equity Ratio:** This ratio shows how much equity and debt a company is using to finance its assets, and whether the shareholder equity can fulfil obligations to creditors if the business starts making a loss.

   Formula: Debt-to-Equity Ratio = Total Liabilities/Total Equity

7. **Cost of Goods Sold:** This is the total of all costs used to create a product or service, which are sold.

Formula: Cost of Goods Sold = Cost of Materials/Inventory – Cost of Outputs

8. **Return on Investment (ROI):** This is usually seen as a percentage. It calculates the profits of an investment as a percentage of the original cost.

Formula: ROI = Net Profit/Total Investment * 100

Simple Interest: This is money you can earn by initially investing some money (the principal).

Formula: A = P (1 + rt); R = r * 100

Where:

A = Total Accrued Amount (principal + interest) P = Principal Amount

I = Interest Amount

r = Rate of Interest per year in decimal;

r = R/100 t = Time Period involved in months or years

9. **Annual Compound Interest:** It calculates the addition of interest to the principal sum of a loan or deposit.

Formula: A = P (1 + r/n) ^ nt

Where, A = the future value of the investment/loan, including interest

P = the principal investment amount (the initial deposit or loan amount)

r = the annual interest rate (decimal)

n = the number of times that interest is compounded per year

t = the number of years the money is invested or borrowed.

Notes

Unit 5.4 CRM & Networking

Unit Objectives

At the end of this unit, you will be able to:

- Define the aspects related to CRM
- Defibe ideas related to Networking

What is CRM?

CRM stands for Customer Relationship Management. Originally the expression Customer Relationship Management meant managing one's relationship with customers. However, today it refers to IT systems and software designed to help companies manage their relationships.

The Need for CRM

The better a company can manage its relationships with its customers, the higher the chances of the company's success. For any entrepreneur, the ability to successfully retain existing customers and expand the enterprise is paramount. This is why IT systems that focus on addressing the problems of dealing with customers on a daily basis are becoming more and more in demand.

Customer needs change over time, and technology can make it easier to understand what customers want. This insight helps companies to be more responsive to the needs of their customers. It enables them to modify their business operations when required so that their customers get what they desire. Simply put, CRM helps companies recognise the value of their clients and enables them to capitalise on improved customer relations.

Benefits of CRM

CRM has some important benefits:

- It helps improve relations with existing customers, which can lead to:
  - Increased sales
  - Identification of customer needs
  - Cross-selling of products
- It results in better marketing of one's products or services
- It enhances customer satisfaction and retention
- It improves profitability by identifying and focusing on the most profitable customers

5.4.1 What is Networking?

In business, networking means leveraging business and personal connections. It is to bring a regular supply of new business. This marketing method is effective as well as low cost. It is a great way to develop sales opportunities and contacts.

Networking can be based on referrals and introductions or can take place via phone, email, and social and business networking websites.

The Need for Networking

Networking is an essential personal skill for business people, but it is even more important for entrepreneurs. The process of networking has its roots in relationship building. Networking results in greater communication and a stronger presence in the entrepreneurial ecosystem. This helps build strong relationships with other entrepreneurs.

Business networking events held across the globe play a huge role in connecting like-minded entrepreneurs who share the same fundamental beliefs in communication, exchanging ideas and converting ideas into realities. Such networking events also play a crucial role in connecting entrepreneurs with potential investors.

Entrepreneurs may have vastly different experiences and background. However, they all have a common goal in mind – they all seek connection, inspiration, advice, opportunities and mentors. Networking offers them a platform to do just that.

Benefits of Networking

Networking offers numerous benefits for entrepreneurs. Some of the major benefits are:

- Getting high-quality leads
- Increased business opportunities
- Good source of relevant connections
- Advice from like-minded entrepreneurs
- Gaining visibility and raising your profile
- Meeting positive and enthusiastic people
- Increased self-confidence
- Satisfaction from helping others
- Building strong and lasting friendships

5.4.2 Tips

- Use social media interactions to identify needs and gather feedback.
- When networking, ask open-ended questions rather than yes/no type questions.

Unit 5.5 Business Plan: Why Set Goals

Unit Objectives

At the end of this unit, you will be able to:

- Analyze the reasons why to set goals
- Evaluate why to create a business plan

Setting goals are important because it gives you long-term vision and short-term motivation. Goals can be short term, medium term and long term.

- **Short-Term Goals**
  - These are specific goals for the immediate future. Example: Repairing a machine that has failed. Medium-Term Goals
  - These goals are built on short-term goals.
  - They do not need to be as specific as short-term goals.

  Example: Arranging for a service contract to ensure that your machines don't fail again.

- **Long-Term Goals**

  These goals require time and planning. They usually take a year or more to achieve.

  Example: Planning your expenses so you can buy new machinery

Why Create a Business Plan?

A business plan is a tool for understanding how your business is put together. It can be used to monitor progress, foster accountable and control the fate of the business. It usually offers a 3-5 year projection and outlines the plan that the company intends to follow to grow its revenues. A business plan is also a very important tool for getting the interest of key employees or future investors.

A business plan typically comprises of eight elements.

5.5.1 Elements of a Business Plan

Executive Summary

The executive summary follows the title page. The summary should state your desires as the business owner in a short and businesslike way. It is an overview of your business and your plans. Ideally, this should not be more than 1-2 pages.

Your Executive Summary should include:

- **The Mission Statement:** Explain what your business is all about.

  Example: Nike's Mission Statement

Nike's mission statement is "To bring inspiration and innovation to every athlete in the world."

- **Company Information:** Provide information like- when your business was formed, the names and roles of the founders, the number of employees, your business location(s) etc.
- **Growth Highlights:** Mention examples of company growth. Use graphs and charts where possible.
- **Your Products/Services:** Describe the products or services provided.
- **Financial Information:** Provide details on current bank and investors.
- **Summarize plans:** Describe where you see your business in the future.

Business Description

The second section of your business plan needs to provide a detailed review of the different elements of your business. This will help potential investors to correctly understand your business goal and the uniqueness of your offering.

Your Business Description should include:

- A description of the nature of your business
- The market needs that you are aiming to satisfy
- The ways in which your products and services meet these needs
- The specific consumers and organisations that you intend to serve
- Your specific competitive advantages

Market Analysis

The market analysis section usually follows the business description. The aim of this section is to showcase your industry and market knowledge. This is also the section where you should lay down your research findings and conclusions.

Your Market Analysis should include:

- Your industry description and outlook
- Information on your target market
- The needs and demographics of your target audience
- The size of your target market
- The amount of market share you want to capture

- Your pricing structure
- Your competitive analysis
- Any regulatory requirements

Organization & Management

This section should come immediately after the Market Analysis. Your Organization & Management section should include:

- Your company's organisational structure
- Details of your company's ownership
- Details of your management team
- Qualifications of your board of directors
- Detailed descriptions of each division/department and its function
- The salary and benefits package that you offer your people
- The incentives that you offer

Service or Product Line

The next section is the service or product line section. This is where you describe your service or product, and stress on their benefits to potential and current customers. You also explain in detail why your product of choice will fulfil the needs of your target audience.

Your Service or Product Line section should include:

- A description of your product/service
- A description of your product or service's life cycle
- A list of any copyright or patent filings
- A description of any R&D activities that you are involved in or planning

Marketing & Sales

Once the Service or Product Line section of your plan is complete, you should start with the description of the marketing and sales management strategy for your business.

Your Marketing section should include the following strategies:

- **Market penetration strategy:** This strategy focuses on selling your existing products or services in existing markets, to increase your market share.
- **Growth strategy:** This strategy focuses on increasing the amount of market share, even if it reduces earnings in the short-term.
- **Channels of distribution strategy:** These can be wholesalers, retailers, distributors and even the internet.
- **Communication strategy:** These can be written strategies (e-mail, text, chat), oral strategies (phone calls, video chats, face-to-face conversations), non-verbal strategies (body language, facial expressions, the tone of voice) and visual strategies (signs, web pages, illustrations).

Your Sales section should include the following information:

- **A salesforce strategy:** This strategy focuses on increasing the revenue of the enterprise.
- **A breakdown of your sales activities:** This means detailing out how you intend to sell your products or services – will you sell it offline or online, how many units do you intend to sell, what price do you plan to sell each unit at, etc.

Funding Request

This section is specifically for those who require funding for their venture. The Funding Request section should include the following information:

- How much funding you currently require.
- How much funding you will require over the next five years. This will depend on your long-term goals.
- The type of funding you want and how you plan to use it. Do you want to fund that can be used only for a specific purpose, or funding that can be used for any requirement?

Strategic plans for the future

This will involve detailing out your long-term plans – what these plans are and how much money you will require putting these plans in motions.

Historical and prospective financial information

This can be done by creating and maintaining all your financial records, right from the moment your enterprise started to the present day. Documents required for this are:

- your balance sheet which contains details of your company's assets and liabilities
- your income statement which lists your company's revenues
- expenses and net income for the year
- your tax returns (usually for the last three years)
- your cash flow budget which lists the cash that came in
- the cash that went out and states whether you had a cash deficit (negative balance) or surplus (positive balance) at the end of each month

Financial Planning

Before you begin building your enterprise, you need to plan your finances. Take a look at the steps for financial planning:

Step 1: Create a financial plan. This should include your goals, strategies and timelines for accomplishing these goals.

Step 2: Organize all your important financial documents. Maintain a file to hold your investment details, bank statements, tax papers, credit card bills, insurance papers and any other financial records.

Step 3: Calculate your net worth. This means to figure out what you own (assets like your house, bank accounts, investments etc.), and then subtract what you owe (liabilities like loans, pending credit card amounts etc.) the amount you are left with is your net worth.

Step 4: Make a spending plan. This means to write down in detail where your money will come from, and where it will go.

Step 5: Build an emergency fund. A good emergency fund contains enough money to cover at least 6 months' worth of expenses.

Step 6: Set up your insurance. Insurance provides long-term financial security and protects you against risk.

Risk Management

As an entrepreneur, it is critical that you evaluate the risks involved with the type of enterprise that you want to start before you begin setting up your company. Once you have identified potential risks, you can take steps to reduce them. Some ways to manage risks are:

- Research similar business and find out about their risks and how they were minimised.
- Evaluate current market trends and find out if the public is well receiving similar products or services that launched a while ago.
- Think about whether you really have the required expertise to launch your product or service.
- Examine your finances and see if you have enough income to start your enterprise.
- Be aware of the current state of the economy. Consider how the economy may change over time, and think about how your enterprise will be affected by any of those changes.
- Create a detailed business plan.

5.5.2 Tips

- Ensure all the important elements are covered in your plan.
- Scrutinize the numbers thoroughly.
- Be concise and realistic.
- Be conservative in your approach and your projections.
- Use visuals like charts, graphs and images wherever possible.

Unit 5.6 Procedure and Formalities for Bank Finance

Unit Objectives

At the end of this unit, you will be able to:

- Define the Information should Entrepreneurs offer Banks for Funding
- Define the Lending Criteria of Banks

The Need for Bank Finance

For entrepreneurs, one of the most difficult challenges faced involves securing funds for start-ups. With numerous funding options available, entrepreneurs need to take a close look at which funding methodology works best for them. In India, banks are one of the largest funders of start-ups, offering to fund to thousands of start-ups every year.

5.6.1 What Information Should Entrepreneurs Offer Banks for Funding

When approaching a bank, entrepreneurs must have a clear idea of the different criteria that banks use to screen, rate and process loan applications. Entrepreneurs must also be aware of the importance of providing banks with accurate and correct information. It is now easier than ever for financial institutions to track any default behaviour of loan applicants. Entrepreneurs looking for funding from banks must provide banks with information relating to their general credentials, financial situation and guarantees or collaterals that can be offered.

General Credentials

This is where you, as an entrepreneur, provide the bank with background information on yourself. Such information includes:

- **Letter(s) of Introduction:** This letter should be written by a respected business person who knows you well enough to introduce you. The aim of this letter is set across your achievements and vouches for your character and integrity.
- **Your Profile:** This is your resume. You need to give the bank a good idea of your educational achievements, professional training, qualifications, employment record and achievements.
- **Business Brochure:** A business brochure typically provides information on company products, clients, how long the business has been running for etc.
- **Bank and Other References:** If you have an account with another bank, providing those bank references is a good idea.
- **Proof of Company Ownership or Registration:** In some cases, you may need to provide the bank with proof

of company ownership and registration. A list of assets and liabilities may also be required.

Financial Situation

Banks will expect current financial information on your enterprise. The standard financial reports you should be prepared with are:

- Balance Sheet
- Profit-and-Loss Account
- Cash-Flow Statement
- Projected Sales and Revenues
- Business Plan
- Feasibility Study

Guarantees or Collaterals

Usually, banks will refuse to grant you a loan without security. You can offer assets which the bank can seize and sell off if you do not repay the loan. Fixed assets like machinery, equipment, vehicles etc. are also considered to be security for loans.

5.6.2 The Lending Criteria of Banks

Your request for funding will have a higher chance of success if you can satisfy the following lending criteria:

- Good cash flow
- Adequate shareholders' funds
- Adequate security
- Experience in business
- Good reputation

The Procedure

To apply for funding the following procedure will need to be followed:

- Submit your application form and all other required documents to the bank.
- The bank will carefully assess your creditworthiness and assign ratings by analysing your business information concerning parameters like management, financial, operational and industry information as well as past loan performance.
- The bank will decide as to whether or not you should be given funding.

5.6.3 Tips

- Get advice on funding options from experienced bankers.
- Be cautious and avoid borrowing more than you need. This is especially for longer than you need, at an interest rate that is higher than you are comfortable with.

Unit 5.7 Enterprise Management - An Overview

Unit Objectives

At the end of this unit, you will be able to:

- Define the steps to manage a company
- Analyze the questions that a person requires asking before considering entrepreneurship

To manage your enterprise effectively, you need to look at many different aspects; right from managing the day-to-day activities to figuring out how to handle a large scale event. Let's take a look at some simple steps to manage your company effectively.

Step 1: Use your leadership skills and ask for advice when required.

Let's take the example of Ramu, an entrepreneur who has recently started his own enterprise. Ramu has good leadership skills – he is honest, communicates well, knows how to delegate work etc.

These leadership skills definitely help Ramu in the management of his enterprise. However, sometimes Ramu comes across situations that he is unsure how to handle.

What should Ramu do in this case?

- One of the solutions is to find a more experienced manager who is willing to mentor him.
- Another solution is for Ramu to use his networking skills so that he can connect with managers from other organisations, who can give him advice on how to handle such situations.

Step 2: Divide your work amongst others – Realise that you cannot handle everything yourself.

Even the most skilled manager in the world will not be able to manage every single task that an enterprise will demand of him. A smart manager needs to realise that the key to managing his enterprise lies in his dividing all his work between those around him. This is known as delegation.

However, delegating is not enough. A manager must delegate effectively if he wants to see results. This is important because delegating, when done incorrectly, can result in you creating even more work for yourself.

To delegate effectively, you can start by making two lists.

- One list should contain the things that you know you need to handle yourself.
- The second list should contain the things that you are confident can be given to others to manage and handle.

Besides incorrect delegation, another issue that may arise is over-delegation. This means giving away too many of your tasks to others.

The problem with this is - the more tasks you delegate, the more time you will spend tracking and monitoring the work progress of those you have handed the tasks to. This will leave you with very little time to finish your own work.

Step 3: Hire the right people for the job.

Hiring the right people goes a long way towards effectively managing your enterprise. To hire the best people suited for the job, you need to be very careful with your interview process.

You should ask potential candidates the right questions and evaluate their answers carefully. Carrying out background checks is always a good practice. Running a credit check is also a good idea, especially if the people you are planning to hire will be handling your money.

- Create a detailed job description for each role that you want to be filled and ensure that all candidates have a clear and correct understanding of the job description.
- You should also have an employee manual in place, where you put down every expectation that you have from your employees.
- All these actions will help ensure that the right people are approached for running your enterprise.

Step 4: Motivate your employees and train them well.

Your enterprise can only be managed effectively if your employees are motivated to work hard for your enterprise. Part of being motivated involves your employees believing in the vision and mission of your enterprise and genuinely wanting to make efforts towards pursuing the same.

- You can motivate your employees with recognition, bonuses and rewards for achievements.
- You can also motivate them by telling them about how their efforts have led to the company's success.
- This will help them feel pride and give them a sense of responsibility that will increase their motivation.
- Besides motivating your people, your employees should constantly be trained in new practices and technologies. Remember, training is not a one-time effort. It is a consistent effort that needs to be carried out regularly.

Step 5: Train your people to handle your customers well.

Your employees need to be well-versed in the art of customer management. This means they should be able to understand what their customers want, and also know how to satisfy their needs. For them to truly understand this, they need to see how you deal effectively with customers. This is called leading by example.

Show them how you sincerely listen to your clients and the efforts that you put in to understand their requirements. Let them listen to the type of questions that you ask your clients, so they understand which questions are appropriate.

Step 6: Market your enterprise effectively.

Use all your skills and the skills of your employees to market your enterprise in an effective manner. You can also hire a marketing agency if you feel you need help in this area.

Now that you know what is required to run your enterprise effectively, put these steps into play to see how easier managing your enterprise becomes!

5.7.1 Tips

- Get advice on funding options from experienced bankers.
- Be cautious and avoid borrowing more than you need, for longer than you need, at an interest rate that is higher than you are comfortable with.

5.7.2 Considering Entrepreneurship

Questions to ask yourself before considering entrepreneurship

- Why am I starting a business?
- What problem am I solving?
- Have others attempted to solve this problem before? Did they succeed or fail?
- Do I have a mentor or industry expert that I can call on?
- Who is my ideal customer2?
- Who are my competitors3?
- What makes my business idea different from other business ideas?
- What are the key features of my product or service?
- Have I done a SWOT4 analysis?
- What is the size of the market that will buy my product or service?
- What would it take to build a minimum viable product5 to test the market?
- How much money do I need to get started?
- Will I need to get a loan?
- How soon will my products or services be available?
- When will I break even6 or make a profit?
- How will those who invest in my idea make a profit?
- How should I set up the legal structure of my business?
- What taxes will I need to pay?
- What kind of insurance will I need?
- Have I reached out to potential customers for feedback

5.7.3 Tips

- It is important to validate your business ideas before you invest significant time, money and resources into it.
- The more questions you ask yourself, the more prepared you will be to handle to highs and lows of starting an enterprise.

Footnotes:

1. A mentor is a trusted and experienced person who is willing to coach and guide you.
2. A customer is someone who buys goods and services.
3. A competitor is a person or company that sells products and services similar to your products and services.
4. SWOT stands for Strengths, Weaknesses, Opportunities and Threats.

   To conduct a SWOT analysis of your company, you need to list down all the strengths and weaknesses of your company, the opportunities that are present for your company and the threats faced by your company.
5. A minimum, viable product is a product that has the fewest possible features, that can be sold to customers to get feedback from customers on the product.
6. A company is said to break even when the profits of the company are equal to the costs.
7. The legal structure could be a sole proprietorship, partnership or limited liability partnership.
8. There are two types of taxes – direct taxes payable by a person or a company, or indirect taxes charged on goods and services.
9. There are two types of insurance – life insurance and general insurance. Life insurance covers human life while general insurance covers assets like animals, goods, cars etc.

Summary

- Primary information is research collected by yourself or by someone hired by you.
- The price of a product will depend on several factors such as profit margins, supply, demand and the marketing strategy.
- Money owed by a company to its creditors is Accounts payable.
- Break-Even Point is the point at which the company will not make a profit or a loss.
- In business, networking means leveraging business and personal connections.
- A business plan is a tool for understanding how your business is put together.
- Banks will expect current financial information on your enterprise.
- Besides motivating your people, your employees should constantly be trained in new practices and technologies.
- SWOT stands for Strengths, Weaknesses, Opportunities and Threats.

Notes

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